Institution: Department of History and Philosophy of Science and Faculty of Philosophy

Unit of Assessment: UoA30

1. Unit context and structure, research and impact strategy

1.1 Introduction

Our UoA includes two departments and two impact-focussed interdisciplinary research centres, as well as a large number of individual researchers, junior and senior (many employed by colleges). Together, we offer a breadth and depth of research expertise, across virtually the whole range of our combined disciplines, that we believe to be unmatched anywhere else in the world. Importantly, we achieve this in a way that integrates the work of different student groups, departments, institutions and sectors. Although our departments are distinct entities within the University, located in different Schools, they often share supervision of graduate students, as well as undergraduate lectures. Our research community is porous and well-connected and all of its resources are easily accessible to any individual researcher or incoming research student. As we show below (e.g. in 1.2, 1.3, 1.4, 3.2, 4.1, 4.3) we collaborate extensively, both within and outside our own research community. Externally, our collaborations reach beyond our own disciplines, beyond Cambridge and indeed beyond academia: much of our research, including our impact-focussed research, is with non-academic partners, national and international.

Our key institutional sub-units are as follows:

1. **Department of History and Philosophy of Science** (HPS) – one of the world's most comprehensive programmes in history and philosophy of science and home to the Whipple Museum, an outstanding collection for conservation, display and research in the material culture of the sciences.
2. **Faculty of Philosophy** (Philosophy) – a small department by UK standards, with a long and discipline-defining history and very strong contemporary reputation.
3. **Centre for the Study of Existential Risk** (CSER) and **Leverhulme Centre for the Future of Intelligence** (CFI) – interdisciplinary research centres respectively focussed on catastrophic risk and the challenges of artificial intelligence (AI). Both centres were launched within our UoA, though each now contains researchers submitted in other UoAs, in addition to those submitted here. As evidenced below, both have international profiles and are among the leading centres in the world on these topics.

HPS and Philosophy submitted separately in REF2014 and preceding RAEs. This is therefore the first REF submission to describe the full Cambridge research community in these disciplines.

In the remainder of this section we begin (1.2) by reviewing the progress of **research objectives** presented separately by HPS and Philosophy in REF2014, before describing joint objectives for the next five years. We then explain **how we achieve impact** (1.3) and

describe our **strong support for interdisciplinarity** (1.4), **open access** (1.5) and **research ethics** (1.6).

1.2 Research objectives

Review of 2014 goals (HPS)

HPS identified research goals linked to new appointments in global studies of science, technology and medicine (STM) and in early science, medicine and philosophy. It also described commitments to digital humanities and new initiatives in the Whipple Museum and plans for philosophy of cognitive science, psychology and artificial intelligence, history and philosophy of social sciences, ethics and public policy and medical history of reproduction and public health. These objectives have all been met, as follows:

- In global studies of STM, the establishment of a new lectureship (Brazelton) has opened up a line of research on science and medicine in China, as well as close collaborations with globally significant specialist groups such as the Needham Research Institute. Funding was secured for research projects on the global history of seed banking (Curry; Wellcome Trust and Profutura Scientia Fellowship, 2016–20, £220k); on crop diversity and food security (Curry; Wellcome Trust, 2020–25, £887k); and on the global histories of navigation technologies (Schaffer on the history of maritime longitude funded by AHRC, 2010–15, £750k; and Margocsy and Brazelton on the global history of transportation systems funded by the DAAD-Cambridge research hub, 2019).

- In early science, medicine and philosophy, HPS made a new appointment in history and philosophy of pre-1700 sciences (Margocsy), whose outputs include the global census of Vesalius' *Fabrica* (2018). The Department supported important research in classical sciences (Taub), including direction of the volume on ancient science for the *Cambridge History of Science* (2018) as well as the *Cambridge Companion to Ancient Greek and Roman Science* (2019). The Department also supported an AHRC-funded CRASSH project on visual and graphic practices of the early Royal Society (Kusukawa, 2015–19). *The Casebooks Project*, directed by Kassell (2009–19), with support from the Wellcome Trust (£1.8m) and Newton Trust, analysed, digitised and published casebooks of principal medical and astrological practitioners and the lives of their patients in early modern England. An anonymous referee for Wellcome described *Casebooks* as 'one of the major historical enterprises of the twenty-first century'.

- Digital humanities were reinforced through these initiatives in early modern history of science and medicine, notably through the online publication of the archives of the Board of Longitude funded by JISC through the Cambridge Digital Library (Schaffer, 2010–15) and of *Casebooks*. With the aid of Cambridge Digital Library, *Casebooks* released 3.5m words of text plus 20m words of metadata, based on the work of a group of seven editors and researchers in early modern scholarship and digital humanities. In 2017, Cliff Siskin (NYU) referred to the website as 'the best digital archive experience that I have ever had' (https://bit.ly/casebooks, at 29:50).

- The Whipple Museum projects amply met the targets set in 2014, including the development of a new Special Exhibitions Gallery, continuation of research projects into the scientific heritage of the University and a significant research project on *The Museums of Cambridge Science* (B. Jardine), supported by a Leverhulme Early Career Fellowship (2016–19).

- In philosophy of cognitive science, psychology and AI, Halina, John and Alexandrova collaborated with Philosophy (Price, Cave) in the establishment of the Leverhulme Centre for the Future of Intelligence (2016–26), described above. CFI includes a programme on *Kinds of Intelligence* led in 2016–20 by Halina and a programme on *Philosophy and the Ethics of AI* led in 2016–19 by Alexandrova and John. Lewens led the six-person project *A Science of Human Nature?* (ERC, 2011–16, £1.2m). He also coordinated a project on the extended evolutionary synthesis, in collaboration with Halina and Hopwood, funded by Templeton (2016–19, £600k to Cambridge out of a £5.5m grant) and linked with research centres elsewhere in Europe and North America.

- In social sciences, ethics and public policy, Alexandrova and John were Cambridge leads on *The Limits of the Numerical* (Independent Research Foundation and the Newton Trust, £300k, 2015–18), a project on the effects of quantitative methods in health care. Since 2018 Alexandrova has been lead PI of the eight-person *Expertise Under Pressure* project (£750k), examining the role of experts in private and public spheres. It is one of two inaugural projects hosted by the University's Centre for the Humanities and Social Change.

- In medical humanities and public health, a new lectureship in Philosophy of Life Sciences was established in 2016 (Stegenga). With the combined interests of Stegenga, John, Lewens and Alexandrova, HPS is now a leading international centre for work in philosophy of medicine and a founding partner of the PhilInBioMed initiative. These strengths are being reinforced across the UoA as a whole with Bird's appointment as Bertrand Russell Professor and Philosophy's increasing focus in this area (Chambers, cosmetic surgery; Holton, illness and the social self, trust in medicine). The Wellcome strategic award on *Generation to Reproduction* (2009–18; Hopwood, Forrester, Kassell and Secord) culminated in *Reproduction: Antiquity to the Present Day* ('The most ambitious and comprehensive treatise on reproduction that has ever been attempted within the compass of a single volume,' Sir Richard Gardner FRS). HPS also established a new interdisciplinary MPhil in Health, Medicine and Society in 2017, in partnership with Social Anthropology and Sociology.

Review of 2014 goals (Philosophy)

Philosophy identified four main research objectives in REF2014: to develop research in philosophy of psychology, in collaboration with the Department of Psychology; to collaborate with Groningen on the *Trusting Banks* project (Oliver) and develop related work in applied ethics; to develop philosophy of science (including philosophy of physics), with closer

collaboration with HPS; and to play a central role in the development of CSER, co-founded by Price in 2012. All objectives were met, in some cases to an unexpected degree:

- In philosophy of psychology, Crane's Templeton-funded project *New Directions in the Study of the Mind* ran successfully for two years (2015–17), employing four postdoctoral researchers. The area is increasingly interdisciplinary: Holton and his PhD students launched a network in moral psychology, sparking in turn the Cambridge-LMU moral psychology network (with Classics and Psychology at both institutions); Jessie Munton has initiated a large empirically informed project on prejudice, attention and salience, bringing together theorists from Psychology, Psychiatry and Philosophy. CFI now provides another source of strong collaboration with Psychology and related disciplines, especially via CFI's programme *Kinds of Intelligence*, led in 2016–20 by Halina, HPS and from 2020 by Cheke, Psychology.

