The Culture of Research in History of Science as Seen through the Transformations of the *Isis* Bibliography in the 20th and 21st c.

Stephen P. Weldon
University of Oklahoma, Norman, USA

I want to call your attention to this photograph that I took the other day from the roof of my hotel. This image of Athens illustrates something that I think is important to keep in mind. We are all historians here, and although we continually spend our time thinking about the way that historical forces change our subjects, we don't always have the same perspective about how historical forces change us. This photograph shows the city of Athens remarkably changed by the twenty-first century. The ancient Acropolis rises above the modern city. In the foreground, a billboard advertising modern apparel. There are dish antennas on the roof that situate us clearly at the beginning of the new millennium.

But this picture is more than simply an image about change over time, it is a snapshot of how the world has come to be populated with the historical remnants of the past. The Parthenon remains dominant in this city, albeit its nature has entirely changed from classical times.

The past remains with us alongside the present, and it continues to inform the present in important ways. The image of a city with its past and present intertwined is the metaphor for this paper. It helps us think about the radical transformation of our scholarly world currently taking place, namely the digital revolution. We tend to focus on the transformational aspects, but the digital revolution is not an entirely new place: it exists as part of a culture with a deep past, transforming it, to be sure, but also deeply affected by it.

The past is continually refurbished in the present, and that keeps that past alive alive in the modern world. This next photograph shows a workman sanding a repaired area on a stone column in the Parthenon. He is standing on metal scaffolding and using an electric grinder, and these allow him to do the work of preservation.

Modern equipment makes it possible to keep the past prominent in our world.

As I discuss the development of history of science, keep in mind this metaphor that old ideas and forms are often consciously maintained in order to make them do work for the present. We historians are doing the same thing as the workmen on the Parthenon.

Scholarship as we know it today has its roots in the distant past, in the medieval universities where texts were translated, copied, and maintained primarily in monastic libraries and later universities. Individuals would have some access to books, of course, but not until the advent of printing was there anything like the kind of scholarship that we encounter today. The flood of information that arose with relatively inexpensive book production resulted in a type of anxiety that we find all too familiar: "the information glut."

Though we tend to associate this information glut with the 20th century, historian Ann Blair has shown that the anxiety was prevalent in earlier days when people compared their feeble brains with the totality of accumulated writing and complained of "too much to know"—which is the wonderful title of her book. (Indeed, this feeling seems to go far back in history. Blair documents it in ancient and medieval times across several literate cultures, Greek, Arabic, and Chinese.) (Blair, 2010)

The problem of "too much to know" became particularly acute when publishing made more and more literature accessible to scholars, making it harder and harder for one person to both find and recall the mass of textual material that existed. So various kinds of reference works came into existence, from encyclopedias, to compilations of book excerpts, to indexes and classified listings of books. Thus, was born the reference book as a partial answer to the overabundance of literature arising from the printing revolution.

A creature of demand, these books were produced by scholars who would then send their compilations to publishers. The result was a growing industry of quick reference guides that would help scholars get at the hard-to-find and hard-to-remember material. In these early days, these reference books were, according to Blair, mostly used by scholars, often times surreptitiously.

The early years of reference books contrast markedly with the conditions of modernity in which we find a very different constellation of players and a new set of values governing the rise of scholarship. In the nineteenth century, bibliographies became standard tools, integral to the process of research and documentation. No longer did scholars simply use these books to take short-cuts through major works of literature. Now bibliographies were means of regularized discovery in themselves. (James, 2000; Lowood & Rider, 2000)

Probably the most important aspect of this new outlook was the re-centering of scholarship as part of professionalized disciplines. Professionalization and disciplinary formation created conditions in which different areas of research were divided from one another. Specialization was a central component of this new culture. One way to think about specialization is to consider it as something that can help people deal with the modern information glut. With specialization, professional scholars could focus on a small set of literature so that they could more easily master it.

This newly professionalized environment had several features. First of all, it was institutionally situated primarily in universities. This was a period in which the university and the research institute were coming into their own as the centers of what we might call "scientific culture." Second, professionalization came with a particular ethos. Max Weber defined this ethos in a widely reprinted work called "Science as a Vocation," in which he explained that professionals were to be disinterested scholars. In their professional work, they were to be disconnected from the political and social world. (Abbott, 1988; Corfield, 1995; Perkin, 2002; Sullivan, 2005; Weber, 1946)

The study of history of science was consolidated into a real discipline at this time. The Belgian scholar George Sarton was one of the most important men in this movement to make history of science a discipline. He understood that for a
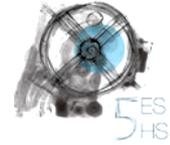
discipline to form, it had to have certain support structures. So he invented these structures. He founded the journal *Isis* and he established one of the first bibliographies of history of science. The development of history of science as a discipline was thus closely connected to a very particular type of reference work, namely the bibliography. (Sarton, 1913a, 1913b, 1913c) It is worth noting that there were at least four major bibliographies arose at about the same time as *Isis*. Indeed, Sarton's work was not even the first. (Kaiserlich Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher & Deutsche Gesellschaft für Geschichte der Medizin, 1902; Josephson, 1911; Sarton, 1913a; Mieli, 1919; Sarton, 1952)

The rise of the discipline took place within the context of social shifts and the production of scholarly tools. The fact that a series of reference tools was available for finding material in the history of science both reflected a desired need to have such a tool, and it helped to unify those people who found this work relevant.

