

Mapping Scientific Memory— Understanding the role of recordkeeping in scientific practice

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How do scientists document their research? As electronic means of communication become the norm, this question has taken on special urgency. If we do not understand the process of recordkeeping within the sciences, we are in danger of losing our scientific memory—with severe legal, financial and cultural consequences. This article introduces the connection between scientific practice and the recordkeeping process, indicating how little we know of the technological, administrative and cultural dimensions of this relationship and how it has changed over time. Archival research that analyses this connection will enable the development of strategies to deal with current and future problems. But how can we fund this research?

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. The rapid uptake of electronic means of communication, data collection and reporting has brought a crisis in scientific recordkeeping—the safety net has gone.

This crisis, although not of equal severity in all scientific disciplines or technology-based industries, has shown itself dramatically in a number of environments. In the late 1980s a large organisation in Victoria introduced an organisation-wide electronic document creation and transmission system. Before its introduction a structured paper based recordkeeping system was in place and, although use was not uniform across all work sites, it provided a workable framework for meeting the record needs of the organisation. When the new system was introduced a disclaimer was made stating that the system was not a recordkeeping system. However, the nature of the system led users (who had little knowledge of recordkeeping systems) to abandon their old practices which then seemed unnecessary. Some seven or eight years later the organisation decided to abandon the service-provider in favour of new PC-based systems. However, many hundreds of thousands of documents which should have migrated to the new systems could not be salvaged. The cost to the organisation is in the millions of dollars and the costs will only increase with time as the need for the lost records increases. As this example indicates, scientific organisations and individuals in Australia, and all over the world, are in danger of suffering from an irrecoverable memory loss.¹

How can we deal with this crisis when we know so little about the nature of the scientific memory—about the documentation processes that occur within science? There is little existing research, and most of this tends to concentrate on the salvage of records within particular disciplines, or the salvage of personal records of particular scientists. The archivist will always be called upon to perform this sort of work, but what we need are the knowledge and the tools to prevent situations developing where there is nothing to salvage. This is the threat being posed by the indiscriminate use of electronic documents and transmission systems.

To embark on such a research program, we have to look beyond the records themselves to that point within scientific practice where records are created. We have to understand the value that scientists ascribe to their records. We

have to know how administrative and technological change constrain their decisions. We have to map the archival pathways that constitute the scientific memory. Only then will we be able to develop strategies that meld with the ongoing practice of science, instead of just cleaning up its messes.

A solid foundation

Much archival research has tended to focus on appraisal—assisting archivists to make judgements about the significance of existing bodies of records.² But waiting around for the leftovers is hardly a satisfactory method of documenting a culture. Consequently there has been a call for archivists to intervene in the process of records creation. ‘Functional analysis’ or ‘documentation research’ has been suggested, by Helen Samuels³ and others, as a way of moving beyond this after-the-fact archiving. Such research examines the functions of the institution within which the records are generated and seeks to identify what records would be required to adequately document these functions. The application of these principles by Joan Warnow-Blewett⁴ to high-energy physics has shown that such research techniques are extremely useful in seeking to document modern science. However, the process by which records are created still remains somewhat mysterious. Functional analysis can help us identify key points in the process, but what goes on at those points?

The principles involved in the functional assessment of recordkeeping practices are also being addressed in the Pittsburgh Project, led by David Bearman and Richard Cox.⁵ This work provides a solid theoretical basis for future study and practice, but it is only a beginning. Once enumerated these principles need to be tested, implemented and assessed. They provide a new avenue for research, not a substitute for analysis and reflection. The real-world environment of modern scientific practice will provide a challenging test-bed.

In the meantime, researchers in the social studies of science have been invading scientific laboratories with their notebooks, tape recorders and video cameras. Like the archivists, they too have been keen to move beyond the documents, but their aim is an understanding of the way science is actually practised. Latour and Woolgar’s pioneering study of the Salk Institute⁶ portrays the laboratory as a factory for the production of papers, or rather ‘inscriptions’. Only when data is inscribed in the form of graphs or tables can it be used in the process of persuasion that results in the construction of a scientific fact. Such inscriptions are thus highly valued. Latour comments in

one article on the 'extraordinary obsession of scientists with papers, prints, diagrams, archives, abstracts and curves on graph paper'.⁷ Archives? Few of us who deal with the archives of science could say that they had noticed such an obsession. Locked away in the inscription process is the creation (or non-creation) of records, but the picture is rather more complex. Inscriptions have value, but they are cleaned-up, modified and finally incorporated into published papers. What value is ascribed to the products of these various stages? And what of documentation not relating to the data itself—administrative material, correspondence, funding applications? Anthropological or ethnomethodological studies of scientific institutions open up the practice of science for inspection, but the focus is on the creation of facts, not records. The tools they provide are useful, but the apparatus of inscription needs to be unpacked to reveal the many moments of record creation (or non creation) that constitute it.

