An archival approach: the documents of a biomedical sciences laboratory*

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Abstract

This article addresses archival methods, techniques, and practices for managing documents generated by scientific activity, using field research carried out at an Instituto Oswaldo Cruz laboratory at the Fundação Oswaldo Cruz as a reference. Based on an analysis combining an archival studies approach with elements of the sociology of science, we believe that the models and instruments of archival knowledge are subordinate to the assumptions of historical research or social memory. They also serve a technical rationality aligned with empirical organization practices that confront the more complex archival reality, leading archival science to negate its foundations and theoretical principles.

Keywords: archival science; archives of scientific institutions; document management; scientific laboratories; Instituto Oswaldo Cruz.

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Since the last decade of the twentieth century, the reflections of the archival science community have been strongly focused on topics related to the impact of information technology on the function of the discipline and its professionals in the globalized world. The emergence of new information production, use and transfer standards, together with profound scientific and technological transformations in the capitalist system, has resulted in a series of questions for the area. The proliferation of electronic documents in institutions raises the question of the reliability of this type of document and, consequently, of its management by archivists. The efforts of archival researchers and professionals have been no less important, in tune with the challenges of digital life, but first and foremost aware of the need for a renewal in archival studies focused on theoretical, conceptual and methodological investigation. The analyses of Luciana Duranti (1994a, 1994b, 1996) reflect this perspective. Concerned with recognizing contemporary documents generated using electronic means as proof of action, the author (Duranti, 1996) uses diplomacy with the eye of an archivist and recovers important aspects of the characteristics of archival documents, among them authenticity and organicity. In this classic work, she performs analyses focusing on understanding documentation forms, categories, and the definition of what is an archival document.

Throughout the twentieth century, international archival practices, and especially those in Brazil, made archiving something very distant from theory. Theory, all but forgotten, was remembered only to reaffirm technical procedures that, invariably, had come from library science sources. This confirmation leads us to agree with Camargo (2000, p.2): "despite the theoretical configuration and formalization of the methods used today, as a scientific discipline, archival studies continue to be seen as a practice based on experience, where even the exercise of good old common sense, also referred to as tacit knowledge, is exercised."[1]

This article reflects on the archives produced and maintained at a biomedical research institute laboratory and establishes their relation to the archival theory concepts, methods and practices available for treating this collection of documents.

In a study carried out at the Laboratório de Genômica Funcional e Bioinformática (Laboratory for Functional Genomics and Bioinformatics) of the Instituto Oswaldo Cruz (Oswald Cruz Institute; IOC), a technological and scientific unit of the Fundação Oswaldo Cruz (Oswaldo Cruz Foundation; Fiocruz), we observed documents being created, document types, and the practices for maintenance and use of the records kept there. To this end, we assumed that the records management models and instruments hallowed by archival science were impregnated with assumptions from historical research or memory. They are simultaneously imprisoned in a technical rationality aligned with empirical organizational practices that encounter the more complex archival reality and lead the discipline to turn its back on its foundations, relieving it of its scientific statute.[2] To analyze the organization of science in the scientists' domain – the laboratory – we used the conceptual instruments of the sociology of science, which in its different approaches serves as a reference for understanding scientific activity.[3]

Modern science is governed by a model of rationality that began with the scientific revolution in the sixteenth century and developed in the following centuries, principally

in the domain of the natural sciences. Objective ideas lead to observation and experimentation, and by starting with them one can achieve a deeper, more rigorous understanding of nature. Mathematical ideas are the center of modern science, and two consequences result from this fact: first, to understand means to quantify; second, the scientific method is based on the reduction of complexity (Santos, 2002, p.14-15).

The experimental sciences are not representative of all scientific fields, but the cognitive structures they value correspond to a 'social experience' specific to the context of the sciences. Among the structures referred to by Isabelle Stengers (2002) is the laboratory, a place that gives meaning to the standards of objectivity present in modern science.

In Brazil, experimental laboratory science in the field of bacteriology and the knowledge it makes possible dates back to the last quarter of the nineteenth century (Benchimol, 1999). The first steps of modern medicine and bacteriological research in Brazil began in the first years of the Republic, in São Paulo, with the creation of the Instituto Vacinogênico (Vaccinogen Institute) in 1892, and the Instituto Bacteriológico (Bacteriological Institute) in the following year. In the same period another institution – which fulfilled a central role in the introduction of microbiology among us – the Instituto de Manguinhos (Manguinhos Institute) – was created. Founded in 1900 and led by Oswaldo Cruz beginning in 1902, the Instituto Soroterápico Federal (Federal Serum Therapy Institute) – later called Oswaldo Cruz Institute – was the beginning of an important center for experimental medicine. More than this, it enshrined the laboratory as the proper place for generating legitimate, relevant knowledge in Brazil, by combining scientific research and training of future professionals in the same environment (Benchimol, 1990). The Oswaldo Cruz Institute established a tradition in biomedical research that, according to Nancy Stepan (1976, p.21), formed the basis for the development of biomedical sciences in Brazil from the first decades of the twentieth century to present times.

The biomedical research performed today in Fiocruz laboratories represents an inheritance from the microbial theory formulated by Louis Pasteur at the end of the nineteenth century, provoked a revolution in medicine and biology and gave rise to a tradition of scientific research. In the last three decades of the twentieth century, biotechnology underwent unprecedented advances, with the development of techniques that allow direct manipulation of the genes of live beings. These new techniques, which we now call genetic engineering, are the most successful result of the knowledge created by molecular biology over a half century (Azevedo et al., 2002, p.140).

