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Preservation and access issues in contemporary scientific archives: a general overview

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1. Preservação de Arquivos Científicos
I. Título.

Preservation and access issues in contemporary scientific archives: a general overview

About 18 months ago I gave a paper on preservation and access issues in scientific archives at a Nobel Symposium in Stockholm. This was a great responsibility because I was the only archivist present at a history of science symposium. I want to revisit now, and bring up-to-date, some of the issues I considered then.

Apart from stating the obvious, that all those historians were dependent in their work on archives and archivists, I wanted to emphasise that today archivists, especially those dealing with science and technology, were living in interesting times, and identified a number of factors that contributed to that state of affairs.

These were as follows:

1. Archivists are responsible for paper collections of great historical importance built up over many years. Of necessity caring for and facilitating access to such collections must take up a great deal of time and resources.

2. At the same time archivists are aware of the great archival legacy of science and technology in the second half of the twentieth century. This archival legacy reflects a vast change in scale and complexity of the scientific enterprise, and much of it is still not secured in archive repositories, but located in offices, laboratories and private homes. Although most of such documentation is still on paper, recent developments in information and communications technology have transformed the way scientists work and keep records. This requires archivists to adapt their thinking and working practices to respond to this emerging electronic environment in science.

3.The same information and communications technologies that have transformed the way scientists work have also transformed the working lives of archivists and the expectations of them in terms of electronic access to information about archives, finding aids [catalogues], and the documents themselves.

Balancing responsibilities and expectations in this hybrid paper and electronic environment is a major challenge for archivists today.

One of the principal purposes of my Stockholm paper was to convey to my audience of historians the idea of archivists as innovators, as professionals who, by addressing the issues I have just outlined, were engaging with the future and preparing the way for the histories of science of the twentieth first century. While there has been work of enormous value in traditional archival structures such as national and state archives, I wanted to focus on a number of the innovative archival arrangements that have marked the scientific archive field.

I shall begin with the first and I believe the most important and for that we must visit the US. The key innovation here is the discipline history centre which has as a principal objective the preservation of historically significant materials in its chosen field. The first discipline history centre was the American Institute of Physics (AIP) Center for the History of Physics, now 40 years old. This has quite simply become the world leader for preserving and making known the historical record of modern physics. It did not do this by creating at the Center some biggest and best unified physics archive but by working to ensure that the records of modern physics were preserved in appropriate archive repositories. It offers advice on the one hand to scientists and their families and, on the other hand, to archivists in the institutions, university or government laboratory, where the scientists worked. One of its principal tasks is to work with scientific institutions to establish archives and records management programmes that will meet both current administrative requirements and future historical needs. An essential element in the success of the AIP Center has been its commitment to collaboration and co-operation with the wider archival community in the United States and internationally. It has not been interested in acquiring an important archive to boost the standing of its own collections, but has pursued the role of 'honest broker' matching the papers of scientists with appropriate archive repositories, the Center itself acting as a repository of last resort when it is the only place where an archive can be saved.

One of my reasons for highlighting the work of the AIP Center is because it has been a major innovator in archival theory and practice. At the heart of this innovation has been an evolving plan or documentation strategy to secure evidence of how the physics community conducts its research - evolving because it has to respond to changes within the physics community and research setting. In order to formulate appraisal guidelines and recommendations to institutions it has undertaken a series of major investigations drawing on the skills of historians, archivists, sociologists and, of course, the scientists themselves. Since its establishment the Center has looked at physics research by individuals in an academic setting and focused on specific fields of physics such as nuclear or solid state physics. It responded to the need to document a new type of research institution created in the United States after the Second World War, the government contract laboratory, national laboratories that provided large research facilities such as particle accelerators that individual universities could not afford. This was a world evocatively described by an AIP staff member at the time of the AIP's first involvement as 'uninhabited by archivists and historians'. It has taken on the challenge of multi-institutional collaborations, teams of researchers from a number of institutions coming together to carry out an experiment and then disbanding. Multi-institutional collaborations were a major focus of AIP documentation research in the 1980s and 1990s; collaborations in high energy physics, space research and geophysics were investigated, key sites examined and case studies designed. All this research comes together in the work of the AIP to inform an overall strategy for

documenting a scientific discipline, saving the papers of individual scientists alongside the preservation of the records of research institutions and significant collaborations. The AIP's most recent project is documenting the history of physicists in industry.

