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- a. genetic
- b. stress

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Science and technology archives in the UK

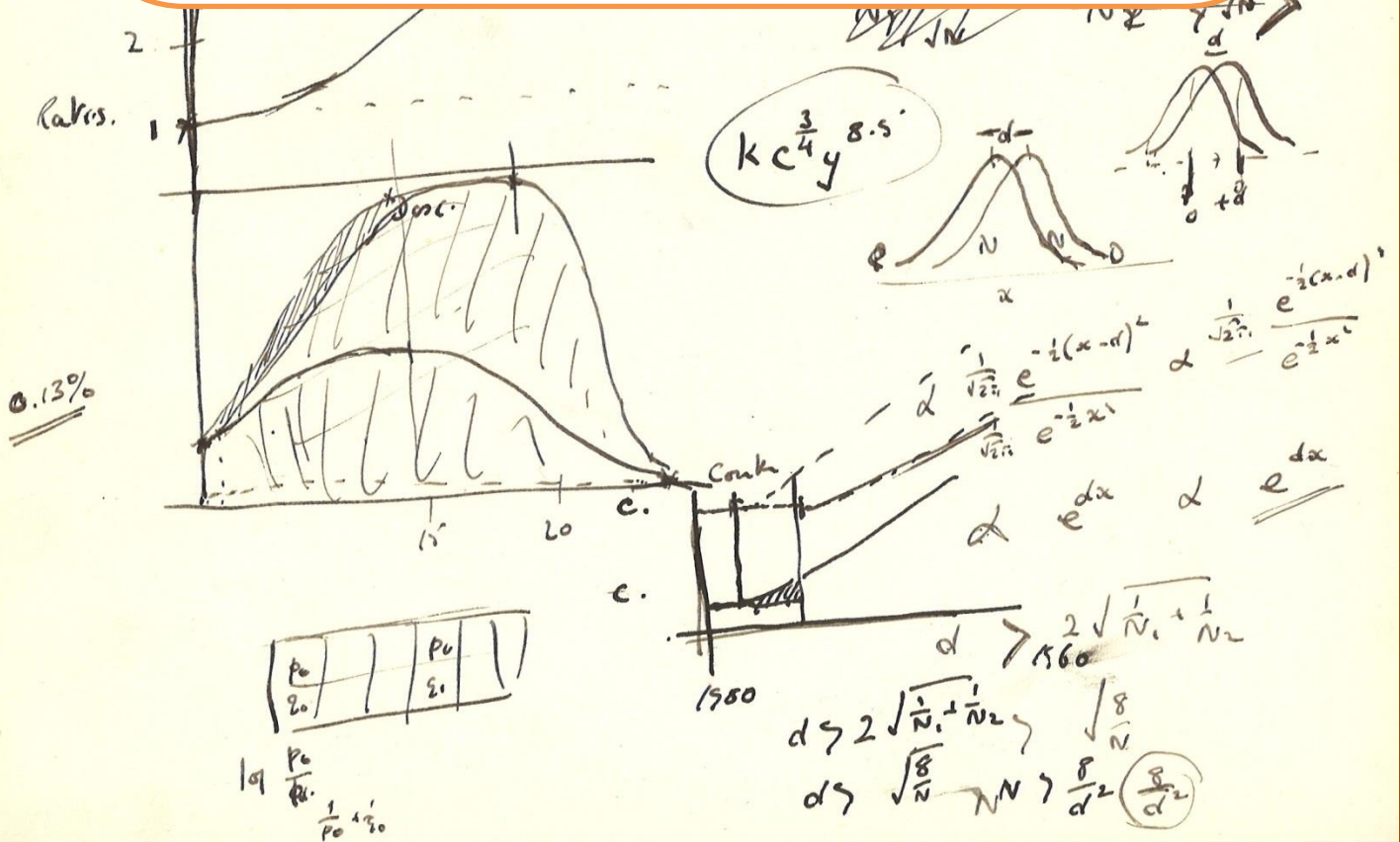
A paper for The National Archives (v 2.3)

Dr Tim Powell and Dr Sarah Marks



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Science and technology archives in the UK

**Dr Tim Powell, Independent Archives Team, and Dr Sarah Marks,
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Development**

Contents	2
Executive Summary	4
1. Defining the issues	6
1.1 Definitions	6
1.2 Remit	6
2. Historical context	9
2.1 Initial concern	9
2.2 Standing Joint Committee	9
2.3 The cataloguing centre model	10
2.4 Sale of archives	11
3. Methodology	11
4. Findings	13
4.1 The challenges	14
4.2 Improving access to and exploitation of existing sources	15
4.2.1 General issues	15
4.2.2 Cataloguing	17
4.3 Improving archival capture of contemporary records	18
4.3.1 Collecting policies	18
4.3.2 Archives of technological industry	18
4.3.3 Research Councils, data management and archives	20
4.3.4 Collecting strategies	22
4.4 Ensuring long-term sector infrastructure to ensure sustainability	22
5. Recommendations	23
5.1 Improving access to and exploitation of existing sources	24
5.1.1 Raising the profile of resources at TNA	24
5.1.2 Cataloguing	25
5.2 Improving archival capture of contemporary records.	25

5.2.1 Survey of collecting policies in science and technology	25
5.2.2 Survey of technology companies	26
5.2.3 Engineering archives	26
5.2.4 The relationship between research councils and archivists	26
5.3 Ensuring long-term sector infrastructure to ensure sustainability: Support groups for scientific archives	28
6. Next steps	28
Appendix. List of those consulted	30

Executive Summary

This paper examines the part that The National Archives might play in the development of a national strategy for the archives of science and technology, principally those outside the scope of the Public Records Act 1958. It arises from concerns expressed in the Archives Sector Development department from 2009 for the representation of science and technology in the archival record. From mid-2014 to date Tim Powell, aided by Sarah Marks, undertook discussions and investigations with a wide range of interested parties. This report considers the various issues at stake, gives the historical context within which these issues have come to a head, sets out the findings of our investigations, analyses the particular challenges identified, and makes initial recommendations.

In the course of our investigations, it became evident that the findings could be seen to have three dimensions, relating to the needs to:

1. Improve access to and exploitation of existing sources.
2. Improve archival capture of contemporary scientific records.
3. Ensure long-term constituency infrastructure to ensure sustainability.

This three-fold schema was adopted to structure the discussion of the Findings in section 4 of the report and the recommendations arising (sections 5 and 6). It should be noted that much stress is placed on the need for collaboration and partnerships, within and outside TNA, both in the consideration and in any implementation of the recommendations.

Summary of recommendations

Improving access to and exploitation of existing sources

- 1) It is recommended that TNA consider appointing a Records Specialist in the Advice and Records Knowledge department in the area of science and technology, see page 24.
- 2) It is recommended that TNA hosts a workshop or seminar based on the resources in science and technology it holds, highlighting research potential within them, page 25.
- 3) It is recommended that TNA publishes a guide or guides to the scientific and technological archives it holds, possibly later extended to PODs, page 25.
- 4) It is recommended that TNA investigate hosting a partnership with AHRC Collaborative Doctoral Award studentship to exploit our resources, page 25.
- 5) It is recommended that existing entries for scientists and scientific bodies in Discovery be checked and where necessary amended, page 25.
- 6) It is recommended that a package of measures is developed to help meet the general challenge of capacity building in cataloguing of, fund-raising for and promoting the use of scientific and technological archives collections, page 25.

7) It is recommended that the Centre for Scientific Archives@the Science Museum be a partner in developing a science and technology archives strategy, particularly in relation to cataloguing, page 25.

Improving archival capture of contemporary records

8) It is recommended that research and mapping be undertaken to clarify collecting policies in the area of science and technology in Britain, page 25.

9) It is recommended that a survey be undertaken of records of Britain's aerospace industry, to gather information, build relationships and offer guidance, page 26.

10) It is recommended that a supportive relationship be built with the Archives of IT project, page 26.

11) It is recommended that investigations similar to those reported here for science and technology be initiated for engineering, page 26.

12) It is recommended that work begin on preparing simple, practical guidance for scientists on identification and long-term preservation of archival material based on UK and international guidance, with a focus on born-digital personal papers, page 27.

13) It is recommended that advocacy material be compiled for scientists which explains the importance and ranges of use of historical archives of science, page 27.

14) It is recommended that discussions be initiated with the science Research Councils and other parties to promote recommendations 12 and 13 and investigate developing a documentation strategy approach to particular lines of research, page 27.