This article is divided into three parts. In the first, we provide a panorama of the literature on what we call scientific archives, produced based on experience in archives resources from public and private research, technological development and teaching establishments. In the second part, we address the general sociological investigatory approach to biomedical science and the institutional history of the laboratory. In parallel, we identify the context of the introduction of a quality system at Fiocruz in the technological research and development environment and its relationship with production and records management. Finally, in the third part, we present the data collected in field studies and interviews with researchers in the Laboratory for Functional Genomics and Bioinformatics, in an analysis founded on archival theory.

Archival studies and the archives of scientific institutions: the problem and approaches

According to Elio Lodolini (1993, p.24), an archival document is one produced during an administrative activity, in the broadest meaning of the term. Also, according to Lodolini, not all documents have archival character and not every collection of documents constitutes an archive. The texts generated by scientific activity, for example, would be excluded from the traditional concept of archival documents. This view is stated in a passage in *Archivística*, a classic work by Lodolini, which describes some elements essential to the development of this study: "the narration of a chronicle writer or the manuscript of a literary or scientific work, due to the fact that they were written from the start with the scientific purpose of transmitting news or *expressing the thoughts* of an author, are not archival in character" (p.24; emphasis added).

By continuing the dialog with the fundamental formulations of archival studies, we question how we can update them without compromising their basic principles. Indeed, we must ask: are the documents generated by the activities of an institution the embodiment of the fact or the fact itself?[4] Can we transpose this question for the activities of a scientific institution? Are the documents generated by scientific activities the embodiment of the fact or the scientific fact itself?

In the classical definition, an archive is a set of documents that, regardless of their nature or form, are collected during the activities of individuals or public or private legal entities and preserved due to their value. According to Camargo (1994), with the introduction of the word value we create a problem: what value? It would be equally legitimate to ask: are archival studies compatible with document appraisal practices?

Camargo (1994) stresses that the origin of archiving is the preservation of authentic acts as proof and refers to Bruno Delmas (1987) to reaffirm that this notion of proof continues to evolve and broaden. The successive broadening of the act of archiving, to beyond authentic documents, was due to a type of extension of the domain of proof to that of memory, of reference sources and information.

The presence of archivists in the environment producing documents generated by scientific investigation is a recent reality on the international scene. According to Odile Welfelé (2004, p.66), one must bring together producers (researchers in the sciences) and archivists with backgrounds in these areas, given that interaction between them would be affected by any lack of knowledge – or even total incomprehension – of the needs, work methods and wishes of the protagonists.

At the end of the 1980s, the first texts on what we call scientific archives appeared[5], many of which were produced based on experience in managing documentation sources of public and private research and teaching establishments.

Scientific tasks and activities take place in a unique environment – the laboratory – where the documents unique to this human endeavor are created, used and preserved. The knowledge of these activities and the documents produced by them require the archival approach, based on the theoretical principles and methods of the area. The archival problems created by this human activity carried out in scientific institutions stimulate reflections that we will explore below.

In France, among the many initiatives to identify and preserve scientific archives, the Archives Issues des Sciences Contemporaines (Arisc) is the most interesting. Active since 1993 and focused on organizing archive services in laboratories, the program reflects on the forms of producing documentation during the contemporary scientific process. Located at the Centre National de la Recherche Scientifique (CNRS), an organization that encompasses various fields of science and has a decentralized structure, Arisc allows study of central research management, laboratory operations, intermediate structures (the research teams) and even return to the initial level: the researcher, the engineer or the technician.

The French include all archival sources that allow study of the evolution of scientific research and teaching policies, the evolution of an area, or even the role of this or that scientist in the development of knowledge, in the definition of scientific archives. The definition is broad and allows us to distinguish three categories of archives: (1) the documents of the research and teaching establishments that, in France, are located in the ministerial archives and allow study of planning and management of the public policies in the sector; (2) the archives of the research and teaching establishments themselves, either from administrative services or institutes, research centers and laboratories; and (3) the personal papers of scientists, generally considered by their owners to be private archives, even if the essential aspects of their research activities were carried out as employees of a public research or teaching establishment; they allow study not only of the role of the scientist in the progress of knowledge, but also his family, intellectual and social ties (Charmasson, 1999, p.13-14). We can add a fourth category of archives related to science, those that bring together the records of scientific companies and associations, such as academies of sciences, privileged locations for the 'militancy' of savants in Europe since the end of the eighteenth century.

According to Welfelé (1999, p.109), the laboratory is the missing link in the chain that connects the institutional and personal spheres. She claims that we find the archival materials of science in laboratory documents, and that is where science develops and transforms itself. If, on the one hand, the archives of ministries and other agencies preserve a portion of laboratory activities – including reports, research plans, financing requests, etc. – it is in the laboratories that the daily activities that create documents, such as protocol notebooks, take place, and these only exist there. As a workplace in a scientific institution, the laboratory has a unique characteristic: it is simultaneously the location of production and preservation of documents.

However, laboratories have common characteristics in all areas of science. They are designed, created, possess material structure, buildings and equipment, and have a hierarchical authority, the head or director. They are peopled by the scientists conducting their investigations, interacting with higher entities, teaching institutions and associations. At the same time, they are in contact with industry, given that they develop products or technological processes for the market (Barbat, 1999, p.132).

What is the relationship between the personal archives of scientists and laboratory archives? According to Thérese Charmasson (1999, p.14), the first are similar to and can be confused with laboratory archives, especially when their owners are in laboratory or group leadership positions. This generates many difficulties in establishing a formal

distinction between personal and institutional documents. Until the start of the 1970s, is was difficult to differentiate the papers of the laboratory from those of its founder, mentor or person responsible for its creation as a center to attract researchers and students. Up until then, there was usually a leader or 'guide' – in some cases the founder of the discipline – who left his mark on the work of his colleagues, and who also produced the documental materials of science. From that point on, science changed and this figure slowly disappeared.