- *Trusting Banks* was also successful. For example, two students were funded for double PhD studies at Groningen and Cambridge and have gone on to successful early careers; one won Best Dissertation Award 2017 from the Society for Business Ethics. The theme of trust has since been developed in several directions: e.g. in the work on trust of Holton's PhD student Domenicucci, in the work of Langton and O'Neill on trust in digital media, in Holton's BMJ work with Fritz (The Healthcare Improvement Studies Institute) on trust in medicine and in CFI's work (Price, Cave, Liu) for the *Trust in AI* track at the 2018 UN *AI for Good Summit* and linked workshops with collaborators in China.

- Philosophy of science has also prospered in several directions. The joint Philosophy/HPS CamPoS (Cambridge Philosophy of Science) initiative has thrived as a weekly seminar series and many research links between the two departments are described elsewhere in this document – e.g. joint involvement in CFI and CSER. Breitenbach's project *Kant and Laws of Nature* with Edinburgh ran very successfully in 2012–15, hosting three conferences and producing two edited collections. Breitenbach was subsequently awarded a ProFutura Research fellowship on *The Ideal of Unity: Regulative Principles in Science and the Norms of Enquiry* (£160k). She also ran a DAAD-funded research network (with partners in Germany, Hungary, USA) on conceptions of unity in German philosophy. Philosophy of physics has also been a major success, with four new grants with external partners (Pitts x 3; Price x 1; total £550k). For the future, the appointment of a leading philosopher of science (Bird; see 2.2) to the Bertrand Russell Chair to succeed Price augurs well for further achievements.

- Finally, CSER has been an outstanding success. It was developed within the Centre for Research in Arts, Social Sciences and Humanities (CRASSH) under the leadership of Price and Ó hÉigeartaigh, winning research grants (e.g. TWCF £1.8m, 2015–20 and £1.3m, 2020–23; Isaac Newton Trust £669k, 2018–23) and £4.8m to date in philanthropic funding. It is a highly interdisciplinary research centre employing almost 20 PDRAs and other researchers and is arguably the world's leading centre for the study of extreme technological risk. It is now larger than the main rival for the title, FHI in Oxford. Another of CSER's achievements was our successful 2015 application for the £10m Leverhulme Centre for the Future of Intelligence (PI Price). Developed by Price and Ó hÉigeartaigh in collaboration with partners from the UoA and further afield, CFI was

launched in 2016 and is funded by Leverhulme from 2016 to 2026. CFI is based in Cambridge, with 'spokes' at Oxford, Imperial and Berkeley. To date it has attracted approximately £2m in additional research funding. It was the world's first interdisciplinary research centre in the now rapidly growing field of the ethics and impact of AI and has strong links to both departments.

Research goals 2021–26

Research objectives across the submitted unit emerge from the research strategies of our departments and centres, and from our many individual researchers. Both departments set great store by the principle that individual researchers are free to choose their own research priorities. The resulting breadth and diversity is a great strength of our UoA, in our view.

The following **four high-level research objectives** characterise plans across much of the UoA. The first three provide scaffolding for the autonomous initiatives we value so much from individual researchers. The fourth expresses our commitment to engagement with today's challenges. We illustrate each with examples (many of which contribute to more than one objective).

1. Reinforcement and expansion of interdisciplinary links, both within the institution and beyond it.
2. Expansion of research collaborations with international institutions.
3. New research related to digital technologies, including both renewed engagement with digital humanities and further work on the ethics and impacts of data and AI.
4. New research on contemporary socio-political, biomedical and environmental challenges, including challenges to public knowledge and expert authority.

Objective 1: Reinforcement and expansion of interdisciplinary links

- HPS will develop interdisciplinary work in Global Studies of STM with History, Asian Studies, the Needham Research Institute and the Centre for South Asian Studies (Brazelton, Schaffer, Singh). Existing collaboration with PDN (Physiology, Development and Neuroscience), Sociology, Genetics, Zoology and Biomedicine will follow the Strategic Research Initiative on Reproduction (Hopwood, Lewens) and the Public Health Strategic Network (John). Interdisciplinary work in medical policy will develop through the new Wellcome-supported MPhil in Health, Medicine and Society with Sociology and Social Anthropology, alongside research with Cancer Research UK (John) and on medical philosophy (Stegenga).

- Philosophy will build on the interdisciplinary work described at 1.4 below, including Chambers' links with politics and law on cosmetic surgery, Holton's links with medicine and psychology, Langton's links to law and Borcherding's links with Divinity. Munton, who joined the Faculty in 2019, will develop research with psychology.

- Almost all the work of CSER and CFI is interdisciplinary from the beginning; we list examples of new initiatives under other objectives below.

Objective 2: New international collaborations

- HPS plans stronger links with both the Medical Centre and the History of Science Museum (John, Taub) at PKU, Beijing. As a founder member of the PhilInBioMed Network, coordinated from Bordeaux, HPS has created a sustainable forum to secure international collaborations between practising scientists and philosophers. The Department has joined an international university consortium in philosophy of biology with Toronto, Montreal, Duke and Paris (Lewens). HPS is also building on shared expertise in the history of botany to cement a relationship (including academic exchanges and joint conferences) with LMU Munich.

- Philosophy has established four new collaborations with LMU, under the auspices of a Strategic Partnership between Cambridge and LMU. These include a moral psychology network (PI Holton, also Langton & Sliwa), a project on black holes (Butterfield), a project on originality and creativity in the sciences with DAAD funding (Breitenbach) and a project on decision theory (Ahmed, Price, Liu). The last builds on existing work with LMU (and now ANU and partners in China) on AI and Decision Theory by Liu and Price under the auspices of CSER and CFI.

- CFI is actively pursuing collaborations with ANU (MoU in place with the Coral Bell School for Asia Pacific Affairs, four joint workshops at ANU in 2019), PKU, Fudan, the Institute of Automation of the Chinese Academy of Sciences (MoU signed 2019) and Bonn (two joint postdoctoral fellows just appointed), among other international institutions. We expect these collaborations to grow during 2021–26.

- CSER is currently building international collaborations across academia, government and industry including the Wittgenstein Centre for Demography and Global Human Capital, the Institute for Futures Studies, the Pacific Northwest National Laboratory, Open AI and the Singapore PMO's Centre for Strategic Futures, all of whom are listed partners on our 2020–23 TWCF renewal grant.

Objective 3: New research related to digital technology and AI

- All of CFI's work, and much of CSER's work, will contribute to this objective. For example, the work of CFI's *AI:Futures and Responsibility* programme, much of it joint with CSER, will provide new insights into the longer-term challenges of AI. Both CFI and CSER are partners in a School-level strategic initiative on *Humanising Our Digital Future*.

- In HPS, initiatives such as the flagship *Casebooks Project* (Kassell) and the digital edition of the Darwin Correspondence (Secord) have contributed greatly to Cambridge Digital Humanities (CDH); the UoA has gained influence over University policy in this area with Kassell's appointment to the CDH directorate. Further developments through Cambridge Digital Library, including the development of history of science holdings of the

papers of Newton and other major figures, will continue to provide major research opportunities in this field. HPS will also maintain and expand its work in the themes of data and society. Projects on the role of machine learning, data analytics, numerical evidence and argument in policy development (Alexandrova, Buskell) and in conjunction with CFI on the character of intelligence and creativity (Halina), will contribute to this objective (also objective 1).

- In Philosophy, a recent development has been the Faculty's active and collaborative engagement on questions in the ethics of communication: on media ethics (O'Neill), hate speech (Langton) and sexual consent (Dougherty). Recent social and political events have made these topics particularly pressing: the role of fake news and hate speech in recent elections and referenda, the issue of a supposed 'post-truth' era in communication. The Faculty is engaged in exploring novel aspects of the ethics of communication: for example, the communication by non-human speakers, such as corporations and robots. This work will be taken forward in conjunction with CFI and others.

Objective 4: Sociopolitical, biomedical and environmental challenges

- In HPS, environmental research will intensify through a new Leverhulme project on climate history (Staley, Schaffer) in partnership with Geography and through Curry's work (in collaboration with the Conservation Research Institute) on post-war food security and plant diversity.

- In Philosophy, Chambers' Leverhulme Major Research Fellowship *Intact: The Political Philosophy of the Unmodified Body* (2018–21) is addressing the complex and politically fraught concept of the 'natural' body and developing a normative theory of political, legal and social protection of the unmodified body.