Ensuring long-term sector infrastructure to ensure sustainability

15) It is recommended that an advocacy or specialist interest group be established for science and technology archives, page 28.

16) It is recommended that work be undertaken to (re)establish a network of European science archivists and that if necessary some funding be provided to support this, page 28.

Next steps

17) It is recommended that the development of a science and technology archives strategy for TNA is taken forward, with a commitment to active participation in any interest group or support network, pages 28-29.

18) It is recommended that this paper, or a version thereof, be circulated widely among interested parties soliciting feed-back and comment, page 29.

19) It is recommended that TNA prepares an initial outline timetable for the discussion and implementation (where applicable) of recommendations presented here, beginning with hosting an initial round table meeting of interested parties, page 29.

1. Defining the issues

*'Gowing recalled how, in the course of interviewing James Chadwick at his retirement home in North Wales, the two sat in his attic, surrounded by wooden filing cabinets full of priceless documents. She was greatly worried when, asking what Chadwick was going to do with them, he 'shut his eyes, groaned, and said, "burn them".'*¹

1.1 Definitions

The term 'science archives' or 'scientific archives' is used here to refer to historical archives that have been created by scientists as individuals and by corporate bodies undertaking scientific research. The archives themselves need not have a scientific content; they are defined as such by the context of their creator.

The definition of science has been limited to the 'hard' sciences. This includes mathematics and medical research. Social sciences such as psychology are not included, nor is medical practice. Engineering² is also excluded from this paper, see p13, although partly covered by the term 'technology archives'.

The term 'technology archives' is used here to refer to historical archives that have been created by corporate bodies, and by individuals working within them, undertaking the application of science to productive processes in a commercial or semi-commercial context. The archives themselves need not have a technical or scientific content; they are defined as such by the context of their creator.

For the purposes of this paper, science and technology archives are being taken as a single constituency.

1.2 Remit

For the last few years there has been concern within the Archives Sector Development department of The National Archives for the archives of contemporary science and technology falling outside the definition of public records under the terms of the 1958 Public Records Act and subsequent updating legislation. This initially was prompted by the news that the University of Bath-based National Cataloguing Unit for the Archives of Contemporary Scientists (NCUACS)³ was to close at the end of December 2009. This unit, as well as performing a cataloguing function, also acted as a central information and advice centre and, to some extent, fulfilled a national coordination role.

In October 2009, Nick Kingsley, Head of ASD suggested a possible project in this area,

¹ Roy MacLeod, 'Margaret Mary Gowing CBE FBA 26 April 1921-7 November 1998. Online version of memoir from *Biographical Memoirs of Fellows of the Royal Society* 2012,

<http://rsbm.royalsocietypublishing.org/content/early/2012/09/10/rsbm.2012.0027.full.pdf+html>, p15.

² As defined by the Concise Oxford English Dictionary as 'The branch of science and technology concerned with the design, building, and use of engines, machines, and structures'.

³ <http://www.webarchive.org.uk/wayback/archive/20090922233733/http://www.bath.ac.uk/ncuacs/>

‘One idea concerns scientific archives (the papers of individual scientists and scientific bodies), which have been flagged in the Collecting Strategies programme and our advisory casework as an area where collections are known to be at risk. I believe there has also been interest in the idea of developing better guidance on the selection of scientific archives within the public records field. More recently, the threat to the future of the National Cataloguing Unit for the Archives of Contemporary Scientists (NCUACS) and its transformation into a charitable operation based at the Science Museum Library at Wroughton (Wilts) with the support and intervention of Imperial College and the National Council on Archives, have focused attention on this area of collecting’.⁴

Nothing came of this at the time, but interest at TNA was revived in 2011 and 2013, focused around the Centre for Scientific Archives@the Science Museum. This is the operation based at the Science Museum at Wroughton, which was seeking support and funding to continue the work of the NCUACS (to which Nick Kingsley referred).

Arising from this Norman James, Head of the Private Archives Team at TNA, drafted a proposal to put before the meeting of the Lord Chancellor’s Forum on Historical Manuscripts and Academic Research on 6 March 2014. In his paper, ‘Future objectives and priorities for the Private Archives Team’, he observed,

‘...our knowledge of science and technology archives is becoming out-of-date. It is over 30 years since the publication of the HMC guide to papers of British Scientists 1780-1940 (1982). Since then, the National Cataloguing Unit for the Archives of Contemporary Scientists has closed (in 2010). Furthermore, much scientific research formerly undertaken by government agencies has been privatised and is being pursued either within universities or in the private sector. It is difficult to locate material on science (apart from personal papers) in the NRA except in specialist fields such as medicine and pharmaceuticals.’

He went on to list some of the difficulties, including the weakness of existing institutions in collecting in this area and the challenge with electronic records.

The paper placed technology as central to its concern and suggested the project might include as a principal objective,

‘To map the archives of the new industries based on science and technology that developed since 1970 and to ensure that there is accurate information about their records, to increase the awareness of the research commercial and cultural value of such material and to assess the long-term sustainability of such material.’

The paper was favourably received and as a result it was agreed that from October 2014, Tim Powell, then Senior Adviser: Religious Archives, should spend a proportion of his time carrying out such preliminary work in the area of science and technology

⁴ Email of 1 October 2009, ‘Scientific archives: possible investment bid’. Nick Kingsley had been in discussion with the Director of the NCUACS, Peter Harper, prior to the dissolution of the Unit and was familiar with the issues involved.

archives with a view to suggesting the scope for a potential TNA initiative in this area. Additionally, in July 2014, he was enabled to attend the Conference of the International Council on Archives' Section on University and Research Institution Archives (ICA-SUV) on Research and Scientific Archives⁵.

Tim Powell had some qualifications to undertake this work. Although at that time his role at TNA was to advise on religious archives, his background was in scientific archives: as a member of staff of the NCUACS from 1988 to 2009, since 1996 as Senior Archivist, and then as lead archivist on the Cardiff University Genetics Archives Project and the initial Bodmer Archives Project in Oxford. Few archivists in the UK, certainly in TNA, have such a background.

Later in 2014 the work was assisted by Sarah Marks of the Collections Knowledge Team in ASD. With both a Ph.D. in the biological sciences and an archives qualification, she brought useful expertise to this initiative.

Nick Kingsley's 2009 observations and Norman James's proposal indicate the broad scope of concern. Recent inputs into the annual Accessions to Repositories exercise indicate that accessions of modern science and engineering collections to UK repositories are not extensive.⁶ This, together with anecdotal evidence, suggests that there is an ongoing problem: archival coverage of this area, never outstanding, is increasingly patchy, not always of high quality and does not reflect the range of scientific activity in Britain. It is certainly clear that certain subjects, particularly the biomedical sciences, are rather better served than physical and other sciences. In the course of our discussions reported below, no respondent demurred from these observations, although some stressed the work being done by their own institutions.

As of 4 August 2015 a search on the Discovery resource for Records Creators, under a variety of epithets, recorded the following numbers of creators: 'scientist' 223; 'geologist' 311; 'chemist' 300; 'mathematician' 275; 'physicist' 255.

These figures should be compared with those for 'general' 2,155; 'historian' 2,113; 'poet' 1,310; 'politician' 1,207; 'architect' 715; 'novelist' 526; 'surgeon' 490; 'composer' 420.

Our discussions and this paper have therefore started from the assumptions that there is a need to ensure that historically important records of contemporary science and technology in Britain are retained in recognised records repositories (in this context principally meaning outside The National Archives) and made accessible to historians and other researchers in the future, and that currently this is not being ensured as comprehensively as would be desired. In the course of our discussions no respondent demurred from these assumptions.

⁵ <http://icasuv2014.univ-paris-diderot.fr/?lang=en>

⁶ Although it should be noted that the digest for the 2014 Accessions to Repositories is unusually strong in the area of science.

2. Historical context

*'Those who cannot remember the past are condemned to repeat it'*⁷

2.1 Initial concern

To help understand the issues today, it is useful to consider past initiatives in this area.⁸ It will be noted there is a certain element of repetition.

Concern had been expressed about the fate of the archives of British scientists from the late 1950s. In 1961-1964 A.E. Jeffreys for the Standing Conference of National and University Libraries conducted an initial survey of holdings of manuscripts of significance to the history of science up to the early twentieth century⁹. The British Records Association Annual Conference in 1966 looked at the problems facing scientific archives, a discussion chaired by Roger Ellis, Secretary of the HMC¹⁰. At this meeting several issues were mentioned which would be encountered again in 2014-2015. They included, in no particular order: the history of science as a discipline being heavily focused on the seventeenth to nineteenth centuries, the challenges of new technology, the fact that scientists generally worked as members of a team, the need for archives guidance for scientists, the role of the PRO in respect of modern scientific records, and the challenges facing archivists with no science background.