The new format, based on large teams of specialists, often located in different locations and working on complex research topics, marked the advent of 'big science' in the second half of the twentieth century. With it, the personalization of scientific work disappeared. According to the authors of the American guide for assisting archivists in evaluating scientific and technological documents (Haas, Samuels, Simmons, 1985, p.21-22), big science is characterized by large, interdisciplinary projects carried out by teams of researchers and by the integration of science and technology in academic and industrial, government and private institutions.

Even recognizing this shift in science towards depersonalization and greater professionalization and specialization of laboratory work, the laboratory still remains as a locus of affirmation of trajectories, by delimiting power and scientific authority and ensuring the training of employees and professional teams capable of continuing the projects and teams. We can affirm that research teams are still organized to work on a specific project, generally managed by a scientist – the principal investigator or team leader.

The line of interpretation that identifies an overlap between scientists' personal archives and those of the laboratories they head (Charmasson, 1999) must be considered in perspective, defends Welfelé (1999, p.105). According to this author, the laboratory houses a set of structured archives related to operations and these include folders on management of personnel, materials, financial resources and infrastructure. Also, in her opinion, the director of a laboratory, especially a large laboratory, has a secretary who centralizes his correspondence and the scientific and administrative activity reports.

In the French tradition, the works of Odile Welfelé stand out due to their original combination of sociological studies and the philosophy of science, with an innovative perspective of archival studies. Traditional archival studies, suggests the author, may be out of step with the reality of contemporary scientific practices and, therefore, should consider current science "while it is made, and full of controversies" (Welfelé, 2004, p.67). Research activities produce paper, of course, and this is its most important objective. However, it also produces other materials: cell cultures on slides, collections (of insects, genotypes, fungi, etc.), machine tools, prototypes, databases, maps, images and films. However, a large percentage of scientists only consider documents worthy of conservation and the results of scientists' work in the form of articles or reprints. The final publication of the results is still the only evidence and the only compilation of information that acquires the status of reference document. The value that, to the scientist, justifies the preservation effort comes from use and scientific interest. If a research project ends and others are started, only the elements required for continuity of the work should be stored (Welfelé, 2004).

A second line of thinking, in the American tradition, is expressed in the works of Helen Samuels (Haas, Samuels, Simmons, 1985; Samuels, 1995). Differing from the French approach, the author proposes what is called an institutional functional analysis, a classification method which treats assessment as the main issue in archiving and focuses on the "documentation actions" of contemporary science and technology, an aspect that is also analyzed by French authors.[6]

Together with Joan Hass and Barbara Simmons, Samuels undertook a study with the Massachusetts Institute of Technology (MIT) as a reference. This resulted in the manual *Appraising the records of modern science and technology: a guide*. This manual describes the results of an extensive project encompassing identifying and systematizing the activities of science and technology and the documents generated by them. The work also discusses the interventions that the archivist intends to introduce into the sites – the laboratories – where these activities are carried out. However, this manual is part of the debate on laboratories as places for production and accumulation of institutional archives, though historically marked by the presence of the scientist, the lead researcher, with a tendency to personalize the collections generated in these environments.[7]

Samuels' (1995) studies focus on the stages of technological research and development in the laboratory: selection of the problem, formulation of hypotheses, conducting of the experiment, patenting and publishing. However, the distinction established between professional activities (teaching and administration, consulting and professional affiliations) and science and technology activities, creates compartments where there are none or brings together things that do not naturally belong together. Our perspective differs from that of Samuels. We believe that scientific and technological activities are also professional activities, and that there is more tension than complementarity between science and technology. In some institutional environments, especially universities, research is not necessarily linked to the development of technological applications. Finally, Samuels mentions another relevant aspect: scientists and engineers do not work in a vacuum. They depend on networks of peers and administrators and communicate with them. This complex environment of internal and external associations mean that the archivist must take into account a universe of interconnected documents (Samuels, 1995).

In Brazil, there are few studies on archives generated by scientific activities.[8] Among these, the work of Verônica Martins de Brito (2002) stands out. It addresses the topic of scientific and technological memory and its preservation in the institutional context of Fiocruz, based on the concepts, practices and intentions of the researchers interviewed for the study. The author begins with the concept of scientific memory – whose central nucleus is the archives – and, in dialog with the French and American literature on the topic, performs an important inventory of aspects of the thoughts of the scientists regarding the records they produce and records management that institutions could implement.

Later, Maria Celina Silva (2007) analyzed the relationship between scientists and the documents produced in their laboratories, in order to extract elements for definition of a plan to preserve the archives of science and technology. The broad survey, performed through interviews with laboratory researchers at research institutes of the Ministry of Science and Technology in Rio de Janeiro, allowed the author to produce the first systematic

work on the archival reality in the area.[9] It also probed deeper into questions about the boundaries of the personal and institutional dimensions that affect the production and collection of these documents, and the viewpoint of the scientists on the importance of the document archives for preserving a scientific memory.

