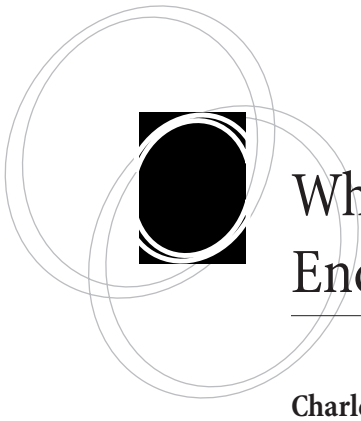

When's this Paradigm Shift Ending?

Charles B. Lowry

Since 1962, when Thomas S. Kuhn published *The Structure of Scientific Revolutions*, one of the century's milestone works in the history of philosophy and science, his notion of the paradigm shift has been interpreted broadly as a model, and applied not only to scientific thinking but also to social phenomenon.[1] The term has been applied increasingly and loosely to a transformation of libraries. As a general rubric, this does no great damage, but as a rigorous explanation, it is wide of the mark. It is past time to examine what we mean in using it in this way and begin to assess more thoroughly the pace and meaning of this change. In this brief essay I cannot provide a very thorough examination of the complex transformation, but it is possible to capture the *gestalt*. The starting point of this discussion is to distinguish between cause and effect and not to make the error of reversing them.

The paradigm shift is found in the organization and delivery of information (scholarly information for this discussion)—not in libraries. Libraries and the profession of librarianship are responding to this change in an effort to maintain their institutional role and to expand it. To understand better what is happening now, we should cast our view back to the middle of the nineteenth century, when libraries as we know them took shape in response to an earlier revolution in information. At the beginning of that century, libraries were principally repositories or archives. They had little in the way of organization, services, or standards—nor was there a profession of librarianship or professional education. Indeed, libraries had not really changed radically since the *scriptorium* was overcome by the Gutenberg revolution. That is not to say there were no libraries, even great ones—for example, the library at Oxford restored in 1602 by Sir Thomas Bodley who secured its future by arranging that it be the legal deposit library entitled to free copies of all books printed in Great Britain.

But, as with so many other things in that century, the industrial revolution made the difference. Arguably, that revolution began in the eighteenth century, but the rapid advance of invention and large-scale industrial organization came after the American

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Revolution—beginning in Britain and expanding outward. This emerging industrial society with high literacy and education rates demanded a systematic recording of new knowledge, particularly the exploding scientific knowledge of the age. Scientific rigor gradually spread to "soft" disciplines and the social sciences emerged. Classical knowledge and training took a back seat as scientific curricula were established after mid-century. Engineering emerged (at first in military academies) as a discipline rather than the provenance of self-taught practitioners. Perhaps the most significant marker was the emergence of the German system of doctoral education that by the 1870s was transplanted to the United States. As new learning and discovery transformed the content of the curricula and classical canonical studies disappeared. the setting was ripe for the invention of the modern academic library. In the United States, a hallmark of this process beginning was the "takeover" of student debating society libraries by colleges as the foundation of institutional collecting efforts. This also occurred around mid-century.

The precise contours of modern scholarly information evolved gradually through the century and the library was invented in response. The first periodicals appeared as early as the 17th century. In 1665, five years after the founding of the Royal Society, *Philosophical Transactions,* the first scientifically oriented periodical, appeared. However, save a very few early examples, neither the scientific journal nor the scholarly society really made an appearance until the 19th century, when science became widely accepted as a subject worthy of university and individual study. Scholarly societies arose—e.g., Royal Astronomical Society 1820 and the American Association for the Advancement of Society, 1847—and along with them the publication of journals. The first general periodical index of William Frederick Poole appeared in 1848 and the growth in scholarly science publishing lead to the rapid appearance of discipline-based abstracting and indexing—*Index Medicus* 1879, *Engineering Index* 1884, *Psychological Index* 1894, *Science Abstracts* 1897, and *Chemical Abstracts* 1907. Until the invention of linotype in the 1880s, large-scale production and distribution of scholarly books and journals was limited. This breakthrough, along with other advances in paper-making and bookbinding, transformed the landscape, eliminating the complaint in college libraries that there was not enough "book stock" available. In 1869, 2,602 new book titles appeared in America. By 1905, more than 8,000 new books and 6,000 periodicals had been published. Unsurprisingly, the century was also the time when the foundations of modern copyright and fair use practice arose. With the first manufacture of practical typewriters in the 1870s and the invention of the telephone in 1876 (by 1887 there were 150,000 phones in the U.S.), the conditions were right for the invention of a really new institution—the modern academic library. And the United States was arguably where much of this work occurred.