The above remarks about the work of the American Institute of Physics draw on an article by Spencer Weart in *Physics Today*, January 2002 and a paper given by Joan Warnow-Blewett at the International History of Science Congress, Liege, Belgium in 1997.

It should be clear from my talk this morning that there are some interesting similarities and major differences between the archives work of the AIP Center and that of my own organisation. Like the AIP Center we act as intermediaries between scientists and archive repositories. Unlike the AIP we encompass the widest range of disciplines while confining ourselves almost exclusively to the papers of individual scientists. Crucially we facilitate the safeguarding of papers by carrying out the traditional tasks associated with archival processing - appraisal, arrangement, listing and indexing - thus removing from the repository some of the burdens associated with the acquisition of large modern scientific collections. Unlike the AIP we never act as a repository ourselves. Very much like the AIP we are at the centre of a network of co-operation and collaboration. This is an absolute necessity for an organisation that catalogues archives for repositories throughout Britain but we have also taken the view that we should have an active role internationally in the promotion of scientific archives.

I certainly do not wish to repeat now what I said this morning but I should like to emphasise the reasons I believe the processing centre model worked in the United Kingdom. These include a continuing relationship with Royal Society [the UK national science academy] which has part-funded the work since 1976, the support of leading British charitable foundations like the Wellcome Trust for extended periods, a large university archives sector interested in building up research collections including scientific archives, and perhaps even the geographical concentration of scientific excellence in the United Kingdom - though we have been criticised for a perceived over-representation in our work of the so-called 'golden triangle' of Cambridge, London and Oxford. It may be of interest to observe at this point that the NCUACS has remained unique in the UK. There is not another subject area that has a national cataloguing unit along the lines of the NCUACS though in very recent times there has been a growing interest in the idea of centres of excellence at a regional if not a national level, for example in fields of archival activity which are marked by particular shortages of skills and resources such as conservation [i.e. the repair and treatment of fragile and damaged documents].

Although there have over the years been many expressions of interest in the processing centre model from colleagues outside the UK, for example in North America

and Europe, its transplantation outside the particular United Kingdom environment does not seem to be very easy. It is however possible to point to the Australian Scientific Archives Project (now the Australian Science and Technology Heritage Centre) which was established in 1985 at the University of Melbourne with a mission to ensure the preservation of Australia's scientific archives heritage. Although this traditional preservation work continues, the Australian centre is perhaps now better known internationally as one of the great pioneers in the application of modern information and communications technologies in archives and heritage work. There is also a more recent example with the establishment in 2001 of a scientific archives service for Catalonia at the Autonomous University of Barcelona. Drawing on the experience of the American Institute of Physics and the NCUACS, it is pioneering its own particular mix of identifying, cataloguing and promoting scientific archives.

The result of a whole range of initiatives in the preservation of scientific archives in the last several decades has been positive: an engagement with scientists and scientific institutions resulting in significant accumulations of archival material saved for posterity, increasingly accessible to researchers though much of it still virgin territory as regards historical research. I refer here of course to material that has already arrived in the repository. What is very evident from my own work is the great quantity and quality of historically interesting materials still to be brought into the repository. After all we have spent thirty years telling scientists that they should keep their papers - and until the last few years we have always talked about papers - and a significant number of those scientists we are most interested in have done what we have wished. We have played a part in encouraging the survival of great quantities of paper which today are still in the hands of their creators and will continue to become available for appraisal, listing and permanent preservation certainly for the rest of my professional career. However, there are questions in my mind, which I shall return to later, as to whether funding bodies will continue to be willing to pay for the expensive processing of large late twentieth century paper archives in a world increasingly perceived as electronic.