- CSER is combining research expertise in the philosophy of science, ethics and social science to develop new methodologies for the integrated assessment of global catastrophic biological and environmental risks (Avin, Beard and Currie). An example is CSER's new partnership with the recently launched Biological Security Research Initiative at St Catharine's College (BioRISC), which joins together work on managing risks to the environment, human, animal and plant health from invasive species, naturally occurring pests and pathogens, deliberate misuse and risks from emerging biotechnologies.

- Illustrating our commitment to this objective, staff across the UoA have been active in research and outreach related to Covid-19. HPS hosted Zoom sessions, attended by several hundred people, linking its research to Covid themes. Brazelton, author of a monograph on vaccination regimes in 20th-century China (*Mass Vaccination* (2019)), joined a WHO thinktank on pandemic histories. John secured a rapid response grant on Covid vaccination ethics; and Alexandrova's project *Expertise Under Pressure* has been active producing podcasts and blog posts on Covid policy. From Philosophy, Holton serves on the local NHS Covid Ethics Committee, has talked on several panels and published pieces in *Philosophers' Magazine* and in *BMJ Opinion*. From CSER and CFI,

Whittlestone, Ó hÉigeartaigh and others published 'Artificial intelligence in a crisis needs ethics with urgency' in *Nature Machine Intelligence*. Several CSER staff contributed to 'A solution scan of societal options to reduce SARS-CoV-2 transmission and spread' [https://osf.io/ca5rh/files], which received extensive media coverage. Outreach activity includes interviews in *The Guardian,* BBC World Service, *Newsweek*, *La República* (Peru), among other venues, as well as invited evidence at a closed briefing session to members of Parliament on 'Future Biosecurity'. Several Covid-related research projects are under development.

1.3 How we enable impact

Impact in our UoA arises in a wide variety of ways. Sometimes (e.g. CS-30-1785 Historical Games) it is a serendipitous outcome of research pursued for other reasons. In other cases (e.g. CS-30-1784 Existential Risk, CS-30-1779 AI Governance) it is the point of the research in the first place: CSER and CFI are designed from the ground up to tackle practical challenges. Often it is somewhere between these extremes: impact emerges as a welcome and anticipated consequence of work that is also pursued for other reasons.

To enable impact from these diverse sources, our departments and centres all make use of the following five pathways: (i) working with impact-focussed organisations and policymakers; (ii) outreach and media; (iii) work with schools; (iv) interdisciplinarity for impact; (v) international collaborations. We give brief examples under some of these headings here and many more examples in 1.4 and 4.3.

(i) Work with impact-focussed organisations and policymakers

We partner with impact-focussed organisations, public and private, UK-based and international. In the case of our two centres, this work is prominent in two of our ICSs:

- Under CS-30-1779 AI Governance, CFI's policy-focussed research partners include the Royal Society and Nuffield Foundation (for whom CFI completed a scoping report on AI Ethics to guide the new Ada Lovelace Institute). Internationally, Price led a CFI team, with many international collaborators, in preparing the *Trust in AI* track of the UN *AI for Good Summit* 2018. Several CFI researchers and affiliates (including Alexandrova, HPS) have participated in the Institute of Electrical and Electronics Engineers (IEEE)'s work on standards for AI and related technology. CFI's *Kinds of Intelligence* programme has collaborated with the Prague-based AI company GoodAI to launch the online Animal-AI Olympics (animalaiolympics.com) designed to provide practical measures of AI progress and hence impact.

- Under CS-30-1784 Existential Risk, similar CSER partners include the Institute for Public Policy Research (working on government responses to environmental breakdown), the Partnership on AI (including leading a project on AI and global food security in 2020), the FT and Economist Business School Rankings (redesigning their assessment processes

to give more weight to training in Environmental, Social and Governance issues) and the Defence Science & Technology Laboratory (Avin, Epistemic Security workshops).

(ii) Outreach and media

Across the UoA we place much stress on outreach, including the use of all forms of media, and this is an important pathway to impact. Many in the UoA have experience as broadcasters on radio and television. For example, in ICS-related cases, participants in the *Medical Risk* project (Lewens and Olszynko-Gryn) collaborated with documentary makers from Sky News and the resulting film was shown in Parliament.

In a different direction (as detailed in CS-30-1785 Historical Games) the Wellcome Trust encouraged participation in the Clover Project games workshop, leading to design of an online digital game based on the *Casebooks* project, with support from the EU Creative Europe Media; likewise, in the case of the virtual reality game based on Curry's research on plant breeding, Wellcome Trust support aided links between researchers and game designers as part of the *Developing Beyond* initiative.

(iii) Work with schools

As detailed in 4.3, we work extensively with schools and educational agencies to enable impact on school curricula and programmes.

(iv) Interdisciplinarity for impact

Across the UoA, interdisciplinarity itself is often an important path to enabling impact. As noted above, it is built in from the beginning in the impact-focussed research of CSER and CFI. These centres recognise that the complex challenges of managing technological risk, or ensuring that AI is used for good, cannot be tackled within any single academic discipline, or indeed within a predefined group of disciplines, fixed in advance. Impact therefore depends on an open-minded approach to where necessary expertise may be found. These centres include researchers from fields as diverse as biosecurity, machine learning, law, economics, literary studies, psychology, politics, gender studies, international relations, synthetic biology and ecology, in addition to the researchers included in our UoA.

(v) International links for global impact

Many of the most pressing challenges of our time are global in nature and some of our research aims to have global impact. As detailed in 4.3, this is enabled by research linkages with international organisations, both academic and non-academic and both public and private.

1.4 Supporting interdisciplinary research

As evidenced in 1.2, much of the work of the two core departments is interdisciplinary by nature. This is especially true of HPS, whose field sits at the intersection of history, philosophy and sociology on one side and science, technology and medicine on the other. It is also true of work in Philosophy in areas such as philosophy of psychology and philosophy of physics – in general, any work in the philosophy *of another discipline*. In these cases, supporting the core research of our researchers is already supporting interdisciplinary work.

HPS examples include:

- The Wellcome-funded *Generation to Reproduction* project (Hopwood with Forrester, Kassell, Secord and PIs from three other Schools), which exemplifies interdisciplinary understanding of natural history and medical sciences. To evidence sustainability, this programme helped to generate the University's new Strategic Research Initiative on Reproduction, funded 2018–21, to bring together researchers from five Schools, including biology and clinical medicine.

- The Leverhulme project on *Making Climate History* (Staley and Schaffer, 2019–24), combining history of science, climatology and geography to study histories of climate and of climate sciences. This initiative emerged from co-institutional work with the Cambridge Conservation Initiatives by Staley and by departmental representative Curry on agro-biodiversity and climate change.

- Departmental participation (Lewens and others) in the £5.5M *Putting the Extended Evolutionary Synthesis to the Test* project, bringing together researchers from zoology and HPS within Cambridge and numerous biological scientists internationally.

- The Darwin Correspondence Project, jointly based at HPS and the University Library.

- The *Casebooks* project funded by the Wellcome Trust and the Newton Trust.

- Chang's work on philosophy of active scientific knowledge (through a British Academy Wolfson Research Professorship, 2017–20), integrating history of science and philosophy of science [integratedhps.org/en/].

- Studies in non-western sciences, through the Department's new post in Global Studies of STM (Brazelton) with the Needham Research Institute, combining Asian studies with history of science.

- The Department's world-leading group in the fast-growing field of philosophy of medicine (John, Stegenga, Lewens), which has contributed to the University's Public Health Strategic Network.

- The new MPhil in Health, Medicine and Society, which brings in staff both from Social Anthropology and Sociology.

Philosophy examples include:

- Crane's Templeton-funded project *New Directions in the Study of the Mind* linking to psychology, cognitive science and neuroscience.
- Chambers' links with politics and law on marriage and cosmetic surgery.
- Holton's links with medicine and psychology, e.g. in his 2018 Uehiro Lectures.
- Langton's links to law (e.g. her Hart Lecture, 2019).
- Dougherty's collaborations with Law about consent.
- Borcherding's links with Divinity, e.g. in the Cambridge Platonism conference co-organized with Leisinger on *Vitalism in Early Modern Philosophy*.
- Much work linking to physics – e.g. two recent grants joint with Curiel (LMU), linking Butterfield, Menon and Pitts to Tong and Wall (DAMTP).