One other thing is important to note. The academic world came to embody a cosmopolitan and internationalist spirit in the first half of the twentieth century. Scholarship since the middle ages had been an international project, with students from all different countries coming to the medieval universities, but in the twentieth century internationalism entered into the profession in a new way. It was perceived as a scientific value, good in itself, and it was believed to be an outgrowth of science. (Crawford, Shinn, & Sörlin, 1992; Greenaway, 1997; Gregory, 1944; "The Members' Vademecum," n.d.)

The idea that science could transcend national divisions brought it into the forefront of international politics. As an example of this, a number of important scientists were appointed to head major international programs like the World Health Organization and UNESCO. There is a wide literature on scientific internationalism. My claim is that this internationalism transcended scientific communities proper and influenced scholarship more generally. One can see this especially clearly in history of science.

As new international scientific organizations sprang up in the middle part of the twentieth century, so too did international history of science organizations. I've mentioned the History of Science Society. In addition, there was an International Academie d'Histoire de Science founded by Aldo Mieli in 1929. (Sarton, 1952, p. 255)

In the decade or so before the Second World War, there were four international history of science conferences. And after the war the International Union for the History and Philosophy of Science was formed. IUHPS was and is still a member of the International Council of Science (ICSU). This internationalist spirit must not be forgotten because it is ideologically linked to many historical practices: Sarton's bibliography embraced internationalism from the outset, recording works in nearly all languages.

To summarize, in the age of printed books, bibliographical tools were developed to overcome problems with information glut. Important aspects of scholarship were closely tied to these tools and to the social networks of scholars who formed societies and held conferences. When the people organized themselves into professions, that professional ethos got distributed throughout the entire body of scholarship. The ethos that ultimately emerged included a very strong internationalist ethic.

The point is that bibliographies did much more than find books. They became boundary markers for disciplines. This is especially clear in the case of history of science. The discipline originated at the same time that specialized bibliographies began to be published.

What does this mean for the profession in the digital age? In the rest of this paper, all I can do is to point to a few highlights of the history of the digital revolution and explore how these changes portend the future of our discipline. I reflect in particular on a proposal I have just submitted to create a dramatically new tool out of the bibliographical data that I collect for the *Isis Bibliography*.

In the years before the digital computer, two men, Paul Otlet and Vannevar Bush both proposed an Internet-like system that could be used to find information from the world's knowledge banks and send it to people all over the world. Otlet's Mondaneum and Bush's Memex have frequently been referred to as precursors of the Internet. Otlet's work was particularly interesting in this regard because he was a close friend of George Sarton, and both he and Sarton embraced internationalism with extraordinary enthusiasm. (Otlet & Rayward, 1990; Rayward, 1975)

In the early 2000s the field of digital humanities arose, based on a set of values that have been altering our understanding of how scholarship can be done. Academics in this field are experimenting with a variety of new ideas and techniques for collaboration, research, and teaching. Teachers have begun incorporating cell phones and popular applications such as Twitter in their classes. Researchers in the humanities are learning to write code that deals with newly digitized resources. Academic blogs that communicate ideas faster and to a wider and more diverse audience are now common. The academic world is opening up. (Gold, 2012; Rosenzweig, 2011)

The digital humanities come with their own set of values. The new ethos favors collaboration, openness, and the free access to digital resources. These scholars collaborate widely, and disciplinary boundaries begin to slip away. The digital humanities brings together groups of people with different skills and backgrounds: scholars in the humanities, digital technicians and engineers, and information professionals like librarians and archivists. (Spiro, 2012)

These new values are compatible with the older ones. The scientific internationalism of the pre-digital era of scholarship is found everywhere in the digital humanities ethos. Like the image of Athens that I started with, the digital humanities is a landscape filled with tools that are utterly foreign to the print-age scholar, but one that retains aspects of that print-age culture. Those older scholarly structures rise up prominently in this new landscape. The forms and the values of the past don't disappear. They simply play different roles.

So what does all this mean for reference works in our discipline? The Isis Bibliography has changed substantially since 1974. That was the year that the bibliography began to be produced with a computer database. After about 1990, that database was no longer just an input device, it became the search and retrieval system when the History of Science, Technology, and Medicine database was made available through the new online system. The database changed the way people accessed the information, but the fundamental purpose of bibliography remained intact. The new database was designed as a citation discovery tool. It may have

worked differently from the print bibliography, but it served the same fundamental purpose. (Weldon, 2009)

I am interested in expanding that purpose. As editor of the Isis Bibliography, I want to find new uses for it. Along these lines, I have proposed a new tool that I am calling the Isis Document Indexing Platform. It takes bibliography to a new level. It is essentially "bibliography 2.0," that draws on the networked-information-and-communication structure that some are calling web 2.0. (Rosenzweig, 2011)

When one looks at the sorts of information that exist in the bibliography, one begins to see bibliographical citations in a new way. By combining the interlinked data in the bibliography with the communication and information networks of the open Internet, ideas for new tools emerge. For example, the possibility exists to create a social network of people linked to each other by way of their publications. This interactive bibliography becomes a social tool with the objects of people's scholarship at its core. One already sees this sort of thing emerging in social bookmarking tools like Mendeley and social networking tools like Academia.edu. The Isis Bibliography has the potential to build on this.

To sum up, I want us to think about the future of our scholarly tools in terms of how the past shapes them. Those of us who manage and develop tools for our discipline need to pay attention. Research tools do not exist in a vacuum. They are made possible by institutions and social networks of people. They come with ideals and ethical principles. We must keep that in mind as we design for the future.

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