2.2 Standing Joint Committee

In 1966 the Royal Society and HMC formed a Standing Joint Committee 'to promote and assist the preservation and use of the records of scientific and technological research and development'. The Committee focused on access to such records. Firstly, by gathering and providing information on location of existing collections and secondly, through encouraging cataloguing. The first task they set themselves was to produce a Guide to location and content of personal papers of leading British scientists up to Lord Rutherford.¹¹ This was published by the HMC in 1982¹².

The Standing Joint Committee went on to oversee a pilot cataloguing project under the lead of Margaret Gowing, Professor of the History of Science at Oxford. This undertook speed listing of the archives of three scientists in three different disciplines: Sir Francis Simon, Sir John Gaddum and Professor L.R. Wager. This project was pronounced a success at the time, although the listing fell below what would later be

⁷ George Santayana, *The Life of Reason: Reason in Common Sense* (1905)

⁸ A history of the initiatives to preserve Britain's science archives was provided by Margaret Gowing, 'The Contemporary Scientific Archives Centre', *Notes and Records of the Royal Society of London* vol 34 no. 1 (Jul 1979), pp 123-131

⁹ Alan E. Jeffreys, 'Manuscript Sources for the History of Science', *Archives* vol 7 no. 34 (Oct 1965), pp 75-79

¹⁰ *Archives* vol 8 no. 37 (Apr 1967), pp 28-32

¹¹ *Archives*, vol 8 no. 39 (Apr 1968), p 143

¹² Royal Commission on Historical Manuscripts, *The Manuscript Papers of British Scientists 1600-1940* (HMSO, 1982).

considered acceptable cataloguing standards,¹³ and from it sprang the Contemporary Scientific Archives Centre, founded in Oxford under Professor Gowing's leadership in 1973.¹⁴ This was created as a specialist archives processing centre, rather than a repository that collected archives and offered reader access. The Archivist, Mrs Jeannine Alton, took advice from the HMC on cataloguing and undertook more detailed listing than the pilot project, producing catalogues of a higher standard.

2.3 The cataloguing centre model

The work that had begun in 1967 under the aegis of the Standing Joint Committee (which was abolished in 1976) continued under a subcommittee of the Royal Society's British National Committee for the History of Science, Medicine, and Technology. It included representatives from the British Library, the Wellcome Trust and the Council of Engineering Institutions, though regrettably the HMC was not represented and consequently the archival side of the Committee was distinctly lacking.

Unfortunately, while the model of a processing centre for science archives solved a number of potential problems and was considerably more economical than a central repository would have been, the funding model was weak, placing the primary responsibility for fund-raising (chiefly for salaries) on the two archives staff themselves.

The CSAC nevertheless continued in being to 1986, producing some 110 catalogues of scientists and engineers' papers and gaining a good international reputation. On the retirement in 1986 and 1987 of Margaret Gowing and Jeannine Alton respectively, the centre was moved to the University of Bath where it continued as the National Cataloguing Unit for the Archives of Contemporary Scientists to 2009. It closed in December of that year, following the termination of the funding that came through the Royal Society. It had produced 177 catalogues of scientists' and engineers' archives and at one point had employed five staff. It was estimated that taken together the CSAC and NCUACS had listed around three linear kilometres of scientific archives.

An indication of the contribution of the cataloguing unit to archival coverage of later twentieth century science can be seen in archives of biochemistry, a discipline that emerged from the 1920s. Of the 59 biochemists recorded as record creators in Discovery, over half are principally or solely represented through the work of the NCUACS.

In 1976 the Wellcome Library had established the Contemporary Medical Archives Centre (CMAC) which, funded by the Wellcome Trust and acting as a repository as well as cataloguing centre, flourished and removed the prime responsibility for the

¹³ The Wager archives had later to be re-catalogued to include the material that had apparently been deliberately omitted at the time.

¹⁴ For the later history of initiatives and work in this area see the introduction to Peter Harper, *Guide to the Manuscript Papers of British Scientists Catalogued by the Contemporary Scientific Archives Centre and the National Cataloguing Unit for the Archives of Contemporary Scientists, 1973-1993* (Bath, 1993).

archives of medical men and women from the CSAC. The CMAC was subsequently brought within the Wellcome Library.

2.4 Sale of archives

In the early part of this century it appeared that a significant market in scientists' archives was emerging, with the sale of Francis Crick's professional papers to the Wellcome Library for around £1.8 million in 2001¹⁵ and the acquisition and attempted sale of molecular biology archives for substantial sums.¹⁶ Although this danger appears to have receded there is still a market for notable items and collections, and scientific archives associated with well-known figures can still achieve large sums: thus a seven page letter from Crick to his 12 year old son Michael was sold in April 2013 for \$5.3 million.¹⁷

3. Methodology

*'As for the future, your task is not to foresee it, but to enable it'*¹⁸

Before undertaking these preliminary investigations, there was no expectation that any particular method of proceeding would be chosen or any particular conclusions would be reached. Although the remit was to produce some findings and make recommendations accordingly, there was a largely blank sheet.

The preparatory work for this report comprises five strands:

- Our own expertise and knowledge. Tim Powell brought over 22 years' experience in the field and Sarah Marks brought the perspective of a qualified scientist.
- Examination of the documentation of previous concern and initiatives within TNA, and looking further back, within the HMC and other bodies.
- There is a significant body of professional literature on scientific archives which discusses many of the issues encountered.
- The ICA-SUV Conference on Research and Scientific Archives, Paris, July 2014¹⁹. The eight conclusions Tim Powell drew from the conference have been influential in directing our thinking, particularly with regard to capturing the contemporary record. They were,

1. The digital records environment means that records management and archiving are not to be seen as separate activities but, because it is important for archivists to be involved 'upstream' in the records life cycle (though this

¹⁵ <http://www.smithsonianmag.com/history/document-deep-dive-francis-crick-explains-secret-life-180947946/#VvX5O6VKqZygMu6Z.99>

¹⁶ Rex Dalton, 'Fury at plans to split historic biology archive', *Nature* vol 421, 6 February 2003, 564; Andrea Rinaldi, 'Private ownership of public heritage: interest in the archives of leading molecular biologists', *EMBO Report* vol 7 (6), June 2006, 571-5.

¹⁷ I am indebted to my colleague Dr James Travers for information on this.

¹⁸ Antoine de Saint-Exupéry, *The Wisdom of the Sands* (1948)

¹⁹ For members of TNA staff, Tim Powell's full report can be found in Objective.

metaphor is perhaps of less relevance in the digital world), they are clearly two aspects of one task.

2. It is imperative to have the records creators involved in the process of records management and archiving, but the records creators must not feel the records keeping process is an unnecessary and burdensome imposition.

3. The requirement, through Europe-wide open data regulations, for research projects to provide data management plans offers a way for the archivist and records manager to engage with the records creators.

4. Collection development policies will continue to be the corner stone of building an effective archive. In the case of science and technology this will require active engagement with scientific experts and historians/sociologists of science, while balancing their advice with an understanding of their biases.

5. Recording context is crucial but some papers gave the impression that scientific data is context-less. In fact the practice of scientific research requires that extensive contextual information is recorded. Thus an experimentalist will need to record not just data but the nature of the experiment. If this is not recorded alongside the raw data, then that data is, scientifically-speaking, junk. What the archivist needs do is to add the wider context, to answer questions such as why is this experiment being conducted, by whom and with whom, and who is funding the work and why.

6. As the archivist will need to be involved at much earlier stage in the records creation process, capturing a 'complete' archive will no longer be a one-off procedure but the result of an ongoing relationship, in which, for example, email correspondence and biographical material might be handed many years after research records have been archived.

7. Digital curation is not cheap. While much less physical storage is required, the challenge of maintaining for the very long-term a resource which is inherently short-term will be costly. Therefore efficient appraisal is important, not merely for eliminating superfluous or trivial material for researchers, but reducing long-term archival costs.

8. For archivists, a key implication of conclusions 6 and 7 (as well as of the continued growth in science and numbers of scientists) is that a significant element of selection will be required from a very early point in the records keeping process. This raises the question of how to make this selection for archiving without the benefit of hindsight. A documentation strategy approach appears unavoidable but this is easier to implement retrospectively than use as a method for contemporaneous selection.