Beyond such examples, the two departments have given enthusiastic support to a large number of large interdisciplinary research projects and centres, in some cases collaboratively. Some of these are one-off initiatives, but others, like our interdisciplinary centres CSER and CFI, are pathways to further projects and funding, greatly enhancing sustainability. Both centres sustain an on-going and open-ended programme of interdisciplinary work. By taking an internationally prominent role in developing new interdisciplinary fields, they have become significant international 'brands'. As such, as evidenced in 1.3(i) and 4.3, they are magnets for offers of collaboration with researchers and other stakeholders elsewhere. This generates tremendous vitality and many opportunities for new funding and growth.

1.5 Open research and data sharing

The unit contributes actively to University-wide, national and international debates about OA process and structure.

- Staley (HPS) leads on this through the Journals Coordination Scheme Steering Committee. Some within the UoA face the challenge that although they are humanities researchers, several of their principal research funders, especially the Wellcome Trust, are based in the sciences. The Wellcome Trust will adopt Plan S, which may affect the stability of smaller journals in the field as well as learned societies dependent on subscriptions. In 2019 Staley managed the University's response to the cOAlition S consultation on Plan S, highlighting issues around implementation speed, challenges to international collaboration, the importance of differences between disciplines, the need to maintain quality and diversity in academic publishing and risks concerning publication costs.

- Breitenbach (Philosophy) is a Syndic of Cambridge University Press, where she represents our discipline in the ongoing discussions about open access.

- Holton (Philosophy), having previously chaired the Open Access group at MIT, has written about the obstacles to open access posed by the power of the commercial publishers in *The Philosophers' Magazine* and continues, in his position on the *Analysis* committee, to investigate new business models that will allow journals to move towards it.

- Bird (Philosophy) is a founder member of the UK Reproducibility Network, which aims to promote open and reproducible research in the UK and worldwide.

For the UoA's contribution to research accessibility through editorial scholarship such as the Cambridge Digital Library and associated digital initiatives see the entry on Digital Technology and AI above (1.2).

1.6 Ethical research and research integrity

HPS, Philosophy, CSER and CFI each have strict guidelines and procedures for ethical approvals and research integrity. Applications for research funding are required to be submitted for this purpose well in advance of funding deadlines. All applicants are made aware of relevant ethical frameworks, based on the UUK Concordat to Support Research Integrity. Ethical approval requires a detailed written case, approved by the HoD in straightforward cases. More complex cases are referred to School Research Ethics Committees, governed by the University's policies on research integrity and research ethics. Strict attention is paid to issues of data protection under GDPR (2018).

2. People

Our people strategies are devolved across our UoA, in our two departments and two centres. In this section we describe practices across the unit, noting differences between sub-units where relevant. The material is organised in three sub-sections: **Staffing and staff development** (2.1), **Research students** (2.2) and **Equality, diversity and wellbeing** (2.3).

2.1 Staffing and staff development

Staff development strategies

Most permanent academic staff belong to one of the two departments (most exceptions being college employees). Career management procedures for academic staff follow the University's Staff Review and Development Scheme (SRD), designed to enhance work effectiveness and facilitate career and research development. The formal expectation is for all UTOs to have reviews at least every 2 years with their HoD or an experienced colleague, and in practice many UTOs have reviews annually. Besides these official arrangements, the Chair/HoD and other senior staff regularly advise less senior staff on matters of promotion and publication. In addition, most UTOs are involved in sustained informal mentoring of early career researchers, including postdocs and JRFs. In HPS, for example, a researcher training programme covers topics ranging from research organisation to publication and work presentation.

Similar arrangements apply in CSER and CFI, with the difference that most researchers in the two centres are employed on fixed-term or open-ended 'subject to funding' contracts. Combined with the interdisciplinary nature of the centres, this creates challenges for the careers of CSER and CFI's researchers, which both centres have strategies to meet – see below. Both centres have policies on line management and staff development. All researchers have a line manager and a project manager (often but not always the same person) and regular meetings with each. Many PDRAs also receive regular support from senior advisors specialising in their project topic area. In CSER the management team also receives advice and support from senior advisors, including through termly meetings of CSER's Management Board.

Staffing and recruitment strategy

Recruitment planning is in the hands of our individual departments and centres, though with considerable inter-departmental assistance (e.g. serving on each other's appointment panels) and departmental assistance with hiring in centres.

- HPS plans staffing to reflect strategic development aims. Since 2014 there have been new hires in Global Studies of STM (Brazelton, 2015), Early Science and Medicine

(Margocsy, 2016), Philosophy of Medicine (Stegenga, 2016) and History of Life Sciences (Müller-Wille, 2019). HPS is losing senior professors Secord (2020), Taub (2022) and Schaffer (2022) to retirement, and has identified the history of non-Western science as a priority area when these posts become vacant, as well as continuation of curatorial excellence in the museum. Secord's position has been filled proleptically (Müller-Wille).

- Philosophy has made three recent strategic appointments, two lecturers (Munton, Borcherding, 2018) and the new Bertrand Russell Professor (Bird, 2020). Munton fills a gap in Philosophy of Mind left by Crane and brings expertise at the intersection of social epistemology, ethics and empirical psychology. Borcherding brings her distinctive approach to the history of philosophy, showing unity in the ethical and metaphysical concerns of Leibniz and neglected women philosophers of the Early Modern period (with potential for close collaboration with Divinity's Centre for Cambridge Platonism). Both appointments are interdisciplinary, connecting to Psychology and Divinity respectively and both add to the Faculty's strength in feminist philosophy, with Chambers and Langton. In a major strategic appointment of 2020, Bird was recruited as the new Bertrand Russell Professor. He succeeds Price, who retires in September 2020, continuing in the UoA as a Director of Research leading CFI. Bird further strengthens our expertise in Philosophy of Science and our close relationship with HPS. He also expands our horizons in philosophy of medicine at a time of increasing energy in this area, with Chambers' work on cosmetic surgery and Holton's on illness and the social self. Our School has approved the Faculty's plan to recruit to two lectureship appointments starting 2021 to fill vacancies and has targeted Philosophy for growth, with an ambitious strategy in development.

- CSER and CFI rely on funding from research grants and philanthropic donations, so their recruitment strategy is necessarily adventitious: they appoint new researchers where funding can be found. The effectiveness of their appointment procedures is reflected both in their growth over the assessment period and in the high proportion of PDRAs who have gone on to win new funding.

Support for early career researchers

The departments welcome and support postdoctoral researchers, funded from a range of fellowship schemes (e.g. British Academy, Leverhulme Early Career, Marie Curie) as well as by project funding secured by departmental PIs. Each has a mentor (often the project PI) and is provided with induction training in the first six months of tenure. A joint appraisal is conducted at the end of the first year. Research management training and career development advice continue throughout the year. Postdocs are encouraged to participate in seminars and reading groups within the department and across and beyond the UoA, where relevant to their interests. Many take teaching opportunities offered by the departments and colleges, e.g. for UG lectures and UG and MPhil essay supervisions. Specialist training, e.g. language classes, is also provided where required.

The departments also extend career support to college JRFs, offering teaching opportunities and training sessions, involving them in seminars, reading groups and social activities and

encouraging participation in the University's postdoctoral mentoring scheme (a scheme in which numerous staff members also participate as mentors). Our centres also support JRFs, several of whom have become Associate Fellows or Research Affiliates.

CSER and CFI face a distinctive challenge in supporting the careers of their ECRs. CSER and CFI are interdisciplinary research centres in novel fields, yet most of their ECRs come from mainstream disciplines. It is in the ECRs' interests as well the centres' interests that ECRs maintain a competitive career profile in their home disciplines. Our expectation has been that some of our ECRs will return to their home disciplines – and that this will benefit the centres, by taking our 'message' back into these disciplines – while others will remain in the new interdisciplinary fields that the centres are helping to establish. Accordingly, we support both career paths. We encourage ECRs to progress in their home disciplines, e.g. by publishing in top journals and attending important conferences and gaining teaching experience within their discipline in Cambridge. And we support our ECRs in becoming CIs and PIs on new grant applications to extend their research contracts and fund promotions within the centres. We now have success stories on both career paths: e.g. Currie (CSER), Vold (CFI), now tenure-track at Exeter and Toronto respectively; Avin, Beard (CSER), Nyrup (CFI), Whittlestone (CFI/CSER) promoted to Senior Research Associate on new grants within the centres.