If public institutions do not take an interest in such papers then others may. In March 2000 there was an article on Rosalind Franklin in the British Sunday newspaper *The Observer*. [Franklin is of great interest because she did crucial work on the structure of DNA but died of cancer in 1958 before the award of the 1962 Nobel Prize for Medicine to Francis Crick, James Watson and Maurice Wilkins]. This newspaper article broke the news that an American private collector was purchasing the papers of leading molecular biologists, including a number of Nobel Laureates, in Britain and other countries. There was also a well-researched feature article on the topic in the international science journal *Nature* in June 2001. Here we have a glimpse of an alternative future of a market in scientific materials and important archives passing into private hands. Since the justification for the activity of the American collector was, in part at least, a perceived lack of interest from libraries and archive repositories in

scientific archives, a colleague from the Wellcome Library for the History of Medicine in London and I wrote to *Nature* to correct any impression of neglect in the United Kingdom. A more significant response came in December 2001 with the announcement that the Wellcome Trust, in competition with the American collector and others, had acquired the papers of Francis Crick for just short of £2,000,000 ($2,800,000), half of the purchase price being made available by the UK national Heritage Lottery Fund. The crucial outcome from the acquisition of the Crick archive by the Wellcome Trust was of course the guarantee of the public availability of the archive for future research [in the Wellcome Library in London]. In a British context there is another significant gain which may have wider implications. This is the recognition by those responsible for the protection of the national heritage, for example the Heritage Lottery Fund, that the archive of a living scientist can be a key part of that heritage, that the archival heritage which needs protecting for future benefit, whether academic research or other uses, can be nearly contemporary.

An article on the Wellcome Trust's acquisition of the Crick archive in the *Times Higher Educational Supplement* in January 2002 concluded by questioning the future of archiving in an electronic age. The writer believed that we would never see this kind of high quality paper archive again and he was sceptical that people would preserve their own e-mails in the way they might their own letters. No doubt the end of archives has been heralded on a number of occasions in the past. I first heard of the end of scientific archives in 1986 when a leading British scientist explained to me that we, the scientific community, all communicated by fax these days and that fax paper quickly darkened and became illegible. Well, of course, the fax paper problem was solved and the period when fax was the principal mode of communication amongst scientists proved very short.

Even when considering present electronic concerns which many would consider more justified I might point out that not all scientists engage with the electronic age to the same degree. In September 2002 there was an article about the British theoretical physicists Peter Higgs and Stephen Hawking in the British newspaper the *Independent*. The passage that caught my eye related to Higgs: 'Communications: Mainly by letter, does not have e-mail or television'. And when the article about the Crick archive was written he was 87 - he has since died - and given the expansion of science in the second half of the twentieth century there are a great number of scientists, 87 year olds, 88 year olds, 89 year olds etc etc whose archives like those of Crick himself will all be paper.

But of course we must take seriously the electronic environment in which scientists today are working and communicating, and I personally take a fairly positive view of the preservation of digital records on the basis of a developing understanding of the respective needs of scientists and archivists.

One of the principal elements of my confidence in the future is the recognition by scientists themselves of the need to get the record keeping right in a digital age in order to secure the validity and integrity of science itself. This can be illustrated from two disquieting episodes in recent research which received wide publicity. A couple of years ago (July 2002) I noticed the following headline in the British newspaper the *Guardian*: 'US scientists admit the truth - new discovery was an elementary fabrication'. Apparently the team of scientists at Lawrence Berkeley National Laboratory, California that announced in 1999 the observation of what appeared to be Element 118 - the heaviest transuranic element at the time - had retracted its original paper after several confirmation experiments had failed to reproduce the results. The *Guardian* reported a speech to Laboratory employees from the Director Charles Shanks to the effect that the discovery had been due to the scientific misconduct of a single member of the team: 'There is nothing more important for a laboratory than scientific integrity … . Only with such integrity will the public, which funds our work, have confidence in us. In this case, the most elementary checks and data archiving were not done'. The second episode relates to the work of Henrik Schön at Bell Labs, New Jersey which, according to a report in the British science magazine *New Scientist*, 5 October 2002, 'promised to revolutionise plastic electronics, high temperature superconductivity and nanotechnology'. When this work was questioned by other researchers Bell Labs employed an independent panel which concluded that much of the data was fabricated. When Schön met the panel he was unable to produce laboratory notes or computer files showing his raw data. He said he had deleted the relevant files after running out of space on his computer. The chair of the independent panel, Malcolm Beasley of Stanford University, is reported by the *New Scientist* as saying that while the panel could not prove Schön was lying such poor record keeping constituted scientific misconduct. There were lessons for other research organisations: 'It's time to go back and re-examine procedures and how you keep records in this computerised age'. In the circumstances it is hardly necessary for me to underline again what is at stake here: scientific integrity, public confidence, funding: powerful incentives to getting things right in scientific recordkeeping.