- Of most importance, however, have been the visits to institutions with an active interest in science archives, and discussions by 'phone, email and face-to-face with a wide range of interested parties (see Appendix).²⁰

We endeavoured to allow respondents to give us their own views, without undue influence from any agendas we had, and to create a dialogue, for we were aware that this is the beginning of a process. They were asked to comment on lines of enquiry that were being pursued and ideas advanced by others and were happy to do so. Respondents were generally interested in the issues being raised and the questions being asked and many requested to be kept informed of our progress and any conclusions reached.

It must be stressed that the preparatory work undertaken for this paper is not considered by us to be comprehensive and it is not claimed that the findings represent an authoritative overview of all interested parties. Although we endeavoured to speak with a range of interested parties, including archivists in specialist and higher education repositories, historians of science, archivists of scientific societies, and representatives of science research councils (see Appendix), it will be noted there are significant omissions in the list of those consulted²¹. Should there be an opportunity to continue the discussions begun in 2014-2015, some of these omissions will be remedied. Nevertheless, while impressionistic, it is thought this paper does represent the views of an important cross-sample of significant parties and may form an acceptable starting point.

Although archives of technology come under the auspices of this paper, archives specifically of the engineering profession and of engineers have not been considered. This is certainly not because engineering is considered unimportant but because, firstly, of the lack of time and, secondly, because this would exacerbate the risk that when science and engineering are placed into a single category for the purposes of study, engineering will be treated as secondary.²² We have therefore suggested that engineering archives receive their own initiative, see 5.2.3.

4. Findings

*'Research scientists are often poorly represented in archive collections. We would like to get all scientists thinking more about preserving their records, beyond published output in journals, in order to help redress this imbalance'.*²³

²⁰ For members of TNA staff, input from respondents can be consulted in the notes of meetings and other documents held in Objective at: Archives Sector Development – Collections Strategies – Science Archives Strategy.

²¹ A particularly evident weakness is that the work undertaken has so far focused on England. This will need to be addressed.

²² Perhaps because engineering is seen as the application of science and thus arising from it.

²³ <http://wellcomelibrary.org/what-we-do/developing-and-caring-for-our-collections/collecting-genomics/>

The findings presented in this section represent, in necessarily condensed form, the common concerns and over-arching issues to have come out of the many and various discussions, meetings and observations over the past months, as outlined above.²⁴

Although there are moves to extend the intellectual property rights of higher education and research institutions over their researchers' work, there was a widespread assumption among respondents that scientists' and technologists' records of their work are, in most cases, their own property. This has crucial implications for any efforts to improve record-keeping and archival representation of science and technology. It means, in particular, that one cannot bypass individual researchers in seeking such improvements.

4.1 The challenges

In the course of the discussions, a number of problems were posed by respondents. Ensuring good archival representation of any subject area presents its own particular problems and archives of science and technology are no exception. Indeed it could be argued that this area presents more challenges than most. The following were identified as principal challenges:

A. Digital challenge. The form in which the bulk of the records is now being created and held is born-digital. There are particular problems with ingesting, preserving and ensuring long-term access to such records, which are well-known.

B. Quantity challenge. ICT makes the generation of huge quantities of measurement and recording data the norm. Furthermore, desktop technology makes it easy to generate multiple copies of documents, and email correspondence can be represented by long and repetitious chains.

C. Engagement challenge. The challenge of conveying to scientists what historical archives are and why they matter.

D. Contact challenge. How to reach scientists with the case to meet the engagement challenge.

E. Retention challenge. How to keep historically significant records between their creation and use and their transfer into the archives.

F. Inter-institutional challenge. ICT technology makes inter-institutional (and very often international) collaboration, with multiple partners, the norm for most projects.

And there are two challenges facing archivists dealing with science and technology archives:

G. Expertise challenge. Archivists often lack the confidence, knowledge and/or background in handling such archives.

²⁴ See n.20.

H. Exploitation challenge. Science archives are generally under-used by researchers, compared with other archives.

'...if there's anything worth preserving, it's already been published, really, that's the answer. I have written for the Royal Society, as you know, notes for anybody who's going to write the biographical memoir, which in my experience is a great help to the writer, because otherwise they have to start from scratch. So that's already deposited at the Royal Society. I know that Charles Frank's papers have been deposited in our [Bristol] university library, which has an archive in the basement, and I know that Cecil Powell's stuff is also there, together with Brunel's notebooks. They're all stored in specially air-conditioned, great sort of cylinders, this size, with great wheels on the end, rather like a morgue I suppose. And the stuff is all in there. So if anything needed to be preserved, that's the place I think to put it, the university library. But I can't imagine anybody would want to preserve anything that I may leave behind, that hasn't been published.'

(Professor John Nye FRS, physicist, University of Bristol, at p409 in his interview for the Oral History of British Science, <http://sounds.bl.uk/related-content/TRANSCRIPTS/021T-C1379X0022XX-0000A0.pdf>)

Challenge G is exacerbated by the familiar problem faced by lone archivists more widely, of lacking the time to undertake initiatives to approach prospective subjects.

Although these challenges were repeatedly encountered, in oral discussion and in the published literature, it will be noted that some challenges, for example A and B, represent comparatively new challenges, resulting from the rapid expansion of ICT possibilities; whereas challenge C, for example, is a long-standing one.

In the course of our investigations, it became evident that the findings could be seen to have three dimensions, relating to the needs to:

1. Improve access to and exploitation of existing sources.
2. Improve archival capture of contemporary scientific records.
3. Ensure long-term constituency infrastructure to ensure sustainability.

Naturally, there are considerable elements of overlap. The remainder of this section and section 5, Recommendations, will follow this schema.

4.2 Improving access to and exploitation of existing sources

4.2.1 General issues

While there was generally thought to be sufficient information on existing scientific archives resources available for researchers, and although our investigations were focused on material outside the scope of the Public Records Act, it was suggested that the very extensive twentieth century science holdings of The National Archives itself (not all of which are legally public records) should be better publicised among and exploited by historians and other humanities researchers. It was also noted that the

information available through Discovery requires some revision and updating and correction.

There is a concern that considerable quantities of science archives are held by repositories uncatalogued and with little prospect of their being catalogued in the short or medium (or even long) term. This situation means some repositories are unwilling to take in collections that they believe will add to their cataloguing backlog (see 'orphan' archives, section 4.3.1).

Scientific archives can present particular challenges to the archivist (challenge G). This, in part at least, stems from the usual cultural and educational background of UK archivists. The content may be highly technical and some archivists feel, rightly or wrongly, that they do not have the skills with which to undertake cataloguing. It is noteworthy that earlier this year the Wellcome Library supported a partnership scheme with the Department of Information Studies at University College London, offering two Archive Traineeships for applicants with an interest in 'pursuing specific projects in relation to science archives and/or digital technologies'.²⁵

Accordingly, preparing grant applications for cataloguing or other work on scientific archives can present itself as more of a difficulty than an opportunity.

It is true that in some more general repositories, scientific archives collections are often noticeably less used in comparison with collections in other areas, such as politics, literature, social history and so on, where there is more active research interest (challenge H).²⁶ Furthermore, much of the focus on the history of science in the UK has been on the period from the eighteenth to early twentieth centuries²⁷.

The promotion of science archives through outreach and education activities is seen to present more difficulties than material requiring less in the way of mediation (challenge G).²⁸ It was also suggested that where outreach is attempted, through blogs for example, these can appear to be written for other archivists rather than the research communities most likely to find modern science archives of interest.

²⁵ ARCHIVES-NRA email list 24 March 2015

²⁶ Thus, for example, in summer 2015 the Institute of Historical Research listed 69 regular research seminars. History of Science was represented only by 'Colonial Science and its Histories' and potentially by 'History and Public Health', <http://www.history.ac.uk/events/seminars>.

Of course, there is something of a chicken-and-egg relationship here. As archival research resources in science and technology are comparatively limited compared with other areas of study (see page 7), less research interest will arise, which in turn discourages repositories from placing a high priority on such resources.

²⁷ Noted by David Edgerton and John V. Pickstone in their forthcoming article, 'Science, Technology and Medicine in the United Kingdom, 1750-2000', *The Cambridge History of Science: Modern Science in National, Transnational, and Global Context*. I am grateful to Professor Edgerton for providing a prepublication copy of this. Other conversations have suggested that one reason for the focus on science in earlier times is the increasing technical specialisation of science in the later twentieth century, and the difficulty for those not specialists in a particular field of science to understand it fully.