Leave policy

Permanent academic staff in the two departments accrue sabbatical leave for research at the rate of one term in seven, subject to approval by the HPS Board/Philosophy Faculty Board. Full-time fixed-term staff are typically entitled to 41 days leave per year (pro-rata for part-time staff). Both departments recognise the role of research leave and 'buy-out' (the latter where an external funder contributes to costs of replacement teaching) and work with researchers to ensure that they receive the benefit of research leave while remaining in close touch with their department; this has been an important avenue for contributions to CSER and CFI, among many other projects. Lewens (HPS) is co-lead of a University Working Party addressing issues of leave and research management.

Staff travel policies and support

All staff have access to departmental funding for travel, workshops and seminars. Philosophy contributes around £4K p.a. for staff awards not covered by research funding. HPS budgets £24k p.a. for staff awards and normally makes 15 awards p.a., between £250 and £2k. Many staff also have access to travel funding from college schemes. Since 2019 Philosophy and HPS have both committed to the British Philosophical Association guidelines that prioritise environmentally sustainable travel and virtual access where possible.

2.2 Research students

Research student recruitment

The departments attract many PhD and MPhil applicants from the UK and overseas. Funding remains a major constraint, though Cambridge is fortunate compared to most UK institutions, with many sources (e.g. from colleges and endowments) not available elsewhere. Both departments use their own funding strategically to support PG students, where possible.

In HPS, current PhD numbers are 55. Together with MPhils, there are c.100 graduate students in the Department at any time. In 2017 HPS established a new MPhil in Health, Medicine and Society. The Department holds regular outreach and training sessions for MPhil and PhD applicants. Senior staff work with strong PhD candidates to help them refine their proposals and secure funding and to assist with admission and induction. The Department commits £100k p.a. from its own Trust funds to partial bursaries for MPhil and PhD students. This has helped to increase applications and acceptances: PhD entry has increased from seven to nine p.a. in 2013–15 to 14 p.a. in 2020-21. Funding for 2020 PhD entrants was secured from Cambridge Trusts (3), AHRC (2), Gates Trust (2), Wellcome Trust (2), other (2).

In Philosophy, there are around 40 graduate students in the Faculty at any time, including 20+ PhD students. Funding remains a major constraint, especially for PhD admissions. The Faculty has two annual studentships, one for PhD (£4k p.a.) and one for MPhil (£3.5k); with a second PhD award (£6k) when funds allow. Most recent PhD entrants secured either AHRC or Cambridge Trusts University funding. In 2019 other sources included a German Academic Scholarship, College funding and the University of Guadalajara.

Philosophy has recently revised its graduate admissions process to pay careful attention to contextual factors and proactively to encourage and support funding applications from promising candidates from underrepresented groups; e.g. we encourage applicants who might otherwise not consider the option to apply for Gates funding. The results show up in funding for 2020 PhD entry: eight PhD students have accepted offers, with funding secured from Gates Trust (3), AHRC (2), a Gulbenkian Yuval Cambridge Studentship, a German Scholarship, and a Faculty award of £6k. The Faculty has increased its proportion of female PhD students from 32% over 2014–17 to 57% over 2017–20.

Research student support

The departments have similar procedures for PhD admission and support. Shortlisted applicants are interviewed by the prospective supervisor and another academic. On arrival, students plan research at an introductory supervision and attend a departmental induction session. All PhD students have an advisor (shadow supervisor) in addition to their primary supervisor. Registration is assessed before the end of the first year at a meeting of the

student, advisor and an academic other than the supervisor. Progress reviews are conducted in years two and three by the supervisor and advisor. All students have access to a wide range of workshops and reading groups.

Students also have access to funds for research and conference travel (currently £300 p.a. in HPS, £200 p.a. in Philosophy). HPS also budgets £4.5k p.a. for fieldwork funding: two to three awards are made each year of approximately £2k each.

Cross-supervision between the two departments is common and all graduate students in both departments have easy access to researchers across the whole UoA. Many participate in joint reading groups and in the weekly joint CamPoS seminar.

Some MPhil and PhD students in both departments also participate in CSER and/or CFI and researchers in the centres act as supervisors, co-supervisors, advisors, or markers for MPhil and PhD work. Research students can become Student Fellows/Affiliates and some of these have now become Associate Fellows, having won JRFs in Cambridge (e.g. Boyle, Williams, Domenicucci (CFI)). Others have joined the centres as PDRAs, e.g. Quigley, Jones (CSER) and Boyle (CFI) who is now employed by Bonn on a joint CFI-Bonn project. So this is a pathway to employment, in some cases, alongside involvement in the research projects, meetings and international networks of these prominent interdisciplinary centres.

Research student skills and employment preparation

Both departments offer research students training programmes for skills development and career preparation, e.g. in library-based research, teaching and transferable skills, job seeking and research fellowship application. HPS also includes museum-based research, featuring site visits to significant collections and archives in Cambridge and London. Less formal series are held fortnightly for job market candidates and research funding applicants. Language courses are offered both within HPS and through other University facilities.

The departments have excellent graduate student progression and placement records.

- In HPS, 30 MPhil students between 2014 and 2020 went on to Cambridge PhD programmes (23 of them staying in HPS); a further 44 students joined doctoral programmes elsewhere. 23 PhD students since 2014 have obtained postdoctoral fellowships in the UK, Germany, Spain, Belgium, Sweden, the USA and Canada, while ten have obtained permanent university positions in the UK, Germany, Spain and Austria. HPS placement has also been strong for museum-based curators – nine recent HPS PhDs now occupy such posts in the UK.

- In Philosophy, 14 MPhil students from 2014 to 2020 went on to the Faculty's PhD programme, while 36 joined doctoral programmes elsewhere, including Oxford, UCL, Harvard, MIT, Stanford and Humboldt. Since 2014 20 PhD students have obtained postdoctoral fellowships in the UK, Australia, Austria, Germany, Israel, Italy and Belgium, while 14 have obtained permanent university positions in the UK, Germany, Norway and Holland.

2.3 Equality, diversity and wellbeing

All sub-units actively promote equality and diversity in research. All follow the University's policy on diversity and inclusion and the Race Equality Charter (2016); staff and student diversity networks; and collaboration on short-notice family-friendly support with My Family Care. Philosophy have implemented the BPA/SWIP Good Practice Scheme and HPS is in the process of doing so. Both departments are preparing to submit applications for Athena SWAN awards in 2021. The departments maintain Equality Champions (Alexandrova, HPS; Breitenbach, Philosophy) and Dignity at Work (Taub and Staley, HPS) and Racial and Sexual Harassment Officers (Langton, Philosophy). Philosophy has an active Equality Working Group and an active Minorities and Philosophy group. CSER and CFI have a joint E&D Working Group and designated external Dignity at Work officers. All staff are required to undertake training in E&D at least every 24 months.

Since REF2014 we have significantly improved the representation of underrepresented staff and students. Proportions of female permanent academic staff have increased from 33% to 40% in HPS and from 33% to 50% in Philosophy.

Philosophy, HPS, CSER and CFI all support the University's Breaking the Silence campaign for prevention, reporting and supporting in regard to harassment and sexual misconduct affecting both staff and students. We work closely with the offices of the Sexual Harassment and Assault Advisor within the University Counselling Service.

E&D career pathways

HoDs actively seek underrepresented staff who may be ready for promotion and encourage them to apply. HPS and Philosophy take part in the University-wide CV mentoring scheme with the purpose of encouraging and supporting more women, BAME staff and staff from other underrepresented groups to apply for promotion.

E&D study leave arrangements

Permanent staff are eligible for leave for secondment and flexible working, in addition to sabbatical leave and externally-funded research leave (see 2.4). Three staff in HPS currently have flexible working arrangements and four Philosophy staff have benefitted from career breaks and/or flexible working arrangements during the review period. Support is also offered for continuing study: fees are reduced by 2/3 and bursaries are available for study at the Institute of Continuing Education. In HPS, two museum staff have pursued PhD courses while employed.

E&D support

HPS and Philosophy make active use of the University's Returning Carers Scheme, which provides funding of up to £10k p.a. to support the career and professional development of individuals affected by periods of leave for caring responsibilities (two staff p.a. on average). Six colleagues (three HPS, three Philosophy) have taken parental leave and four PhD students (two HPS, two Philosophy) have taken shared parental leave. Arrangements for return to work after such leave are carefully managed, often involving phased return and flexible working.

All sub-units require diversity in speaker selection for seminars and conferences, and encourage an inclusive discussion culture. Important events are scheduled in core working hours.