Functional analysis helps us to identify sites for investigation, and anthropological studies of science provide us with some of the tools to conduct the investigation, but neither offers much of an historical dimension to the study. We do, after all, need to understand the way that recordkeeping processes in science change over time. To do this we need to find a way of exploring past practices. We cannot walk into a working laboratory of the 1920s, but we can analyse the documentation that survives from the laboratory. The toolkit we put together from archival practice and sociology of science will need to be applied across time, in order for us to understand the nature and significance of the current situation in the sciences. The various methods of historical investigation will be called into play—biographical research, institutional history—as will a general understanding of the development of the scientific disciplines both in Australia and overseas. Together these approaches will draw from the existing records the story of their own creation.

Existing research and techniques will provide us with valuable landmarks in our mapping of the scientific memory, but how do we begin to fill in the outlines? We suggest a three-stage research program that begins by investigating changes in practices over time through the analysis of surviving records. This would then be compared against the current situation by studying recordkeeping practices within specific scientific institutions. The knowledge gained by these studies could then be used to design and test appropriate tools and strategies for dealing with current and future problems.

The process of change

Science is undertaken within a matrix of social and technological forces. The tools that scientists use, the way they communicate, the means in which their projects are funded and administered have all changed over time, and they continue to change. The process of records creation is equally dependent on such forces, but how are the two linked?

This question can only be addressed by mapping changes over time—by looking at what records have been preserved and locating these records within contemporary scientific practice. A combination of archival expertise and historical understanding are required to draw out the connection between the science and the records.

An excellent starting point for this research would be the analysis of information on existing archival holdings relating to Australian science already collected within RASA (the Register of the Archives of Science in Australia) by the Australian Science Archives Project. By looking for patterns within the remaining records and correlating these against developments in Australian science, it would be possible to provide a baseline for further studies that looked at the contemporary scientific environment. Once the process of change is better understood, current and future problems can be placed in a meaningful context.

A snapshot of current practices—who is responsible?

Rather than being overwhelmed by the vast amount of electronic information currently being generated in the sciences, we need to examine in detail the processes according to which this information is being generated, and assess its significance in providing a record of scientific activity. We need to explore the various levels of responsibility at which the creation of records can or should occur. Such responsibilities start with an obligation that scientists have to themselves, to their career and to their discipline in general. However, responsibility extends beyond the individual to work groups, project teams, supervisors of research students or staff, departmental heads and, in science, extends into much more complicated arrangements that include multi-institutional multi-national collaborative research projects.

Detailed case studies within scientific institutions are required

Through interviews with scientists coupled with an examination of their administrative environments and communication practices, detailed data could be gathered that would provide a snapshot of current practices, needs and problems. But as well as identifying the holes in the recordkeeping process, such studies would suggest targets for intervention—critical points within the practice of science that could be directly addressed by improved documentation strategies.⁸

New tools and strategies

We need to comprehend the problems facing recordkeeping in the sciences more clearly than ever before. Once understood, these problems can be dealt with. The aim should be to develop a range of intervention strategies that address the technological, administrative and cultural dimensions of the current situation. New software tools that aid the documentation process may be one aspect, but equally there will be a need to work with scientists to find ways of incorporating appropriate recordkeeping processes within scientific practice. Any such strategies will need to be rigorously tested in real life situations.