²⁸ Although the London Metropolitan Archives are running some imaginative and worthwhile uses of science and technology archives to support the National Curriculum (and other educational activities, 'Fun Palaces FREE ART EVENT Friday 2 October', ARCHIVES-NRA, 28 September 2015).

Furthermore, funding sources are limited. While it was widely thought the Wellcome Trust has been stretching its definitions to bring much that can be broadly categorised as biomedical science within its grant-giving for archives, it nevertheless has its limits and its policy of funding thematic streams was not without critics.

In these circumstances, with limited time and resources, and in some cases, pressure to bring in users and resources, many archivists, especially those working in isolation, are likely to place the processing or exploitation of an archive of a non-scientist higher in their list of priorities.

4.2.2 Cataloguing

The crisis in scientific archives noted in the 1960s led to the establishment of a specialist science archives processing centre (see 2.3). The progress reports of this centre (the CSAC/NCUACS) testify to the effort needed to find the funding to continue. By 2009, following the worldwide financial crisis, the funding required could not be found. Although the Centre for Scientific Archives@the Science Museum is seeking to continue this role, it is questionable whether an autonomous, largely free-standing archives cataloguing unit is viable in the current economic climate. Another model to consider might be the Business Archives Council's awards of cataloguing grants for business archives and for arts related business archives.²⁹ Additionally, repositories with potential projects to process scientific archives collections could be encouraged to approach the PRISM Fund³⁰ for support. Although the Fund's terms and conditions explicitly rule out funds for cataloguing, it does allow for the costs of suitable packaging which may form part of a cataloguing project.

In the longer-term there will be a need to look for particular partnerships and TNA has a role to play in brokering these. The particular difficulties facing science archives in respect of cataloguing do suggest that a special initiative, or initiatives, is required and, though ambitious, perhaps a feasible funding model for a cataloguing unit or programme would be a subscription scheme supported by HEIs and other bodies (e.g. scientific societies).

There is some feeling antipathetic to the perceived previous focus on cataloguing archives of individual 'great' scientists.³¹ However, it is difficult to see how else an autonomous unit or programme, dependent on funding from and offering a service to a variety of HEIs and potentially other bodies, could operate. Furthermore, focusing on significant individuals is more likely to ensure the capture of the sort of personal records that can give a scientific archives collection interest to researchers beyond history of science, narrowly defined.

²⁹ <http://www.businessarchivescouncil.org.uk/activitiesobjectives/catgrant/>;
<http://www.businessarchivescouncil.org.uk/activitiesobjectives/catgrantarts/>.

³⁰ <http://www.artscouncil.org.uk/funding/apply-funding/apply-for-funding/prism/>

³¹ Jenny Shaw, 'Documenting science: applying archival theory to the Human Genome Project', paper to 24th International Congress of History of Science, Technology and Medicine, 26 July 2013.

4.3 Improving archival capture of contemporary records.

4.3.1 Collecting policies

An obstacle that was encountered several times was the lack of information about repository collecting policies in science and technology archives, and the need for more information and clarity on such policies emerged from the discussions.

Major universities supporting significant scientific activity are generally willing to accept archives of senior scientists with a close connection to the university. It is an impression, however, that few are proactive in this area, and the position of the scientist within the hierarchy of the university is often the decisive factor, rather than their scientific eminence or the research potential of their records. This can also make it harder to capture the multi-institutional nature of contemporary scientific research.

There is some concern for ‘orphan’ collections, where an important archive has no obvious home. This is not only a problem for science and technology archives, but it is particularly pronounced in this area given the challenges identified in section 4.1, especially G and H.³²

Although covered by the definition of scientific archives used here (1.1), the administrative records of science departments within research and higher education institutions were generally accepted to be the responsibility of the general record-keeping functions of those institutions.

4.3.2 Archives of technological industry

The approach to the Lord Chancellor’s Forum in March 2014 suggested mapping ‘the archives of the new industries based on science and technology that developed since 1970 and to ensure that there is accurate information about their records, to increase the awareness of the research commercial and cultural value of such material and to assess the long-term sustainability of such material’.

‘TNA could work more closely with the BAC and with the ARA to raise awareness among UK businesses, including those that carry out scientific research or apply science to industrial processes, that the country has a network of archive repositories that can care for their historic records and help them to make their history accessible.’

email from Jan Hicks, Archives & Information Manager, Museum of Science and Industry, Manchester, 30 March 2015

There is certainly a gap in our knowledge which appears to reflect a paucity of more recent historical records. However, while enhancing the archival coverage of contemporary technology-based enterprises would be a valuable activity, it is not clear

³² When Tim Powell was at the NCUACS, it was not uncommon for repositories to state that they would accept science archives on the condition that they were catalogued first, being unwilling to take in uncatalogued science collections or to commit resources themselves into making the material accessible.

that the results from a general survey of such enterprises, whether the minimal format used for the Religious Archives Survey or the more intensive format used for Archiving the Arts, would represent a cost-effective way to approach this area.

The problems identified are:

- These industries have no track record of understanding of or engagement with archives and simply communicating to them what is required and why would be a major, time-consuming challenge.
- There would be a preponderance of material in digital form, and much of it in highly specialised forms.
- With one or two possible exceptions, there is little evident interest on the part of collecting institutions in taking on the responsibility for such records.
- Commercial confidentiality means that little significant material relating to research and development of new products is likely to be released.
- As some of these businesses will be very young, much material would not be available for some years anyway.
- Given the difficulty of working with this constituency, work spent building up the relationships required could well be wasted without ongoing close support over years, rather than months.

Thus, as the March 2014 project outline notes, ‘This would be an ambitious project on a considerable scale and requiring extensive funding over several years focusing on companies and institutions with documentation overwhelmingly in digital formats and often dealing with commercially sensitive material.’ It seems doubtful whether the results would justify the scale of expenditure required.

In this context, it is significant that the Wellcome Library, which is to undertake an initiative to document new biotechnology companies, has concluded that a pursuit of archival material from them is unlikely to be an effective use of resources, and instead will focus at this stage on collecting the promotional and other grey literature that such companies produce.

Engaging with scientific research in higher education, the best documented side of science, therefore offers advantages over trying to capture archives information in the commercial sector. Furthermore, changes in the past two decades in particular have resulted in closer relationship between higher education and businesses, so it may also be a way into exploring archives in the commercial sector.

This is not to say there is no scope for seeking to improve representation of modern technology in UK archives. In the course of our discussions, we were alerted to the need to preserve records from the decades following the Second World War (roughly 1950s to 1980s) in the areas of electronics (particularly computer technology), aviation and aerospace, pharmaceuticals and chemicals, and medical technology, in which Britain had major international technology-led industries. Although some remain and flourish, many of the companies have now disappeared, through merger, take-over or failure, while the bulk of those individuals involved are now retired (or have died) and

the opportunities for capturing personal records are diminishing. While it was stressed that any initiative to preserve a record (in the form both of archives and oral history accounts) from this era must proceed with some urgency, it will be important to secure partnerships to ensure any projects are sound and sustainable in the long-term.

4.3.3 Research Councils, data management and archives

A major issue coming from the ICA/SUV conference was the relationship between the data management of current research data and historical archives. The Research Councils (in this context meaning the scientific Research Councils) have a remit to preserve records to maintain scientific integrity and ensure the fruits of public funding for science are made available. Rules governing open access to research data covering the Research Councils (and also subscribed to by some major funders such as the Wellcome Trust) require data management plans be submitted as part of grant proposals, indicating measures to ensure the data is preserved and made accessible after the grant ended (for 10 years), and a named person (frequently the Principal Investigator or a member of their immediate team) to be responsible for this.³³

'I wonder if at some point in the near future, even if a full strategy is still in the offing, whether a statement could be issued to Places of Deposit or researchers by the TNA along the lines of – "TNA recognises the importance of the supporting correspondence, presentations, other information and records that accompany research data in ensuring that there is a full record and that the integrity and reliability of the research can be assured"
...some kind of statement from yourselves would certainly help in giving authority to our collection policy and interaction with NERC funded researchers.'