Wellbeing

We actively support wellbeing activities. For example, HPS has offered free exercise classes at lunchtimes for staff and students as well as additional activities in recognition of Mental Health Awareness. Philosophy organises regular Faculty teas and walks that promote a healthy departmental culture. We encourage open dialogue between colleagues and the Wellbeing Advocates (Alexandrova and Russell, HPS and Harcus, Philosophy). Printed material is distributed to staff and students and displayed in communal areas, encouraging people to reach out and seek extra help and support.

E&D Output selection procedures

We based output selection on a ranking determined by repeat triage, with increasing numbers of assessors close to the borderline for inclusion to minimise the risk of unfair exclusion. E&D oversight was maintained at all stages. During the triage process outputs from researchers with protected characteristics and ECRs that fell just below the cut-off for inclusion in the next stage were 'bumped up', to minimise the risk of disadvantage from unconscious bias at points where there was most chance that it might make a difference to whether a researcher's outputs were chosen for submission.

3. Income, infrastructure and facilities

Once again, the unit's funding strategies are devolved to its component sub-units, though with overlaps (e.g. in the support of our two centres). In this section we report mainly by sub-unit. As we note below, disciplinary differences across the UoA mean that some kinds of research infrastructure are also specific to particular sub-units.

3.1 Funding strategies

In HPS, an important funding strategy is to identify research fields of strategic importance (e.g. public health and medical history, environmental sciences, museum-based projects in instrumentation) and provide research leave, peer support and administrative expertise to allow researchers to develop competitive funding applications. Because many of these fields are interdisciplinary in nature, HPS builds strong partnerships with University units specialising in interdisciplinary research, including the Centre for Research in Arts, Social Sciences and Humanities (CRASSH), where HPS staff (e.g. Lewens, Alexandrova, Curry, John) have taken research leave to develop successful grant proposals.

This strategy has worked well, generating a broad portfolio of projects in terms of both topic (ranging from food security to early-modern astrology) and funding source. Since 2014, HPS research income rose from £1.7m (2014–15) to £3.4m (2017–18); cumulative research income (2014–20) was £12.4m. HPS hosted five major externally-funded research project grants: Board of Longitude (AHRC, 2010–15, £795k); Generation to Reproduction (Wellcome, 2009–18, £809k); *Casebooks* (Wellcome, 2015–19, £1.3m); Science of Human Nature (ERC, 2011–16, £1.2m); and EconPublic (ERC, 2012–16, £1.3m).

The Department is now supporting a new cycle of major project grants. *Making Climate History*, launched in autumn 2019 (Leverhulme, 2019–24, £500k), includes a five-year postdoc, two three-year postdocs plus research leave for three PIs. A Wellcome Trust Investigator Award (Curry's project on *Crop Diversity and Food Security*, 2020–25, £819k) has been secured to begin in 2020, as has a £1m AHRC grant (Taub, Nall and B. Jardine,*Tools of Knowledge: Modelling the Creative Communities of the Scientific Instrument Trade, 1550-1914*, 2021–24), to begin in 2021.

Philosophy is a small unit and our strategy has been to support a range of grant types, creating centres and networks, building an ECR community and strongly supporting individual faculty. We have aimed to foster the full range of our research strengths. This has paid off with an exceptional record on grant capture. In recent years we have had the highest average success rate in our School (application to success ratio 43.5% over 2014–18). This was encouraged by a novel Research Incentive Scheme, 2010–18, which compensated colleagues' efforts on grant applications, even when unsuccessful. Nearly all permanent staff won external grants in this period, on topics ranging from decision theory to moral knowledge, consent and communication, aesthetics in science, philosophical logic, the politics of language and the politics of the unmodified body.

In addition the Faculty has supported several large project grants (Crane, Templeton US$1.6m, Price, TWCF, £1.8m; Price, Newton Trust, £669k; Price, Leverhulme Trust, £10m) for projects and centres, in each case offering flexible buy-out arrangements for project and centre leadership and development and, again, career development for ECRs.

CSER and CFI are products of these department strategies, with extensive involvement from both departments. Researchers within the centres have been highly successful in pursuing their own research and philanthropic funding; for the latter, the centres work closely with the University's Development Office.

As noted in 2.1, the UoA also encourages many successful applications by ECRs for fellowship funding, both from national and international schemes (e.g. British Academy, Leverhulme, Marie Curie) and from college Junior Research Fellowships. Our strategy is to find, encourage and assist excellent candidates and support them when they are successful.

3.2 Organisational infrastructure

Within the assessment period our departments have developed two major interdisciplinary research centres, each with a novel and highly distinctive area of work: CSER, focussing on catastrophic risks, especially those associated with new technologies; and CFI, focussing on the challenges of what is widely viewed as a potentially epoch-making technology, viz., artificial intelligence. The work of these centres is already highly impactful and promises to become more so. Between them, they have already attracted more than £20m in research and philanthropic funding. They maintain close links to both core departments in the unit, as detailed elsewhere and have similarly close links in other disciplines within the University.

3.3 Physical infrastructure supporting research and impact

HPS is built around the Whipple Museum of the History of Science. The Whipple is supported by R. S. Whipple's original endowment (1944) and is designated a pre-eminent collection of scientific manuscripts, books and instruments. Prof Liba Taub is the Museum's Director and Curator and Dr Joshua Nall is the Curator of Modern Sciences. The Museum is further staffed by an Exhibition and Project Coordinator, Collections Manager and Learning Coordinator, who work alongside the Whipple Library team.

The Museum is an important site for the integration of research, teaching and public engagement. It hosts exhibits by students and staff, who gain the opportunity to develop research-led displays illustrating the material culture of science: e.g. *Embryos in Wax* (Hopwood), *Kitchen Chemistry* (Al-Gailani). HPS scholarship often underpins the Museum's temporary exhibitions: e.g. *Science and Industry in Cambridge* (Nall); *The Art and Science of Brewing* (B. Jardine, Nall), *Why is This Here?* (Taub, Schaffer, B. Jardine, Nall).

Use of the collections for research is enhanced through seminars, graduate training and collaborative projects: e.g. work investigating forgeries in the Museum (Nall, Jardine); workshops on *Historical Authenticity* organised in collaboration with the Leibniz Research

Alliance (Taub, Nall); and a colloquium and special issue on *How Collections End* (Bangham, Jardine, Hopwood, Curry). Further impact is delivered by the Learning Co-ordinator and curatorial staff through displays, tours, online 'Explore' guides, formal school sessions (KS1–KS5) and family outreach events organised in collaboration with the University of Cambridge Museums consortium. The Museum has also hosted television shoots (e.g. Schaffer in BBC4's *Mechanical Monsters*).

Research and impact are also supported by flexible shared office and meeting space, especially in our two interdisciplinary centres. CSER was initially launched as a project within CRASSH and from 2014 its first staff were housed in CRASSH's incubator space in the Alison Richard Building. Two years later, when the Cambridge Conservation Initiative (CCI) moved into its new home in the David Attenborough Building, a rapidly expanding CSER and the new CFI became the first occupants of a space in the building designed to support new research start-ups. This supported collaborations with CCI (e.g. extending horizon scanning techniques developed by Sutherland's group in CCI). It also provided a superb venue for hosting external visitors. In 2018 the two centres moved to two floors of a building in central Cambridge. This provides flexible open-plan space and meeting rooms for 40+ researchers, visitors and core staff. Many projects and outputs result from the kind of spontaneous creativity that the space facilitates. It also supports many external collaborations, with partners elsewhere in Cambridge and with further afield.

4. Collaboration and contribution to the research base, economy and society

4.1 Research collaboration

The departments and centres all encourage and maintain strong national and international collaborations. Many of these are described elsewhere (e.g. new international collaborations under Objective 2 in 1.2 and collaborations for impact in 1.3(i) and 4.3(v)).

Our collaborations arise in many ways. Some are developed one-to-one by individual researchers, some via larger joint research projects and others at the sub-unit level. We give a few examples of each, although there are many more.

- **One-to-one.** These include John's links on bioethics with PKU Medical Centre; Brazelton's joint research projects in medical history in Beijing and Shanghai; Alexandrova and John's work on numerical methods with UC Santa Barbara and Chicago; Marenbon's collaboration with PKU on medieval philosophy; and Hopwood's and other researchers' collaboration on medical history with Leuven.

- **Project-based.** These include Oliver's *Trust in Banking* collaboration with Groningen, funded by the Dutch Research Council; Halina's Templeton-funded project (with ANU and Macquarie) on cognitive transitions; Breitenbach's DAAD-funded network linking Kant scholars in the UK, Germany and the USA; Breitenbach's Leverhulme-funded project *Kant and Laws of Nature* with Edinburgh; and Price's TWCF-funded project with Oxford.