My degree of confidence in the future is founded secondly on the engagement of archivists in understanding the records environment in scientific institutions and working with record creators, the scientists, to secure the preservation of the digital records both for the present and future health of science and in due course for the history of science and technology. I am well aware of major research and funding initiatives in such areas as government records and large scale administrative systems but it is the scientific researcher and how that individual fits into the wider institutional picture that interests me here. [You will recall from this morning that the focus of my own organisation's work is the individual scientist rather than the scientific institution]. Let me give a very few examples of the engagement I have in mind.

It is some years ago now that my colleague Anne Barrett of Imperial College London Archives promoted a survey on changes in scientific practice and its effects on records creation and record keeping. She saw this as part of her job as institutional archivist in documenting the history of the College. To do this and gain an overview of the work of the institution it was necessary, she reported, 'to look at what members of the institution are doing and see and discuss their work practices with them, in order to plan for record transfer to the archives in the future. … The proactive approach stands archivists in good stead with other members of their institutions and can make the scientists feel that there is some point to a coherent records keeping policy being followed, if the records are to be retained safely for their use, and from the archivists' point of view, for posterity'. When in September 2001 Anne Barrett hosted at Imperial College an international archives conference, entitled significantly 'Exploring electronic records: sharing problems and solutions across the archival and scientific worlds', she ensured that archivists from around the world would be joined by members of a number of College science departments (chemistry, biochemistry and bioengineering), the College administration, the communications technologies division and historians from the College's Centre for the History of Science, Technology and Medicine. We are all in this together.

It was the co-organiser of the conference at Imperial College, a Swedish colleague, Renata Arovelius of the Law and Documentation Department of the Swedish University of Agricultural Sciences, Uppsala who drew my attention to the course which her university runs for all postgraduate students on information retrieval and the handling and preservation of the records of science. The course comprises such elements as: information retrieval strategies, bibliographic databases on the World Wide Web, scientific electronic publishing, copyright legislation and the preservation and handling of scientific records. As our Swedish colleague points out: 'the participation of the university's archival function in this course with lectures and information about the handling and the preservation of the records of science spreads knowledge about existing rules at an early stage in the scientific process and prepares the way for future co-operation with the scientists'.

It was as a postgraduate history student some thirty years ago that I met my first archivist but in those days the role of the archivist was to help with deciphering the esoteric scripts of old documents or to offer general advice about traditional archival sources. Now they may be competent partners with researchers in the electronic age. My colleagues at the Australian Science and Technology Heritage Centre, for example, currently teach a course at the University of Melbourne on 'Fact, Fiction and Fraud Essential Skills for the Information Age Worker'. According to the online course introduction: 'this subject explores how society comprehends, evaluates and uses information technology, computer science, World Wide Web resources, copyright and other pertinent technologies in the modern workplace'. The fundamental questions

addressed by the course were how we distinguish between fact, fiction and fraud in digital information environments and how we do it in the paper world.

It is of course necessary to move on from learning and instruction to action on the preservation front and, since this paper was originally prepared for delivery in Sweden, I chose a Swedish example from the Swedish Agricultural Sciences University. Here the forestry department has appointed a steering group for the preservation of the digital records of science, comprising researchers, members of the administration and the Information and Communications Technology department and the university archivist. Their programme comprises the inventorying of current preservation and access needs, identifying appropriate methods and media for long term preservation and future access, advising on the creation and keeping of the metadata needed for researchers other than the creator to access data in appropriate circumstances, advising on the cost and funding of digital preservation and providing best practice guidelines to all departments. All of which must comply with Swedish Archival Law which requires an appraisal process which takes into account the value of the material for the actual research area and other disciplines and its historical value for the history of science, culture or individual history. Records that contain data about the aims, methods and results of a scientific project must be kept for ever.

[It may be of interest for me to indicate what advice my own organisation gives on electronic records. The online version of the little guide we first prepared many years ago to advise scientists on preserving their archives deals with the question thus:

Electronic records, whether computer disks, emails, files on a personal computer or databases, present an unresolved challenge for archivists and researchers. They are a vital and growing part of modern documentation but at the moment there is no generally accepted strategy for their long-term preservation and access.