(Email from Rod Bowie, Geoscience Information and Records Manager, National Geoscience Data Centre, British Geological Survey, 23 June 2015)

Investigating the potential relationships between the Research Councils and archives repositories and between research data and historical archives is complex and difficult, and our investigations are still at an early stage. However, the EPSRC, MRC and NERC themselves are now covered by the Public Records Acts and their Records Management policies recognise the historical and public interest aspects of their archives. Some universities also have developed overall information management policies which cover both research data management and institutional records management (and thus, through records retention schedules, extend to the archives).³⁴

³³ The principles behind the regulations are explained at <http://www.rcuk.ac.uk/research/datapolicy/>. A useful summary of the requirements of the individual Research Councils is provided at <http://www.dcc.ac.uk/resources/policy-and-legal/funders-data-policies>.

The importance of the notion of open access can hardly be understated. The Royal Society report *Science as an open enterprise* (2012) is the key document, setting it out as 'an ethical imperative for science, whose default position is to make scientific knowledge freely and promptly available to others, whether scientists and citizens, in an accessible and useable form, unless there is an appropriate reason not to do so'.

<https://royalsociety.org/topics-policy/projects/science-public-enterprise/>

³⁴ For example, De Monfort University, Leicester,

It is important to note that the issues are being discussed in terms of born-digital material. There are four strands to advancing this investigation:

- What will happen to research data at the end of the prescribed 10 years retention period.
- How metadata schema for the retention and accessibility of research data might map onto schemes for archival metadata and thus potentially allow transfer of such data into the archives.
- How archivists might be involved in the post-10 years process appraisal and selection of research data, and thus allow them a role in selection for long-term preservation and accessibility in the historical archives.
- How the requirement for scientists to meet Research Council rules might be used to introduce them, at an earlier stage, to wider record-keeping (e.g. of correspondence, grant applications, pre-project planning) for the long-term.

Discussions were held with information officers of the BBSRC, BGS and NERC, and MRC, and with data managers in the HE sector. It was notable that challenges C and D (Engagement and making Contact) were repeatedly mentioned as being more of an obstacle than the technical challenges; so if there is a cultural gap that inhibits archivists from engaging with scientific archives, there is also a gap between scientists and their understanding and appreciation of the various ways scientific archives can have value.

There appear to be four main issues:

- The belief in some scientific disciplines that everything worthwhile will be published.³⁵
- Individual modesty ('standing on the shoulders of giants') which can apply even to distinguished scientists who are aware that archives of their scientific peers are kept.
- Science (and its records) is widely perceived as a product of teamwork, while private archives are more likely to be seen as products of individuals working in the humanities.
- A lack of knowledge of and interest in humanities research (which can even extend to suspicion of the motives and standing of humanities researchers).³⁶

<http://www.dmu.ac.uk/documents/about-dmu-documents/quality-management-and-policy/records-management/research-records-retention-policy.pdf>

³⁵ 'Scientists are generally very much concerned with their own projects and perhaps the ultimate goal of publication...The historical and future research value to historians and biographers of their methodology and projects is not something they consider', Anne Barrett, 'Documenting current science: results of a survey on changes in scientific practice and its effects on records creation and record keeping, carried out by the ICA/SUV 1997', in ed. R.W Home, P. Harper, O. Welfel , *Archives of Contemporary Science. Proceedings of the Symposium organised by the Commission on Bibliography and Documentation, Li ge 20-26 July 1997* (IUHPS Division of History of Science Works in Progress 2, 1998), 49-60, at p 51.

'Nobel Prize winner (1962) Dr Max Perutz explained in a letter (which I have never quite forgotten) "I am no Einstein whose every scrap of paper betrays a facet of his great thoughts and my correspondence is not of lasting interest in the history of science".' [Max Perutz Papers, Churchill Archives Centre PRTZ 3/1/2].

Cited in email from Sandra Freshney, Archivist, Sedgwick Museum of Earth Sciences, Cambridge, 2 June 2015

There is a need to try to close the cultural gap with scientists. This will require explanation and advocacy. Related to this are the difficulty of overcoming terminological confusion³⁷, and the often profound ignorance of what practical steps to take. Furthermore, this is a challenge made considerably more demanding with born (and stored) digital material (challenge E).

4.3.4 Collecting strategies

The issue of what to collect was raised, partly in relation to the challenge of quantity, partly in relation to the perceived advantages of a documentation strategy that has proved highly successful for documenting the human genome project.³⁸ However, this approach is seen as opposed to collecting of archives of eminent individuals, in whom there is likely to be future research interest. It must be observed that in practice it is still individual scientists who retain archives, and even contemporary data management regulations require a named individual to have responsibility for the archives, and unique person identifiers will be key to tracing an individual's research. Nevertheless, where it can be funded and given disciplinary support, a documentation strategy approach offers the prospect of outstanding in-depth capture of archives.

4.4 Ensuring long-term sector infrastructure to ensure sustainability.

Support group

Respondents overwhelmingly supported the idea of a support group for the archives of science and technology. However, there were different (though not necessarily contradictory) views as to the form such a body should take: whether it should be a high-level strategic body or a lower-level support network; whether its primary role should be to provide advocacy, offer information or give practical advice.

Everyone seems to be waiting for someone to take the lead. Could it be you? If the outcome of your research could be a commitment from TNA and/or some of these other bodies to fund a full-time administrator/surveyor/(fundraiser?) and a decent website then I think it would not be difficult to set up a flourishing special interest group that would encourage partnership working and information sharing.

³⁶ This might be seen in a wider context as a reflection of the 'Two Cultures' thesis of C.P. Snow (although Snow's emphasis was on the ignorance of humanities intellectuals about science, rather than vice versa). See https://en.wikipedia.org/wiki/The_Two_Cultures.

³⁷ Thus the very word *archive* can mean different things to archivists, data managers and scientists.

³⁸ This approach was also adopted to initiate an GM Crops and Food archive, a collaboration between CropGen and the Science Museum, see http://www.cropgen.org/article_511.html.

Email from Georgina Ferry, science writer, author and broadcaster, 25 November 2014

There are a number of potential models, from well-established bodies such as the Business Archives Council³⁹, or more recent groups largely run through voluntary effort of individuals such as the Community Archives and Heritage Group and the Religious Archives Group⁴⁰, or the new Legal Records at Risk Project⁴¹, supported by the legal sector (through the Institute for Advanced Legal Study) itself.

The mixture of cataloguing, advocacy, information and advice, and coordination that the NCUACS was able to offer, although widely thought to be desirable, was not generally believed to be replicable in the current environment.

It was stressed that no institution was able to take responsibility for the nation's scientific and technological archival heritage alone, nor was that thought desirable. The need was for partnerships encompassing the interested institutions, organisations and individuals. This includes TNA and our interest in this area was widely welcomed as a positive and encouraging step.

5. Recommendations

*'In recent years a dramatic change has occurred in most areas of scientific practice - the work that scientists do is no longer being systematically documented. In the past, activities like the keeping of notebooks and the writing of correspondence were an unremarkable, but integral, part of being a scientist. Records such as these provided a documentary safety-net, ensuring that crucial information was not easily lost. This is no longer the case.'*⁴²

The current situation in respect of scientific archives can be compared to that in the 1960s. While it is not, of course, an exact comparison, it nevertheless is salutary to note the similarities in the concerns being expressed. In making these recommendations, therefore, long-term sustainability has been a paramount concern.

It must be stressed that this report does not present a strategy for The National Archives, although it advances a number of strands of work upon which a strategy might be built. Many of these recommendations require buy-in by other stake-holders, so at present can only be seen proposals for further consideration or investigation, or continuing liaison. In this context recommendations 17-19, which suggest ways in which this paper might initiate wider discussion and the building of partnerships, are particularly pertinent.

³⁹ <http://www.businessarchivescouncil.org.uk/>

⁴⁰ <http://www.communityarchives.org.uk/>; <http://religiousarchivesgroup.org.uk>

⁴¹ Clare Cowling, 'Legal records at risk project', ARCHIVES-NRA email list, 7 September 2015

⁴² Gavan McCarthy and Tim Sherratt, 'Mapping Scientific Memory: understanding the role of record-keeping in scientific practice', *Archives and Manuscripts*, vol. 24, no. 1, May 1996.

The resources of The National Archives in general, and the Archives Sector Development department and Independent Archives Team in particular, do not allow for prolonged support of any particular archives constituency. The strategy for providing support for private archives constituencies has been to undertake sequential engagement, generally using a wide-ranging form-based survey of a particular area, in part to add information to TNA's Discovery resources, but also to initiate focused short-term support to leave that constituency more sustainable, through measures such as the support of key institutions, building capacity among those retaining their own archives, and the strengthening of specialist interest groups and support networks.