- **Sub-unit initiatives**. HPS has an especially close connexion with the Max Planck Institute for History of Science in Berlin (involving Schaffer, Secord, Hopwood, Bangham and several postdoctoral researchers during the review period); HPS is also a founder-member of the PhilInBioMed community of researchers coordinated from Bordeaux. Philosophy has several links with LMU, Munich, under the auspices of a Cambridge–LMU agreement; CFI has MoUs with the Coral Bell School for Asia Pacific Affairs, ANU and with the Institute of Automation at the Chinese Academy of Sciences, Beijing.

Another route to collaboration is for our researchers to take primary roles in prestigious international institutions, e.g. Hopwood's direction of the Ischia Summer School in History of Life Sciences and Schaffer's direction of workshops on science policy at the Cini Foundation Venice. Other researchers hold prestigious visiting fellowships; e.g. Breitenbach and Curry both held ProfuturaScientia fellowships at the Collegium for Advanced Study, Uppsala.

Some collaborations involve research training. This happens in several ways. HPS has supported AHRC collaborative doctoral awards with the National Maritime Museum on magnetic navigation, with the Science Museum on aeronautics and on electromagnetism and with the British Library on photography. Oliver's *Trust in Banking* project with Groningen supported two PhD students (who obtained PhDs both from Cambridge and from

Groningen). Several staff have taken research residencies in combination with research students: e.g. regular philosophical and historical research and teaching in France at Paris-1 (Lewens), at EHESS (Schaffer) and at Bordeaux (Stegenga); and in medical projects such as Kassell at Johns Hopkins and McKay at the Yale Medical School.

Strong international collaborations also develop through curatorial work on collections study and publication: examples led by Taub and Nall include the Deutsches Museum, the National Museum of American History and the Chemical Heritage Foundation; and by Hopwood at the Ernst Haeckel Haus Jena.

4.2 Engaging with the recipients of research

The departments maintain strong links with beneficiaries after initial delivery. The project on the Board of Longitude (Schaffer, completed 2015–16) sustains continuing connexions through Cambridge Digital Library with user communities to re-edit transcriptions and metadata of key documents and identify new materials of relevance to navigational and colonial histories (rmg.co.uk/content/explorers-key-stage-2). Strong connexions are maintained by the Darwin Correspondence Project (J. Secord, White, A. Secord) with educational users of school packages, through the Galapagos Conservation Trust and in training for KS2 and KS3 programmes that in turn reorient editorial work of correspondence and linked materials. The project on *Limits of the Numerical* (Alexandrova, John, 2015–18) involved early strong links with the National Institute for Health & Care Excellence that then prompted novel forms of research inquiry on policy models. John's project with Cancer Research UK (2017) has led to research initiatives on early detection methodologies as well as significant doctoral research (e.g. Wu's PhD thesis 'The Limits of Screening', 2019). Close links between work in AI (Halina, Wright: CFI) and private sector partners, including Google DeepMind and GoodAI, have generated innovative research trials such as Animal AI Olympics.

4.3 Relationships with key stakeholders and audiences to develop impact

As noted in 1.3, our departments and centres all make use of the following five pathways to enable impact: (i) working with impact-focussed organisations and policymakers; (ii) outreach and media; (iii) work with schools; (iv) interdisciplinarity for impact; (v) international collaborations. The examples here supplement those given in 1.3.

(i) Work with impact-focussed organisations and policymakers

We partner with many impact-focussed organisations and gave examples related to our ICSs, with an emphasis on our centres, in 1.3(i). Additional examples include the following.

- HPS focuses especially on charities, businesses and public institutions concerned with medical and social policies. Links with the National Institute for Health and Care Excellence (John and Alexandrova) have been essential for the development of research

in numerical methods in medical and social sciences; other links (for example with AstraZeneca and the Nuffield Council on Bioethics) are explained in our case studies. John worked with the Cambridge Cancer Centre on early detection of cancer. In a different direction, Schaffer took a lead role in the Bank of England's Banknote Character committee in 2019, recommending that Alan Turing appear on the £50 note.

- Philosophy examples include Chambers' work on cosmetic surgery, again with the Nuffield Council on Bioethics and Holton's work with the Healthcare Improvement Studies Institute.

We also work extensively with policymakers, both by hosting meetings in Cambridge and by participating in meetings elsewhere. In the former category, for example, the University's Centre for Science and Policy (CSaP) has arranged *circa* 250 one-on-one meetings since 2013 between their visiting Policy Fellows (typically civil servants, senior charity workers, EU officials and industry representatives) and researchers from the UoA. This culture of policy engagement underpins the many specific relationships – e.g. with various APPGs, government departments and parliamentary committees – detailed in our ICSs.

(ii) Outreach and media

Many researchers across the UoA do a great deal of outreach activity, much of it with an eye to the impact of their research. The following examples are very far from exhaustive.

Several UoA members have acted as *New Generation Thinkers* and taken part in BBC Radio 4 *In Our Time* broadcasts (Nall, Secord, Kassell, Schaffer, Chang), as well as participation in *How the Light Gets In* (the world's largest music and philosophy festival; Langton, Halina, Price, Lewens) and TV broadcasts for BBC4 and Channel 4 on themes in history of the sciences and technology (Secord, Staley, Schaffer, Kassell, Nall).

In 2017 Langton was the invited keynote speaker on 'The Authority of Hate Speech' and participated in two panel discussions at *Integrity 2017: Truth, Disorder and Optimism,* a major outreach conference bringing together politicians, journalists, academics and the general public at Griffith University, Queensland, Australia.

Whipple Museum projects (Nall, Jardine, Taub) deliver significant educational and heritage outreach through documentation of historical collections, educational programming and development of innovative curatorial and interpretative training programmes. Examples include continuing initiatives on climate change (e.g. *Climate Hack*, 2017); arts education (*Activate,* 2017–18); and events in regular education festivals including the Cambridge Festival of Ideas and Science Festival.

Studies in the origins and public reportage of AIDS crises (McKay, 2014–19) have generated policy analysis and education initiatives around representations of HIV epidemiology in the media, as well as work on the AIDS epidemic with the London HIV prevention campaign. McKay's book *Patient Zero and the Making of the AIDS Epidemic* has also served as the basis of a major documentary film, *Killing Patient Zero*.

From our centres, CFI has engaged with a wide range of media to disseminate its research and embrace a range of publics. Its launch was covered by most of the UK national newspapers and many international media outlets and its staff have contributed regularly to these outlets since – e.g. Cave has published in the *Guardian, Telegraph* and *Financial Times.* In 2018, CFI organised a major conference with the BBC on AI and the media and has contributed content to numerous BBC programmes, from Radio 4's *Today* programme, to the World Service's *Click.* CFI also has a partnership with the online magazine *Aeon* and actively supports its junior researchers in preparing pieces for this and other audiences. A recent CFI publication 'The Whiteness of AI' (Cave, Dihal)[1] was mentioned in nearly 100 media outlets worldwide, with an Altmetrics score in the top 5% of *all publications*.

Similarly, CSER researchers have contributed articles to a wide range of media sources, including BBC News, BBC Future, *Aeon, The Huffington Post* and *Metro* and have been featured on the *Today* programme and BBC *Newsnight* as well as a range of international media and podcasts. Researcher Simon Beard was selected for the BBC *New Generation Thinkers* scheme (2017) and currently makes radio programmes with BBC Radio Documentaries. CSER's high-level report on the *Malicious Use of Artificial Intelligence* was covered by newspapers and media around the world and was also widely shared on social media.

We also work with museums and galleries to deliver outreach for impact. The HPS Department has a long and successful record of initiatives in engagement with historical outreach, through Black History Month (in the case of the Darwin Correspondence project), through carefully-planned exhibition series (such as the *Making Visible* exhibition at the Royal Society) and nationally and internationally (for example, in Berlin exhibitions and performances in the case of the *Patient Zero* project and at the University of Westminster Ambika Gallery as part of the planned impact of the *Casebooks* project).

(iii) Work with schools

We work with educational agencies to enable impact on school curricula and programmes.