A new significance

This research is urgently required and of international significance. It is no longer acceptable for archivists to trundle along in science's wake, picking up the records that just happen to be left behind.⁹ Electronic records will not afford us such a luxury. Whereas paper documents can only be consciously disposed of, electronic data can be easily lost by changes in technology, inadequate backup procedures and poor documentation. And what of concerns about fraud and misconduct, intellectual property, legal and financial accountability? The demands being made on our recordkeeping systems are growing, but how do we make them work better, when we know so little of how they work? These are not new problems—they are all too familiar, multiplied by inaction, exacerbated by lack of communication. In recent times, some work has been carried out within organisations or by private consortia, but the results of this work have not been made public. General outcomes need to be published to reveal both the results of the studies and the research techniques employed. These techniques are likely to be of international interest and of use in a wide range of research based environments.

As we turn to finally face the horror, we must be careful not to be merely reactive. As we pursue this long overdue research, we have the opportunity to develop a deep understanding of the processes involved. We need to extend the archival research agenda beyond the analysis of institutions and projects to the moment of creation—the point where the actions of a particular scientist determine whether a record is created or not. That moment where scientific practice and the recordkeeping process connect. This is new territory, drawing together archival, historical and sociological techniques. There is both urgency and opportunity.

It's time for funded archival research in Australia

For too long archival research in Australia has been conducted in the margins and with very poor funding. We have relied heavily on a few individuals who have been given the time by their institutions to carry out this work and on the Australian Society of Archivists to lead and cajole members to produce policy and position papers that help further the understanding of our profession. The Australian Council of Archives has also attempted to further archival knowledge through working groups and meetings. However, despite having a number of universities teaching archives and records management at the postgraduate level, the Australian Research Council still has not created research categories for archives or records management.

Conclusion

The need for archival research in the practice of contemporary science is well demonstrated to the extent that some scientists and scientific administrators are funding small preliminary projects to deal with their immediate concerns. However, we need to progress beyond this piecemeal effort and find funding for larger-scale research resulting in the publication of substantive contributions to our professional knowledge. This will empower us to meet the demands being placed before us. A positive first step would be for the Australian Society of Archivists and the Australian Council of Archives to lobby the Australian Research Council for the inclusion of archives and records management as categories of research. We need to make the fund-givers aware that there is important research that must be conducted. Such research will reap significant benefits not only for the scientific community but for government, business and industry.

Endnotes

1. The key evidence for this view stems from the recent work of the Australian Science Archives Project in contemporary scientific and technological workplaces where the explosion in numbers of networked personal computers, replacing either mainframe computer systems or paper based systems has led to rapid and uncontrolled changes in work practice and a dangerous degradation of recordkeeping practices. The importance of the issue is now being recognised in some industries and organisations where attempts are being made salvage the damage inflicted over the last ten years.
2. Joan K. Haas, Helen W. Samuels and Barbara T. Simmons, *Appraising the Records of Modern Science and Technology*, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1985.
3. Helen W. Samuels, *Varsity Letters: Documenting Modern Colleges and Universities*, The Society of American Archivists and The Scarecrow Press, N. J. and London, 1992.
4. Joan Warnow-Blewett, 'Documenting Post war Science: the Challenge of Change', *Recovering Science—Strategies and Models for the Past, Present and Future: Proceedings of a Conference held at the University of Melbourne, October 1992*, Australian Science Archives Project, Canberra Office, 1995.
5. David Bearman, *Electronic Evidence: Strategies for Managing Records in Contemporary Organisations*, Archives and Museum Informatics, Pittsburgh, 1994.
6. Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, enlarged paperback edition of the original 1979 version, Princeton University Press, 1986. See also Bruno Latour, *Science in Action*, Harvard University Press, Cambridge, 1987.
7. Bruno Latour, 'Visualisation and Cognition: Thinking with Eyes and Hands', *Knowledge and Society*, vol. 5, 1986, p. 15.
8. The phrase 'documentation strategies' does not refer to the particular meaning that has been accorded this term by archivists (see, Larry J. Hackman and Joan Warnow-Blewett, 'The Documentation Strategy Process: A model and a Case for Study', *The American Archivist*, vol. 50, 1987, pp. 12–47). It could, however, be seen as applying the concept of the archival 'documentation strategy' at the micro level—at the point of records creation rather than at the level of macro archival appraisal.
9. The work being conducted by the CSIRO Corporate Information Management in re-evaluating the role of the 'Laboratory notebook' and its importance to corporate recordkeeping is an example of this change. Another example is the 'Guidelines for Research Records' project currently being undertaken by the Australian Science Archives Project and the University of Melbourne Records Services Section.