Electronic records come in a variety of forms, from emails to databases to dynamic programs, and the same solution is not necessarily applicable to all. Our current advice is that, if possible, significant electronic documents such as emails, correspondence, lecture drafts etc, should be printed out and, where necessary, identified and dated. If for some reason this is not possible, they should be transferred to DVD, CD or disk and labelled with the file names, the software used, file size, and the dates of creation and transfer of the document onto disk. Material that cannot be printed out without losing information (such as relational databases for example) should be transferred to DVD, CD or disk and again labelled with the file names, the software used, file size, and the dates of creation and transfer of the document.

Entire *directories* of material on a computer (for example, saved emails on a particular subject, letters to a particular correspondent) should if possible be

transferred to DVD, CD or disk and labelled with the directory name, the software used (if relevant), directory size, the span dates of creation and transfer of the document.

Whether it is legitimate to advise any printing out of electronic records is a matter of some controversy. My colleagues at Bath disagree on this point. To strengthen my own organisation's ability to respond to the electronic records environment I have recently invited the curator of e-Manuscripts at the British Library to join our advisory board. He is not only responsible for looking after the Library's e-Manuscript collections but is an active researcher in the field]

As we all know, archivists engage with the electronic age not only in terms of their role in preserving records for posterity but also in the access side of their work. By embracing the potential of modern communications technologies we are able to transform access to information about archives, finding aids [catalogues] and in certain cases the documents themselves. In a very short period of time the World Wide Web has become a major focus of professional activity. Its promotional character in terms of enhanced visibility for the archive within and beyond the archivist's own institution is obviously important. But what has been most striking has been the way archivists' engagement with the internet has opened up major funding for large scale, often multi-institutional, projects which facilitate research in the higher education sector or exploit archival sources to support the public understanding of science or wider educational agendas.

Those of us working in an academic environment in the United Kingdom have seen in the last decade an unprecedented influx of funding into libraries and archives from the Higher Education Funding Councils to support research collections in the humanities, including the history of science and technology. [The Funding Councils channel government funds on a competitive basis to support research in the universities]. This major renewal of the research infrastructure in the humanities [supported by Funding Council money] has included cataloguing projects, conservation of fragile documents, extended opening hours for reading rooms but especially electronic access projects where collaboration might be seen to maximise the benefit from distributed resources. The history of science benefited greatly in the most recent three-year programme which ended in the autumn of 2002, with a number of projects illustrating the potential of the new information and communication technologies.

Let me give three examples:

(1) NAHSTE (Navigational Aids for the History of Science, Technology and the Environment) which created a cross-searchable database of standardised archival descriptions of the relevant archival collections held by the three partner Scottish universities <http://www.nahste.ac.uk/>.

(2) HOST (History of Science and Technology) whose eight university partners in England and Scotland sought to increase access by researchers to a range of significant printed and archival material relating to the history of the non-medical sciences from 1801 to 1914. One of the project strands was the targeted digitisation of catalogues, with all catalogue records created made available over local, national and international networks <http://www.kcl.ac.uk/depsta/iss/library/speccoll/host/>.

(3) AIM25, a project to provide a web-accessible database of descriptions of the archival holdings of more than 50 higher education institutions and learned societies in the area bounded by the M25 London orbital motorway which gives the project its name. Although without the exclusive history of science focus of the previously mentioned projects, the inclusion of a number of leading scientific institutions and medical colleges makes its significance for the discipline evident <http://www.aim25.ac.uk/>.

Not all internet projects have been considered equally cost-effective by archivists, researchers and funding bodies, and in the United Kingdom (but not necessarily elsewhere) drilling down to the original document has not generally found favour in modern science and technology archives. [That was what I said in Stockholm but since this paper was first delivered the question of the large scale digitisation of documents for online access to a wide public has become much more prominent].