It is not thought that such a broad survey-based approach is appropriate here. The main issues do not seem to be to ascertain what material exists and where it is held, but to ensure progress in improving access to and exploitation of existing sources, improving archival capture of contemporary records and ensuring long-term sector infrastructure to ensure sustainability. However, there is a case for more narrowly focused surveys and for devoting some resources to updating the National Register of Archives contribution to Discovery, as many of the entries need updating or in some cases correcting⁴³ and clarifying.⁴⁴

Whichever of the recommendations, if any, are adopted, partnerships will be essential, within the Archives Sector Development department, within TNA more widely (including other departments of the Research and Collections directorate) and most importantly with the many different stake-holders (such as the Royal Society, the British Society for the History of Science, the Science Museum and the Wellcome Library) who must be involved in the process, some of whom have already expressed an interest in helping to take things forward.

5.1 Improving access to and exploitation of existing sources

5.1.1 Raising the profile of resources at TNA

Highlighting the enormously rich resources for research into modern science and technology held at TNA (beyond the study of their application to military purposes) would, as well as being worthwhile in its own right, indicate an institutional interest in and commitment to preserving contemporary scientific records. Therefore,

It is **recommended (1)** that TNA consider appointing a Records Specialist in the Advice and Records Knowledge department in the area of science and technology to explore and highlight TNA's resources, provide advice and facilitate research.⁴⁵

⁴³ Thus of the 59 Discovery entries where 'biochemist' is given as the epithet of the records creator, at least 8% required some form of adjustment.

⁴⁴ For example, there are 223 Discovery entries where 'scientist' appears as the epithet of the records creator. For a significant proportion of these, a more precise term can be found without much difficulty. Of the 59 biochemist records creators, over 10% required some form of adjustment.

⁴⁵ The extension of the Public Records Act to encompass three of the science research councils means TNA will see regular ingestion of records of substantial scientific importance.

It is **recommended (2)** that TNA organises and hosts a workshop or seminar based on the resources of records of science and technology held by it and highlighting research potential within them.

It is **recommended (3)** that TNA publishes online guide or guides to the resources of scientific and technological archives it holds.⁴⁶ This might be extended to collaborative investigation and publicising of resources held by Places of Deposit such as the British Antarctic Survey, British Geological Survey and others.

It is **recommended (4)** that TNA investigate hosting a partnership with AHRC through the Collaborative Doctoral Award studentship scheme⁴⁷ to explore and exploit our resources.⁴⁸

It is **recommended (5)** that existing entries for scientists and scientific bodies in the Discovery resource be checked and where necessary updated, corrected and amended.

5.1.2 Cataloguing

The issue of cataloguing resources is clearly an important one but the discussion in section 4 suggests this must be seen in the context of the broader issues of the understanding and use of scientific archives, including meeting challenges G and H (see 4.1). It is **recommended (6)**, therefore, that a package of measures is developed by TNA in partnership, towards meeting the general challenge of capacity building in terms of cataloguing of, fund-raising for and promoting the use of scientific and technological archives collections.

It is **recommended (7)** that the Centre for Scientific Archives@the Science Museum be included as a partner in developing a science and technology archives strategy, particularly in relation to the issues around resources for cataloguing. Its legacy as the successor to the CSAC/NCUACS, and the wealth of information it holds regarding scientists and their archives, makes it eminently suitable for such a role.

5.2 Improving archival capture of contemporary records.

5.2.1 Mapping collecting policies in science and technology

It is **recommended (8)** that research and mapping be undertaken into collecting policies in the area of science and technology in Britain (see ICA-SUV conclusion 4)⁴⁹. This might be an opportunity for a partnership with the Higher Education Archivists Programme as well as building on the emerging relationship with RLUK⁵⁰ and would

⁴⁶ <http://www.nationalarchives.gov.uk/help-with-your-research/#find-a-research-guide>

Current guidance under S: sacrament certificates, Schools, Scotland, Seals, second world war, second world war personnel, security services, shipping, ships, Slavery, silver war badge, soldier, solicitors, special operations executive, Sport, squadrons (Royal Air Force), star chamber (court of), state papers, stationery office, statistics, supreme court

⁴⁷ <http://www.ahrc-cdp.org/about/>

⁴⁸ Possibly extended to participation in future in the RCUK's internship scheme, see <http://www.rcuk.ac.uk/skills/policyinternships/>

⁴⁹ See page 12.

⁵⁰ See <http://www.rluk.ac.uk/about-us/blog/rluk-tna-visit/>

feed into the wider TNA concern for harmonising collecting policies across all the archives sector.

Undertaking such surveying might itself help to raise the profile of scientific archives, indicate the significance being attached to them and in this way offer the prospect of enhanced collecting and begin to address the problem of 'orphan' collections.

As noted at the ICA-SUV Conference (conclusion 6), a particular problem (challenges A, E) is that there is a need to capture born-digital records at a much earlier stage in their life. A survey of collecting policies might include a component asking what is being done in this respect.

5.2.2 Survey of technology companies

To take forward the approach to the Lord Chancellor's Forum in March 2014 that suggested surveying the archives of industries based on science and technology, it is **recommended (9)** that, led by TNA's Independent Archives Team's Business Archives Adviser, an initial survey be undertaken of records of Britain's aerospace industry⁵¹, perhaps similar to the Architecture and Building Industry Records survey, to cover both aircraft manufacturers and manufacturers of components therefor. This is an area in which UK companies have made and continue to make a significant contribution, and it therefore combines significant historical collections with more recent records.

There are potentially a highly diverse range of interested parties: businesses; museums, large and small; archives repositories; historical societies; individual creators; and private collectors; with accordingly widely dispersed material. Improving our knowledge and understanding of this area would be a valuable exercise in information gathering to enhance TNA's information resources, as well as an opportunity to build vertical and horizontal relationships, and offer sound, practical archives advice, thereby improving archival curation of collections and increasing the chances of survival of vulnerable material. There is also considerable research interest in this area.

If successful, this could be a practical example for further mapping of technologically based industries. It is **recommended (10)** in this connection that a supportive relationship be built with the software and computer services archive project, Archives of IT, launched through the auspices of the Worshipful Company of Information Technologists.⁵²

5.2.3 Engineering archives

It is **recommended (11)** that related investigations be initiated for engineering. Contact has been made with Carol Morgan, Archivist of the Institution of Civil Engineers, which may well provide a good starting point for discussions with all the major engineering institutions.

⁵¹ Where aerospace is defined as 'The branch of technology and industry concerned with both aviation and space flight'.

⁵² The pharmaceutical industry is another obvious area for in-depth investigation.

5.2.4 The relationship between research councils and archivists

While it is acknowledged that there are difficulties hindering a relationship between the Research Councils, data managers and archives repositories, and between the curation of research data and historical archives, progress in this area would be a major achievement which could significantly improve the chances of particularly born-digital material surviving by reaching scientists earlier in their career.⁵³ Discussions to date have been positive.

In this connection, it is **recommended (12)** that work begin on preparing simple and practical advice on identification and long-term preservation of archival material based on existing UK and international guidance⁵⁴, with a focus on born-digital material personal records. It should be noted that there are many partnerships that might be established to forward this, including with the Research Councils, RLUK, the Royal Society, Digital Preservation Coalition, UK Data Forum, participants in the Paradigm project, and other parties.

It is **recommended (13)** that advocacy material, in both online and hard-copy form, be compiled to explain the importance and range of uses of historical archives of science.⁵⁵ This needs to be well-written, authoritative and persuasive. There are many partnerships that might be invoked, including the Royal Society, AHRC, BSHS, ARA, and discipline-based history of science societies.

In addition it is **recommended (14)** that discussions be started with the science Research Councils and other parties to promote recommendations 12 and 13, and to investigate developing a documentation strategy approach to particular lines of research in fields of science they oversee (following the example of the Human Genome Archives project)⁵⁶. As noted above, some progress was made with creating a 'GM archive'⁵⁷ and 'Fracking' has been suggested as another such area, in

⁵³ See Anne Barrett, 'Documenting current science: results of a survey on changes in scientific practice and its effects on records creation and record keeping, carried out by the ICA/SUV 1997', in eds Home, R.W., Harper, P. and Welfelé, O., *Archives of Contemporary Science. Works in Progress 2*, International Union of History and Philosophy of Science Division of History of Science (Liege, Belgium, 1998).