The files and documents of biomedical science: between wet and dry laboratories[10]

New perspectives indicated by social studies of the sciences, especially in the areas of history, philosophy and sociology, have awoken interest in biomedical laboratories. Beginning in the 1970s, ethnographers of the laboratory began to observe the experimental practices of modern science, located almost always, if not exclusively, in laboratories. They focused on themes such as the creation of local, contingent knowledge, the importance of acquiring and transmitting specific skills, the role of inscriptions and the impossibility of encoding – and, consequently, analyzing and transcribing – all scientific tasks. Several of these new ethnographers observed biological, biochemistry or physiological laboratories. These studies considered biomedical laboratories to be representative of the general 'scientific laboratory' and not a specific location for affirmation of knowledge or practices. However, they did permit the creation of a collection of observations of the experimental practices of biomedical scientists (Löwy, 1994, p.234).

According to Ilana Löwy (1994), the historians of science began to investigate experiments and returned to objects such as the study of inscriptions (laboratory notes, research projects, graphs, drawings and photographs), scientific instruments, measurement devices, calibration and standardization techniques, and the transmission of knowledge, tacit skills and laboratory cultures.

These laboratory studies made some of the most original contributions to the sociology of science and became a mandatory reference for almost all later work. The book *Laboratory life* by Bruno Latour and Steven Woolgar, published in 1978, was a radical departure. Without proposing a description or a social explanation of the sciences, it approached scientists with an eye so foreign to their culture (including that of social scientists) that it 'omitted' the only question that they (and social scientists) consider essential – that of the knowledge produced, the content, the sense that emerges from the debate of ideas between the actors (Latour, Woolgar, 1997). The microscopic, unique character of Latour's field research is one of the most innovative aspects in addressing science, as it differs from former studies of a historiographical and/or sociological nature based strictly on textual sources, without direct, live observation of scientific practices.

In subsequent work, Latour (2000) changed his focus to beyond the scientific environment, profoundly marking this line of research. The focus is characterized first and foremost by the desire to understand the efficacy of science in action, and understand how laboratory practices have come to influence the world and transform it. Thus, Latour 'left' the laboratory and sought to understand how the scientific and technical world and society (re)define themselves and, at the same time, (re)build themselves. It is no longer just in the laboratories that we seek the secret of knowledge and its validation, but also in the retakes and translations that operate on society as a whole (Pestre, 1996, p.12).

Management of science and technology: laboratory quality systems

Based on the theoretical perspectives and methodologies of archival studies, and having established the reflections of the history and sociology of science, we now focus on a biomedical laboratory in the area of molecular biology.

The origins of what is now the Fiocruz Laboratory for Functional Genomics and Bioinformatics date back to 1987. What was then the Laboratório de Biologia Molecular e Doenças Endêmicas (Laboratory for Molecular Biology and Endemic Diseases) was the first laboratory in the Department of Biochemistry and Molecular Biology (DBBM), created in 1980 at the inspiration of the researcher Carlos Morel.[11] In 1983 it was accredited by the Oswaldo Cruz Institute as the Laboratório de Biologia Molecular e Diagnóstico de Doenças Infecciosas (Laboratory of Molecular Biology and Diagnosis of Infectious Diseases), and ten years later was renamed to its current name.

The laboratory reconfiguration process intensified at the end of the 1990s, and the projects focused increasingly on functional genomics.[12] Starting in 2001, the bioinformatics area was created and the laboratory began to house three technological platforms related to the Fiocruz Programa de Desenvolvimento Tecnológico em Insumos para a Saúde (Program for Technological Development of Health Supplies; PTDHS).[13]

In the last two decades, in the context of the propagation of neoliberal policies and the growing internationalization of the economy, we have seen a global trend towards modernization of public research institutes. The purpose of this is to manage the greater complexity, interdisciplinarity and cost of research, as well as increase innovative efficiency and capacity, in order to achieve practical results for society with greater frequency and impact.

The concept of science using procedures and standards that ensure reliability in the research and technological development process is a part of this broader management framework, anchored in planning, monitoring and evaluation instruments. Among these instruments, the most important is the Quality System, adopted by public and private institutions for managing processes, including laboratories and research and development institutes.

At Fiocruz, reorganization of the structures for health care research and services for the purposes of certification, including hundreds of laboratories, is a recent process. In 2002, as part of a series of initiatives by the institutional program on Reference and Environment Services, a set of requirements necessary for internal recognition of disease diagnostics reference laboratories was approved.[14] With this perspective, the laboratories were involved in implementing a quality management system including definition and implementation of document control activities.

As a result, the Programa de Gestão da Qualidade em Pesquisa & Desenvolvimento Tecnológico (Program for Management of Quality in Research and Technological Development) was implemented. The objective of its management procedures and practices is to guarantee that laboratory activities, services and products comply with quality requirements and with related criteria, such as biosafety. The types of documents used in this program are classified in accordance with their characteristics and their different uses, while the institution determines the sectors in which each must be used and implements

control and monitoring mechanisms. In the Fiocruz institutional program, the Standard Operating Procedure (SOP) is an important element. It is defined as the "Quality System document that describes the method for implementing a specific activity, attributing responsibilities to groups, subunits and organizational units" (Fiocruz, undated).

Implementation of this program at the institution has been modular, and PTDHS has served as an implementation pilot for the laboratories that integrate technological networks and platforms. Thus, we saw a tendency to obey the procedure in the various laboratory activities related to quality, confidentiality of information, biosafety and environment, among other aspects, with the goal of Quality System certification.

The documents of a biomedical sciences laboratory

The data collected through direct observation of the Laboratory for Functional Genomics and Bioinformatics and interviews with its researchers were analyzed, guided by the following questions: which types of documents have we identified? Are laboratories spaces that serve or submit to the normalizing and regulating presence of archival studies? How can we appraise the documents generated by research? Do the records produced by science in the laboratory represent a 'personal science'? Are they comprehensible to 'non-scientists'? Which components of archival knowledge could manage this reality?[15]

For the purpose of analysis, the set of questions asked in the interviews were grouped under three main topics, namely: creation, current use, organization and storage of documents; limits between the institutional and the personal; documents as records and memory of institutional action. I address these themes here taking a specific type of document as my principal reference for analysis: the research protocol notebook.