- In HPS, Lewens has collaborated with the Faculty of Education and the charity Sapere to pilot the teaching of philosophy of science in local primary schools. His introductory book *The Meaning of Science* has been adapted to produce teaching materials for this purpose. The Whipple Museum's learning coordinator conveys key elements of our research collections to a variety of audiences including schools, families, adult learners and community groups. The Darwin Correspondence Project at the University Library also employs an education officer who designs teaching materials for use in schools. These links have developed internationally: a project on the history and politics of the AIDS epidemic (*Patient Zero:* McKay) worked with the US National Library of Medicine to produce learning modules for educational programming in travelling exhibitions.

[1] Dihal is returned to UoA27.

- In Philosophy, Dougherty (2014–19) secured AHRC Impact and Engagement funding to support his work on *Promoting Consent*, producing a series of educational tools and partnering with Super Super PR to promote their dissemination. His work on sexual consent underpinned a Sixth-Form Consent Workshop (July, 2018), co-organised with GenPol, a gender-focussed thinktank and consultancy, convening sixth-form students and teachers to discuss students' and teachers' perspectives on what should be covered in consent teaching in Relationships and Sex Education (RSE). It also supported a policy workshop co-organised with the University's Centre for Science and Policy (CSaP), enabling academics, civil servants from the Department of Education, sexuality and sexual abuse charities and others to discuss how academic research can contribute to how consent is taught in RSE.

(iv) Interdisciplinarity for impact

Collaborative interdisciplinary research is, by nature, a bridge to stakeholders beyond our home disciplines. In our case, as the extensive examples given in 1.4 and elsewhere show, it often connects us to stakeholders and audiences well beyond academia.

(v) International links for global impact

Many of the most pressing challenges of our time are global in nature and a significant proportion of our research aims to have global impact. This is enabled, among other things, by research linkages with international organisations, both academic and non-academic, both public and private. Good examples for CSER and CFI include the Centre for Strategic Futures, Prime Minister's Office, Singapore, with whom CSER and CFI hosted two workshops in 2018; the Australian Department of Foreign Affairs and Trade, who funded a workshop on *AI, Politics and Security in the Asia Pacific* co-organised with the Coral Bell School, ANU, March 2019; and the ITU, who invited CFI to put together the *Trust in AI* track at the UN *AI for Good Summit,* Geneva, May 2018. CSER has growing links with similar centres including the Global Catastrophic Risk Institute, Future of Life Institute and Bulletin of the Atomic Scientists in the USA, the Global Challenges Foundation in Sweden and the Graduate School of Advanced Integrated Studies in Human Survivability at the University of Kyoto in Japan.

4.4 Contribution to sustainability of our disciplines

- The departments' contribution to the sustainability of the discipline is evident in their strong graduate progression and placement records – see 2.2 above.

- Support for interdisciplinary research is evidenced in 1.4 and by the unit's two major interdisciplinary centres, CSER and CFI. The work of these centres also illustrates our responsiveness to international priorities (existential risk and the challenges of AI) and to sustainability in the global sense.

- Responsiveness to national and international research priorities and initiatives is evidenced by: (i) response to Wellcome Trust initiatives in medical humanities (12 studentships and postdoctoral fellowships since 2014, especially in early modern history and the Strategic Award on generation and reproduction funded since 2009); (ii) response to initiatives from the Leverhulme Trust, John Templeton Foundation and the Templeton World Charity Foundation in many successful funding applications with important institutional investment in fields such as philosophy of social sciences, of evolutionary sciences, of social policy (through CRASSH), of mind and of AI; internationally, ERC initiatives in fields in the human sciences were met through projects on the science of human nature (Lewens, 2011–16) and the use of economics in the public sphere (Mata, 2012–16).

4.5 Wider influence of our researchers

Learned societies and academic links

- Six researchers are Fellows of the British Academy (Butterfield, Langton, Marenbon, Price, Schaffer, Secord), several acting as reviewers and Chairs of research and funding committees. Langton is also a member of the American Academy of Arts and Sciences (elected 2014) and Academia Europaea (elected 2018). Price is a Fellow of the Australian Academy of the Humanities (AAH) and acted as intermediary between the BA and AAH in assessing a joint grant programme (2019). Nall is a fellow of the Royal Astronomical Society, where he currently serves as Chair of the Heritage Committee.

- Many researchers take leadership roles as Chairs, board members and executives in national and international learned societies. Examples include: the Philosophy of Science Association; British Society for Philosophy of Science (Bird is President 2019–21); British Society for History of Philosophy; Royal Institution of Philosophy; European Philosophy of Science Association; International Network for Economic Method; Society for Philosophy of Science in Practice; International Society for History, Philosophy and Social Studies of Biology; British Society for the History of Science (Fara was President 2016–18); History of Science Society; International Academy of History of Science (Taub is currently vice-president); and the American Institute of Physics (Staley has a senior role on the history programme).

- Breitenbach is a Member (2019–25) of the Advisory Board, DFG Priority Programme 2205 *Evolutionary Optimization of Neuronal Processing*, Max Planck Institute for Dynamics and Self-organisation and University of Göttingen.

- Price is on the Board of the Ada Lovelace Institute, is UK Chair of the China-UK Research Centre for AI Ethics and Governance based at the Chinese Academy of Sciences, Beijing, and was co-Chair of the first annual AAAI/ACM Conference on *AI, Ethics and Society* (New Orleans, 2018). In 2018 he was also keynote speaker at the launch of a new Department of Logic and Philosophy of Science at Fudan University,

Shanghai and of the new PKU Center for Philosophy and the Future of Humanity, Beijing.

- Staff have been external examiners for universities throughout the UK and in Austria, Belgium, France, Germany, the Netherlands, Norway, Sweden and the United States.

- Many staff have editorial roles, for example: Alexandrova, Philosophy of Economics Editor for *PhilPapers;* Breitenbach, Subject Editor for Kant, *Stanford Encyclopedia,* and Kant (Science, Logic and Mathematics) Editor, for *PhilPapers;* Chambers, co-Editor-in Chief, *Res Publica,* since 2019; Margocsy, co-Editor of *Techne* book series, Brepols; Mueller-Wille, Editor-in-Chief, *History and Philosophy of the Life Science*s, 2014–19; Staley, co-Editor-in-Chief, *Physics in Perspective*, since 2019; Stegenga, Chief Editor of the book series *Elements in Philosophy of Science*, CUP, 2018–22.

Named lectures and awards

- Butterfield gave the Nagel Lecture, Columbia (2014). Langton gave the John Locke Lectures, Oxford (2015) and the Hart Lecture (2019). Holton gave the Uehiro Lectures in Practical Ethics, Oxford (2018). Hopwood gave the William Bynum Lecture in History of Medicine, York (2015) and the H.G. Wells Lecture on Science and Society, Kent (2016). Lewens gave the WYNG-Hatton Lecture in Medical Ethics and Law, HK University (2015). McKay gave the History of Medicine Manuelidis Memorial Lecture, Yale (2019). Price gave the Frege Lectures, Tartu (2016), the Pitowsky Lecture, Jerusalem (2016) and the Jacobsen Lecture, London (2018); he was also invited to give the 2020 Dewey Lecture at Fudan University (postponed to 2021 due to Covid).

- Schaffer won the Dan David Prize (2018). Chang holds the British Academy's Wolfson Research Professorship. Both Chang (2015) and Schaffer (2019) have been awarded the Wilkins/Medawar/Bernal medal and lectureship of the Royal Society for achievement in history, philosophy and social studies of science. Secord holds the Founder's Medal of the Society for the History of Natural History. Button won a Philip Leverhulme Prize (2014). Pugliano won the Stannard memorial prize for history of pharmacy (2016) and PhD researcher Sebastian de Haro won a Beyond Spacetime essay prize in 2016.

- Langton was awarded an honorary doctorate from the University of Klagenfurt in 2020.

Publication awards

Kusukawa's *Picturing Nature*, Hopwood's *Haeckel's Embryos* and Nall's *News from Mars* won awards from the History of Science Society. Brazelton's paper, 'Engineering Health: Technologies of Immunization in China's Wartime Hinterland, 1937–45' (*Technology and Culture*) won a Zhu Kezhen Award (2019). Button's book *Philosophy and Model Theory* was chosen for an American Philosophical Association Symposium and an APA Author-meets-Critics session in 2019. Chambers' *Against Marriage* won the American Political Science Association's David Easton Award (2018). Curry's development of digital tools won a Wellcome Trust Developing Beyond Award. Vold (CFI) won an APA Philosophy Op-Ed

Award (2019). Currie (CSER) won the Fernando Gil International Prize (2019) for *Rock, Bone and Ruin.*