⁵⁴ There is some existing literature in this area. Joan Haas, Helen Samuels and Barbara Simmons book *Appraising the records of modern science and technology: a guide* (MIT, 1985) is still a crucial work.
<http://babel.hathitrust.org/cgi/pt?id=mdp.39015011296897#view=1up;seq=7>

⁵⁵ See for example, the booklet by Katherine Webb, 'The value of Health Archives for research' (Health Archives and Records Group, 2009). There are good reasons to retain scientific archives *beyond* their continuing use for scientific research: to support research integrity, to provide accountability for decisions taken, to promote the public understanding of science and for historical research, and referring to uses other than purely historical research will carry more weight in certain contexts (see the 'Concordat for Engaging the Public with Research', <http://www.rcuk.ac.uk/pe/concordat>).

⁵⁶ 'The Human Genome Project (HGP) was a hugely ambitious international project to sequence the DNA in human cells. Ensuring that the original papers relating to this historic achievement are preserved for future generations has been the aim of the Human Genome Archive Project (HGAP)...The second phase of the project, known as Collecting Genomics, is now underway. It was set up to build on the work of the HGAP by collecting materials identified in the survey, and to address areas of concern, such as the absence of record keeping systems in some scientific organisations.'

<http://wellcomelibrary.org/what-we-do/developing-and-caring-for-our-collections/collecting-genomics/>

⁵⁷ See footnote 38.

association with the NERC, which could combine scientific interest with documentation of the wider political and social debate surrounding the issue.

5.3 Ensuring long-term sector infrastructure to ensure sustainability

Support groups for scientific archives

As in the 1960s, any initiative taken by TNA (as the successor to the HMC) to support scientific and technological archives must be in partnership. This is in part because TNA does not have the resources of staff time or expertise to take this on alone, but more importantly because such engagement requires credible partnerships for sustainability.

To provide focus, structure and sustainability for the scientific archives constituency into the future, particularly assuming the absence of significant ongoing funding for a specialist unit or specialist archivists, it is **recommended (15)** that an advocacy or specialist interest group be established. Such a group could comprise repository archivists, honorary archivists of scientific societies, historians and sociologists of science and allied areas, scientific museum curators and other interested individuals. However, some institutional involvement on the part of key bodies such as the Royal Society will probably be imperative. This body would be able to develop its own programme for support of science and technology archives (and archivists), and could have a lead role in coordination, information and guidance-giving⁵⁸, as well as advocacy.

Science is an international pursuit. Research crosses institutional bodies and national frontiers. It is **recommended (16)** that work be undertaken to encourage an international network of archivists and records managers with an interest in or responsibility for science and technology archives, perhaps recreating a grouping like the CASE (Cooperation on Archives of Science in Europe) network of archivists⁵⁹ and that, if necessary, modest funding be made available to support this.

6. Next steps

*'History repeats itself, the first time as tragedy, the second time as farce'*⁶⁰

The investigations begun in the second half of 2014 have been ongoing (in December 2015) for some 18 months. Although initially simply focused on the means by which TNA itself might develop a strategy in this area they have in themselves, in terms of contacts made, ideas floated and awareness raised, been more widely fruitful.

⁵⁸ This might, for example, include providing guidance to archives students and trainees and archivists in general repositories on handling scientific and technological records.

⁵⁹ Its roles were the exchange of information on projects through an online newsletter and organising conferences, held every two years. Although principally a European body, this network spanned the globe, with Brazil, India, Australia and the USA all represented.

⁶⁰ As Karl Marx did not write in *The Eighteenth Brumaire of Louis Bonaparte* (1852).

A weakness of previous initiatives in the area of science and technology archives has been the lack of sustained participative engagement by leading bodies in the archives sector. This cannot be allowed to happen again. It is **recommended (17)** that the development of a science and technology archives strategy for TNA is taken forward, with a commitment to active participation in any interest group or support network (see recommendation 15) that may arise.

As stressed previously, any progress in implementing many of the recommendations set out here will require close partnerships with other stakeholders. At the same time, such partners are likely to bring their own ideas, proposals and priorities which may well improve on the recommendations set out here.

It is therefore **recommended (18)** that this paper, or a version thereof, be circulated widely among interested parties soliciting feed-back and comment.

And to build on recommendation 18, it is further **recommended (19)** that TNA prepares an initial outline timetable for discussion and, where applicable, implementation of recommendations presented here, beginning with hosting an initial round table meeting.

'We have come to the conclusion that what is required is some means of engaging with active scientists so that they are aware that there is interest in their papers and to involve them in the process of selection. This was well summarised by the comments of Dame Julia Higgins, who served on the project advisory board: "I and my peers simply do not know what might be interesting/useful, and I am afraid that when someone dies the family and colleagues do not know what to do with the papers etc. Doing something while the owner is still alive makes sense".'

(cited by Sally Horrocks, Academic Advisor, Oral History of British Science, in notes attached to email of 18 June 2015)

Appendix: List of those consulted

In the course of the preparation of this paper we have been in communication in various ways with many people. We are most grateful to them for the time and thought they put into their submissions and conversations with us, both at the initial stages and in commenting on drafts of this paper.

Natalie Adams, Archivist and Information Services Manager, Churchill Archives Centre, Cambridge

Jon Agar, Professor of Science and Technology Studies, University College London

Emma Anthony, Project Archivist, MRC National Institute for Medical Research

Garry Baker, Head of National Geoscience Data Centre; Rod Bowie, Geoscience Information and Records Manager, National Geoscience Data Centre; Andrew Morrison, Archivist; Andy Riddick, Geoscience IT specialist. British Geological Survey

Michael Ball, Strategy and Policy Manager, Biotechnology and Biological Sciences Research Council

Anne Barrett, Archivist & Corporate Records Manager, Imperial College; Chair of Trustees of the Centre for Scientific Archives

Geoffrey Browell, Senior Archives Services Manager, King's College London

Joanna Corden, Archivist, Royal Society

Victoria Cranna, Archivist & Records Manager, and Gareth Knight, Research Data Manager, London School of Hygiene & Tropical Medicine

David Edgerton, Hans Rausing Professor of the History of Science and Technology, King's College London

Peter Elliott, Head of Archives, RAF Museum Hendon, and Chair of the Royal Aeronautical Society Historical Group

Annette Faux, Archivist, Medical Research Council Laboratory of Molecular Biology, Cambridge

Georgina Ferry, author and science writer

Sandra Freshney, Archivist, Sedgwick Museum of Earth Sciences, Cambridge

Roger Graham, Chairman of Trustees, Archives of IT

Peter S. Harper, University Research Professor (Emeritus) in Human Genetics and founder of the Genetics and Medicine Historical Network

Paul A.D. Harvey, Vice-President, British Records Association

Jenny Haynes, Archives Manager, Wellcome Library

John Henry, Chair, History of Geology Group, Geological Society of London

Jan Hicks, Archives & Information Manager, Museum of Science and Industry, Manchester

Sally Horrocks, Lecturer in Modern British History, University of Leicester; Academic Adviser on British Library's Oral History of British Science project

John Hudson, Chair, History Group, Royal Society of Chemistry

Frank James, Professor of the History of Science and Head of Collections, Royal Institution

Valerie Johnson, Director of Research and Collections, The National Archives

Chris Jones, Chair, Scientific Archivists Group

John Lagnado, Honorary Archivist, Biochemical Society

Anne-Flore Laloë, Archivist, European Molecular Biology Laboratory, Heidelberg

Caroline Lam, Archivist and Records Manager, Geological Society of London

Hannah Lowery, Archivist, Bristol University Library

Carol Morgan, Archivist of the Institution of Civil Engineers

Katie Ormerod, Archivist and Records Manager, Natural History Museum

Allen Packwood, Director, Churchill Archives Centre, Cambridge

Adam Perkins, RGO Archivist, Cambridge University Library

Cathy Pink and Lizz Jennings, Bath Data Management project

John Poulter, Archivist, Worshipful Company of Information Technologists

Jenny Shaw, Special Collections Manager (Development & Stewardship), Wellcome Library

James F. Stark, Honorary Archivist and Chair of the Outreach and Education Committee, British Society for the History of Science

Geraldine Clement-Stoneham, Knowledge and Information Manager, Medical Research Council

Mark Thorley, Head of Science Information, Natural Environment Research Council

Stephen Twigge, Head of Collections (Modern), Advice & Records Knowledge, The National Archives

Symeon Ververidis, Development Officer, London Metropolitan Archives

Nick Wyatt, Acting Head of Library & Archives, Hadrian Ellory-van-Dekker, Head of Collections, and Beata Bradford, Archive Collections Manager. Science Museum

Patrick Zutshi, former Keeper of Manuscripts and University Archives, Cambridge University Library