Questioned about the documents they create and/or use in their research activities, scientists and technicians mentioned a diverse array of types of documents organically linked to the different steps of the investigatory process. In this context, the data relating to protocol notebooks and articles show they are clearly the most important. With respect to the first, its daily, routine utility for workbench work and occasional use when preparing reports of results, especially articles, should be noted. However, in the competitive world of the sciences, articles still represent the text created individually or collectively in a confidential environment, and necessary because it records novel data and results. At the same time, we can identify the tendency towards the disappearance of intermediate versions of articles, since researchers only store an electronic copy of the final version sent for publication and/or published.

Table 1 shows the types of documents cited and the respective percent of researchers who mention them:

The four types most often mentioned play a central role in the different stages of scientific work, which, according to Helen Samuels (1995), we can divide into: (1) research planning and management; (2) research development; (3) communication and publication. Thus, while plans pay an important role in stage 1, protocol notebooks are more important in the second stage and articles and reports in the third.

Table 1: Types of documents at the Laboratory for Functional Genomics and Bioinformatics/Fiocruz: mentions by researchers and technicians

Type of Document*	**Mentions** (%)
Protocol	63,6
Article	54,6
Report	54,6
Plan	36,3
Research note	18,2
Paper	18,2
Catalog	9,1
Memory	9,1
Standard	9,1
Poster	9,1
Certificate	9,1
Declaration	9,1

*As per definitions proposed by Belotto, 2008.

Protocols or laboratory notebooks, according to Welfelé (1998), are objects that perfectly symbolize scientific research, but are not necessarily archived. A study carried out in a physics laboratory led the author to describe the many characteristics of this unique document, considered a personal object, written by hand, with chronology and in a format that acts as a way to record the time passed. Welfelé's reflections address a supposed comparison that both she and we judge to be unfounded. We refer to the attempt to establish a parallel between the laboratory notebook and a literary manuscript, a point which will be addressed below.

The only document covered by a standard or procedure in the Laboratory for Functional Genomics and Bioinformatics is the Record Book (Green Book), which functions as a protocol notebook for projects related to the PTDHS. Created under the Program for Management of Quality in Research and Technological Development, together with researchers, the goal of the SOP is to guide experimenters (researchers, scientists, technicians, grant-holders, students and interns) "in the use and care of record books, to maintain traceability of the data generated in experimental laboratory work at the institution" (Fiocruz, 13 jul. 2007, p.1).

In an interview, the researcher at the Functional Genome Laboratory and coordinator of the Fiocruz Research and Technological Development Infrastructure Promotion area noted that the creation and mandatory use of the Record Book (for experimentation) are fundamental to the contemporary scientific work process, due to its daily use and the element of proof of its documentary records:

> So, you look in the freezer: "that little tube from three years ago is labeled 24, but I no longer know the concentration, the source." So this no longer works for today's research. And, needless to say, the Record Book officially belongs to the institution. If a person leaves, they can copy it, but they cannot take it. And, in the laboratory, normally everything is noted down, though with differing degrees of precision. What we did was... in that black book... Now, then, we have standardized a bit, to make things easier.

Among the researchers, there is an understanding that this document is created, used and archived based on a set of procedures inherent to archive documents and compatible with the parameters of contemporary science. It has evidentiary value. In the description of the process of its creation and use, we see the general conditions that establish its purpose:

> The purpose of the record books is to maintain operational records of research and technological development activities, with the intention of recording all experiments, results and datasets created by these activities. ... allowing tracking of the full history of the scientific experiments, even in the absence of the experimenter, and proving experimental execution for the purposes of intellectual property or other reasons that arise (Fiocruz, 13 jul. 2007, p.2).

Use of the Green Book (for experimentation) is mandatory for all experimenters, who must strive to safeguard it and keep it updated. It is considered the property of Fiocruz. Although still restricted to PTDHS platform projects, its use represents a new way of working and adoption of the Program for Management of Quality in Research and Technological Development, even though not consensual.

The Green Book and the Bordeaux Book (management) were created for use by all Fiocruz laboratories, both those dedicated to research and those that combine research with provision of reference laboratory services, such as for diagnostic exams.[16] However, there seems to be a tendency on the part of the researchers to not follow the rules of the standard because they feel they impede scientific work. From their perspective, experimentation does not obey rules, even though one should always record anything new in the notebook. The following extract from one of the interviews illustrates this aspect well.

> I love the sensation of going to the workbench... with the protocol in my head... some things do not need to be memorized. The composition of a solution... these are all things that you look at, calculate on the fly, go, weigh and do. But I love the sensation of going to the workbench to do an experiment with almost no guidelines on how I must do it. Most of it I already know. I will have noted anything new and I will follow that carefully, but I love to collect a bit of this and that and do something that should result in something new. So, I think that this aspect of research will never change.

The Green Book is a research protocol book for laboratory projects. However, its possible advantages are minimized by the researchers' philosophy, since most of them prioritize the experiment log together with the use of the computer and/or personal notebooks with their own formats.