At the same time as these higher education projects were being undertaken, archives and their users in the United Kingdom were benefiting from further large scale initiatives to create an online national archival network. The English component, to which my own organisation is a contributor, is Access to Archives (A2A) <http://www.a2a.org.uk>. Supported by the National Archives, A2A aims to provide access to archives through the catalogues drawn up by archivists across England and which typically have previously been available only at the relevant archive repository in paper form or on a local electronic system. The principal source of funding is the Heritage Lottery Fund, with A2A infrastructure funding coming directly from the government sources. When the A2A database was updated last month [August 2004] it contained 7.05 million catalogue entries from 357 archive repositories. [I can give you some idea of how rapidly the database is growing. In October 2002 the A2A database contained just 3.95 million catalogue entries from just 197 archive repositories]. It is possible to browse the full text catalogues on the screen as well as perform a variety of searches of the whole database. [At the end of August 2004 A2A had been searched 4.2 million times since its launch in June 2001, with 9.6 million catalogue downloads as a result].

We are all familiar with the ‘big science’ that developed after the Second World War. Can we now thanks to the internet talk about ‘big archives’?

In the first phase of the development of A2A which ended in March 2002 the NCUACS was a partner in a Web of Science Archives consortium which was led by the national science academy, the Royal Society and included a number of other science-based institutions in London. The Web of Science Archives project contributed 27,000 pages of science and technology archives catalogues to A2A, 14,000 of them coming from the NCUACS. What my own organisation has been able to achieve through A2A is to mount almost all the catalogues we have compiled since 1973 on the World Wide Web (including a major programme of digitisation of old paper catalogues). Of great importance for the future, equipped with appropriate archival software for our cataloguing work, we shall be able, as a matter of routine, to add our catalogues to the national online network as they are completed.

Whether these access projects are in higher education to serve primarily academic research or involve the wider archival community in serving a broad educational agenda, their utilisation of the latest communications technologies has unlocked significant funding. Likewise, electronic archives, as a pressing problem that requires the interested parties, including the archivist, to act now to preserve for a digital future, have also benefited from the interest of funding bodies in a priority area. If, however, we are interested in a healthy future for science and technology archives then this essential response to electronic needs and opportunities has to be balanced with an investment in the preservation of the paper legacy of the recent past, still substantially outside the archive repository. This requires the location of the materials, and the traditional archival skills of appraisal, arrangement and listing, though the listing may be with the aid of the latest computer software and the resulting catalogue or finding aid may be accessible online. This also requires the storage in appropriate conditions of large quantities of paper for ever. It may also require timely intervention to conserve fragile materials before physical access can be allowed.

Since my own work centres on facilitating the transfer of scientific archives, predominantly paper, from private hands to public repository by means of our cataloguing service I am obviously interested in whether funding bodies will be willing to continue supporting this activity. The answer is uncertain. On the one hand I have been saddened by colleagues telling me that they could not get funds to save and process papers at risk but could get funds for digitising images of papers already in the repository for presentation on the World Wide Web. I could ask, which better serves the future of the historical research?, but it might very well be that without the prospect of an internet project there would have been no money at all.

On the other hand we have seen that in rather exceptional circumstances, when a great name like Francis Crick is in play, exceptional sums can become available for saving papers. To strike a positive note, in more routine circumstances in the United Kingdom, as part of phase two development of the Access to Archives (A2A) online network which began in April 2002, my own organisation was awarded funding

to catalogue the archives of six twentieth century University of Bristol physicists, including two Nobel Laureates, under the title ‘Cosmic Rays and the Solid State’. Those responsible for the direction and funding of A2A understood that the support of traditional cataloguing projects was necessary to sustain the growth of the online network. Even so, I do signal this question of the paper legacy of the late twentieth century as a matter of concern.

I concluded my Stockholm paper by echoing my opening remark that archivists live in interesting times as they try to manage in association with researchers and funding bodies this hybrid paper and electronic future. The mix of interests and considerations is highly complicated and the interplay and outcomes will vary from institution to institution and country to country. Nevertheless I feel able to affirm a qualified optimism about the future founded on the pro-active approach of practitioners in science and technology archives: their seeking out of archival materials for preservation; their tackling of problems arising from changes in the workings of the scientific community; and their adaptations in their own work of modern technologies. In this way they aspire to provide the essential foundation for future developments in the history of science and technology and other areas of historical research.

The original Stockholm paper has now been published in *The Science-Industry Nexus History, Policy, Implications*, Nobel Symposium 123, Science History Publications/USA, 2004.