In the domain of personal decisions, the most popular is the protocol notebook free of the imposition of standards from institutional programs that seek quality standards and process control and are not always amenable to the scientists. The French call it the *cahier de laboratoire*, used in daily scientific work, a transcription of experiments and a distinct, immutable object (Welfelé, 1994, p.2). This document is called a laboratory notebook to differentiate it from the field notebook, used in the social sciences (archeology, ethnology, sociology, anthropology, etc.). However, the two notebooks have features in common and obey the rules of writing and preservation of these disciplines. Moreover, it is important to remember that the biomedical sciences also make use of field notebooks, especially those linked to the naturalist tradition of botanists, zoologists and entomologists.

Since it serves as a record of comments and observations made in the field or laboratory, for natural sciences or social sciences, the laboratory notebook or research protocol notebook is mistaken for a literary manuscript, in which the power of creation is fully manifested. The error in this comparison reveals a lack of understanding of the different nature of literary and scientific activities. In archival literature, there are references to 'personal creative archives' that bring together literary, musical, scientific, artistic, photographic, audio, audiovisual and other archives (Escobedo, 2006).

According to the historian Gerald Geison (2002), who examined a hundred notebooks produced and preserved by Louis Pasteur, these documents represent a set of discerning, detailed records of experiments carried out by the scientist and his colleagues during forty years of active, almost daily research. According to Geison, "they are the central reservoir of Pasteur's personal science" and "a very special literary genre" (p.25).[17] Here, we once more find an attempt to establish a similarity between scientific and literary activities, seen in the laboratory notebook treated as a personal diary of the work of a scientist. More than revealing the need to increase studies on personal archives using archival theory, the attempt to find similarities between the activities of a writer and a scientist disregards the fact that the latter, in his professional activities, performs tasks and acts that produce documents in the context of the acts of organized entities and groups. Science is a collective activity, organized in special locations through institutions (Latour, 2000; Latour, Woolgar, 1997); the same does not occur with literature and writers.

The researchers who use the protocol are consciously 'careless' with respect to systematic use of it for recording research procedures, from the protocol used. Note also the following aspects in relation to the notebook: (a) it is always organized in some way, which could vary slightly (one notebook per project, one notebook per researcher, numbered pages, index, etc.); (b) it is frequently used throughout the experiments, daily or two/three times a week; (c) it is consulted during the experiment, when preparing an article or report and, occasionally, to recover a specific protocol written some time earlier; and (d) it contains the researcher's comments, but is used decreasingly for this purpose; this task is increasingly transfered to assistants and students.

Heirs of a research tradition that appears to resist time, researchers, assistants and students do not question the authenticity of this document. After all, they consider the research protocol notebooks authentic – is this a characteristic that distinguishes archive documents?

Authenticity, according to Duranti (1996), is linked to the creation, maintenance, safekeeping *continuum*; the documents are authentic because they are created, maintained and preserved for safekeeping in accordance with regular procedures that can be proven. The author broadens the universe of authenticity to include both documents prepared specifically for an official transaction and those included in it.

The protocol, called the *livro de registro* in the Fiocruz SOP, is an archival document. If we use Duranti's formulation, it would be a "narrative manuscript," a document linked to the investigative role of a university professor or researcher (Duranti, 1996, p.53-54). This category, according to the author, includes the documents that provide evidence of a legally irrelevant activity, whether or not it ends in a legal act or not. In Duranti's view,

these manuscripts are "not legal documents" that result in activities whose nature requires a good deal of individual initiative, revealed clearly in the resulting forms of archival records (p.54). In this respect, we can consider the protocol notebook – governed by a written rule or procedure – a legal document that constitutes written evidence of a legal act. Its evidentiary character, associated with the experimental act that produced results and effects, could turn it into a record. The author herself provides arguments, when affirming that the identification of one document as a record or manuscript does not depend on the nature of the creator (public or private) or on its collective or individual character (entity or person). Rather, it depends on the type of activity that generated it; and, given that an activity is defined by the will that produced it and by the effects of it, a document may be a record or manuscript depending on the will of the person who created it and the effects it was intended to produce.3[18]

The protocol is the document that describes the routines of the research task in its development stage, and serves as evidence of experiments performed, and the data and results obtained. As an archival document, it maintains organic relationships with the other documents in the archives and with the context in which it was produced.

The questions "do you keep documents of a personal nature in the laboratory?" and "if so, are they mixed with institutional documents?" guided the section of the interviews dedicated to understanding the limits between the institutional and the personal. We must establish a distinction between the two questions. The first addresses the difference that researchers establish between documents of a personal nature, that deal with personal topics, and those of an institutional nature, linked to actions of the institution to which they belong. The second refers to a specific understanding that certain documents produced as part of scientific activities are personal because they have a high degree of connection to their producer, the scientist. This viewpoint is evidenced by an extract from one of the interviews: "My viewpoint is that this [the protocol notebook] is personal, but I understand that this is only because I have never had to patent anything. As soon as you want to do something a little beyond... So, I know that my record book is not mine, but my relationship with it, on a daily basis, is that it is mine."

For the scientists, the protocol is – of all the documents produced during their activities – that which best falls under the description of a personal document. It therefore lacks the evidentiary value that is typical of archival documents. Similarly, some archivists consider these notebooks 'intimate diaries' of daily scientific life; most of the time they are individual, and do not represent transactions nor are subject to rules (Welfelé, 1998).

Contrary to this perspective, we noted a tendency to affirm the institutional character of these documents, whose purpose is to record what happened on the workbench as part of the experimental activities of a project, even if they contain (and should contain) notes by the researcher. And the researcher, although part of an institutional group, lives the ambiguities of the scientist, an autonomous agent seeking to generate knowledge, working in an environment that allows him to be an individual, even in the collective, organizational context (Merton, 1957).

Even with what we refer to as the boundaries between the institutional and personal document, it is worth reflecting on the main justifications presented by the scientists to

define the documents generated in the work environment as personal. According to Silva (2007), three of them should be highlighted: they are the fruit of personal effort; there is no institutional standard that regulates them; they will not be made available. On the other hand, some scientists are able to define which documents have an institutional character and which are of a personal nature. There are also those that identify the intermingling of the personal and institutional dimensions in some documents, such as in scientific articles and patents.

Although scientific work depends increasingly on the efforts of a team with differing, complementary skills, the individual character of this activity is incontestable. Thus, we are not necessarily talking about personal documents in the strict sense of the term, but rather documents that show the mark of the individual, if they are not submitted to procedures or rules, even if they are "nominal for each experimenter" (Fiocruz, 13 jul. 2007, p.3).[19] The protocol notebook is an example.

"Which documents should be preserved as the memory of the laboratory's activities?" In the responses to this interview question from scientists in the Laboratory for Functional Genomics and Bioinformatics, the articles and protocol notebooks were considered the most important, and compete for the role of main record of scientific activities. Together, they were mentioned by a little more than 50% of those interviewed. Curiously, no researcher mentioned both documents simultaneously, that is from the perspective of retaining a memory, we identified two distinct views. While the notebook focuses on the daily work in the lab, the article favors the final product.

Production and communication of knowledge are the tasks of the scientist. The principal task, according to the paradigm of Mertonian sociology, is to publish scientific discoveries through formal communication processes. The articles, part of scientific production, fulfill this role and are increasingly associated with productivity and performance indicators in the sciences that intend, through assessment by peers and promoting agencies, to be productive, efficient and socially useful. The other documents mentioned by the scientists in the interviews also fulfill significant roles in the process of scientific work and relate, in some way, to research development activities, communication of results and researcher training. From the scientists' standpoint, these documents have value as elements of proof of what is done in the laboratory and, therefore, can perpetuate a given memory. However, when they are asked to think about the use that historians could make of these scientific records, the concept seems very distant to them. The preservation value they attribute to this material is related to the value they attribute to their science, to the science of their group or their institution. In other words, we could see, in the scientists, a certain difficulty in establishing connections between what they produce today, the sum of what they will produce during their careers, and the use that society may find for it.

Final considerations

Nowadays, the classification and appraisal of documents are the keys to archival knowledge, that is, they occupy the central focus of theoretical reflection and development of the methods and techniques of the area. The appraisal of documents should not be

based on intuition or on arbitrary conjectures of value:[20] On the contrary, it must be based on full analysis of the documentation in question as a whole. Analysis is the essence of archival appraisal, because it identifies the evidentiary value of documents.

In the opinion of Duranti (1994b), there are appraisal risks that are unavoidably directed at the content of archival documents that have certain characteristics. The author defends the idea that appraisal should only be based on the internal functionality of the documents and of groups of documents, on their interrelationships, so that "compact, meaningful, economical, and impartial societal evidence can be preserved for the next generations" (p.341). Archival theory assumes that an archive consists of all the documents created and received during an intentional activity and the relationships between these documents, asserts Duranti. Since the circumstances of creation give archives certain inherent characteristics necessary for preserving their evidentiary role, one question remains: if the archivist is responsible for preserving the full, complete archive, how can he reduce this archive to a manageable size without affecting its integrity and full meaning?

Appraisal has increased in relevance and is understood to be a main problem in archival theory and practice, but its solution is irremediably tied to a research effort on methods and techniques applied to the organization of the documents in the current stage. The establishment of a framework that includes functions, activities and the creation of documents in the laboratory may employ Samuels' formulations and be perfected in an applied project (Samuels, 1995). In this respect, I share the perspective that begins with the understanding of the structure of the producing entity, skills, positions and activities to arrive at a typology of documents. Following this line of reasoning, there is no need to identify the subjects of the documents and define codification and filing systems, but rather establish the cartography of contexts and organic relationships that characterize a given set of documents.

When dealing with the archives of scientific institutions, especially those produced in laboratories, we come upon some documents resulting from a practical activity that, even if they comply with the procedural requirements, have strong ties to their creator and a given action. Thus, in addition to the particularities of scientific work and the relationships scientists establish with their activities and the products of these activities, the uniqueness of the management structures and the laboratories' interconnections require a deeper analysis that, in my opinion, has not yet been done using archival methods. These reflections, however, should begin with questions that do not compromise the analysis of the archives, uncontaminated by any attributes foreign to them or that affect their status as archives.

NOTES

***** This article is based on the chapter "Archival studies and science archives: the problem and approaches" from my doctoral dissertation, submitted to the Universidade de São Paulo (Santos, 2008).

[1] In this and other citations from texts published in other languages, free translation is used.

[2] Ana Maria Camargo (2000, p.3) proposed a plan combining valuing of theoretical knowledge with a utilitarian understanding applicable to the "complex, unstable and sometimes conflicting universe the archivist must deal with in his daily work."

[3] We refer to the line of research inaugurated by Robert Merton (1957, 1970, 1974) and the studies on laboratories, especially those undertaken by Bruno Latour (1983, 2000; Latour, Woolgar, 1997).

[4] When discussing the characteristics of archive documents and their "unique evidentiary power", Ana Maria Camargo (2003, p.11) refers to Luciana Duranti (1994b), for whom the document is the embodiment of the fact, and to Angelika Menne-Haritz (1994), for whom the document is the fact itself.

[5] Camargo (2006, p.13) does not agree that the attribute 'scientific' can be applied to an archive, claiming that the expression is inadequate. According to her, one cannot define an archive as being literary, artistic or 'repressive,' because these qualities only apply to it by contamination. Thus, it would be more appropriate to call them "archives of interest for science or for the history of science."

[6] According to Ana Maria Camargo (2006), documentation strategy consists of a type of mapping of active institutions, with the dual goal of determining the activities that, even though they exist, do not produce documents, and those that, 'nonexistent,' should be recorded and documented. According to the author, while this effort of anticipation could be seen as meritorious from several viewpoints, it is contrary to the attribute of naturalness traditionally associated with archives (p.16). Thus, the act of documentation is not similar to the daily functions and activities of an institution that generate archival documents.

[7] The concept of personalization was developed by Pires-Alves (199?) to address sets of documents collected by researchers based on a logic that combines individual and institutional characteristics and that, nevertheless, reveal an organic character clearly connected to sufficiently precise archival contexts and institutional spaces. In research laboratories, we commonly find the laboratory archive alongside the 'research archive,' including both personal and institutional materials.

[8] Studies on scientific archives include Brito, 2002, Santos, 2002, Encontro..., 2006, and Silva, 2007. It is worth mentioning the existence, in 2003, 2005, 2007 and 2009, of the first Encontros de Arquivos Científicos, coordinated by Museu de Astronomia e Ciências Afins (Museum of Astronomy and Related Sciences; Mast) and the Casa de Rui Barbosa Foundation. These events represent an effort to reflect on the theme and create a network of universities and scientific research institutes with mature or maturing projects in the area of archival studies.

[9] The work of Silva (2007) included about one hundred laboratories from seven institutes.

[10] The expressions wet laboratory and dry laboratory were used by laboratory researchers in the area of bioinformatics to differentiate *in silico* experiments performed in the dry laboratory (on the computer) and *in vivo* or *in vitro* experiments in the wet laboratory – that is to say the actual workbench, where experiments using reagents, materials, equipment and test animals take place.

[11] After graduating from the Federal University of Pernambuco, in 1967, Carlos Morel interned the following year at the Molecular Biology Laboratory of the Biophysics Institute at the Federal University of Rio de Janeiro, as part of the graduate course in sciences (biophysics). That same year, he entered the University of Brasília (UnB), where he acted as visiting professor and junior professor (1968-1972) of the School of Health Sciences and assistant professor and associate professor in the Department of Cellular Biology of the Institute of Biology (1972-1978). In 1974, to obtain a doctorate in natural science (biophysics), he submitted the dissertation *The metabolism of messenger RNA in animal cells*, defended at the Institute of Biophysics at the Federal University of Rio de Janeiro. In 1978, already at Fiocruz, he began organizing a research group in molecular biology consisting of foreign scientists and young Brazilian researchers recruited at the universities and sent for training in scientific research centers abroad. In 1980 he created the Department of Biochemistry and Molecular Biology, linked to the Oswaldo Cruz Institute.

[12] Functional genomics is one of the Oswaldo Cruz Institute's research areas. It is an area of genomics, the science that studies the genome of organisms through sequencing, with the objective of understanding its structure, organization and function. It uses the data generated by the Genome Project in studies of physiological genetics. Bioinformatics is an area still being consolidated in the area of biological research. It proposes using, organizing and analyzing the biological information generated by DNA sequencing. In particular, it includes organizing biomolecular databases using software to analyze and compare the information generated by sequencing. On this topic, see CIB, undated.

[13] Designed as an instrument to promote technological development, the PTDHS consists of 11 technological platforms and seeks to promote multidisciplinarity through cooperative networks, with the goal of generating products, processes and services that impact public health and economic and social development in Brazil. It also intends to act as an agent to change institutional cultures, overcoming

fragmentation by establishing connections between applied research, the production of health supplies and technological management.

[14] The NBR 14500:2000 standard defines the reference laboratory thus: "a clinical laboratory of excellence, recognized formally by a scientific entity, whether national or international, governmental or private, used to verify laboratory results" (ABNT, jun. 2000, p.3). Good Laboratory Practices are the "quality system encompassing the organization of and conditions under which laboratory and field studies are planned, carried out, monitored, recorded, reported and archived" (Inmetro, dez. 2000, p.5). On the relationships between archiving and quality management systems, see Cardoso, Luz, 2004.

[15] We interviewed 11 laboratory employees, including researchers, scientists and graduate students. We employed the questionnaire given to CNRS researchers in France, under the Arisc Program, as a basis for our survey. On this program, see CNRS, undated.

[16] The Green Book is for recording experiments carried out during the research process, while the Bordeaux Book is for recording the different research project management activities, such as purchase and maintenance of equipment (Fiocruz, 13 jul. 2007, 24 nov. 2008).

[17] When defending the importance of research in laboratory notebooks, Geison (2002, p.28-29) affirms that this does not mean agreement with the viewpoint that these personal documents allow direct access in some way to the 'true' work of the scientist. According to the historian, even laboratory notebooks are incomplete vestiges of the scientist's activities, which remain mostly tacit, unobservable and only deduced from annotations, many of which are difficult to decipher and interpret.

[18] According to the American archivist Schellenberg (2004, p.269), the term manuscript, in the more restrictive sense, only includes documents written by hand or typed, whereas the term records is generic and applies to all types of documentary material.

[19] The Fiocruz SOP for "Uso do Livro de Registro" (Use of the Record Book), for experiment books, indicates that they "are nominal for each experimenter or occasionally for each project, as appropriate" (Fiocruz, 13 jul. 2007, p.3).

[20] For an analysis of the attribution of historical value to documents and the distinctions between archival and historical approaches, see Camargo, 2003.

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