A sketch of the highlights provides a sense of the compressed period of this development. Cutter's *Rules for a Printed Dictionary Catalog* appeared in 1876 along with Dewey's first *Decimal Classification* and the foundation of the American Library Association; Frederick W. Faxon founded the first subscription agency in 1886; Columbia University offered the first library school program in 1887; USGPO was established in 1895; Library of Congress Classification in 1898; LC began offering printed cards for sale in 1901 the same year H.W. Wilson began the *Reader's Guide to Periodical Literature* the successor to Poole's *Index*; the English *Subject Classification* appeared in 1906; the *Anglo-American Code* was released in 1908; and the first *LCHS* in 1909.

By 1910, most of the characteristics of the academic library were evident at least in embryonic form—public services such as reference and circulation; technical services such as acquisitions, collection development, cataloging and serials check-in; and bureaucracy and record-keeping became an essential part of these organizations. In the profession (and on the international scene) the essential tradition of standards had emerged early. Thus within thirty-five years of Cutter's *Rules . . .*, an institution that would be easily recognized today as an academic library had taken shape. It had done so to facilitate a specific role in higher education—the delivery of scholarly information to students for learning and to doctoral faculty for research. The central role of academic libraries had emerged as the classical curriculum and non-scholar faculty gave way to modern disciplines and faculty trained in the German doctoral tradition. The themes established in those years have been built upon and strengthened and now after less than a century will have to be rethought in the face of a new transformation of scholarly information and higher education that is closely tied to a new technology—information technology.

Benefited by long perspective, it is easy to see that most of what transpired in the emergence of the library during the late nineteenth century was based on two things—changes in the role and function of higher education and technological advances in printing. The task today will be different—not to invent a new institution, but to reinvent a venerable one. Living of the midst of another transformation, it is anything but clear how this should be done. Moreover, during the last fifty years, the paths of IT development, scholarly information, and library transformation have merged, creating a complex interaction that makes it difficult to distinguish cause from effect. In the last decades of the twentieth century an explosive array of developments stimulated a rethinking of the way in which scholarly information could be transmitted—indeed, in what information really was. It is tempting to create metaphors, but in some measure the facts and events speak for themselves.

In looking for "markers" indicating when we began to see the next shift in the information paradigm, I have always liked to use Vannevar Bush's publication in 1945 of his concept of "Memex" a desk-sized mechanical device that would allow the individual to manage massive amounts of information. This device was totally impractical, but it did include the basic elements of the Web and a Windows-like screen format. The year 1946 is also convenient date from which to start because modern computing technology began to emerge with the mathematician John von Neumann's a seminal paper describing the design for the modern, or classical computer.[2] Equally critical was the establishment of the NISO, the National Information Standards Organization in 1939 and the International Organization for Standardization in 1947. Without entities such as this, competing commercial interests would have had no restraint on their proprietary impulses and networked computing simply would not have emerged.

A very sketchy outline of the advances in computing and telecommunications during the last fifty or so years has the following highlights. Early computing experiments (most at major universities) after World War II gave rise to the appearance of mainframe computing and to the rather monolithic computing organizations that managed central processing. This was accompanied by an immensely successful business enterprise. By 1980, this mature form of computing was faced a new period of change—

conditioned by the appearance of the personal computer, improvements in microelectronics and storage, and networking of a new kind. The TCP/IP protocol was developed for the Defense Department (DARPA) and by the early 1970s was being used to exchange data between remote computers over the first packet switched networks. Closely allied were the development and distribution of other key technologies such Simple Mail Transfer Protocol and File Transfer Protocol—along with the pervasive use of Berkeley Unix. These were followed soon by X Windows System, Network File System, and Remote Procedure Call protocols. In the 1980s, the National Science Foundation's funding of networked super computers brought universities and their research firmly into the mix. By the end of the decade the stage had been set for a major transformation in computing—the emergence of distributed computing. But I get ahead of myself.

In publishing, the post-war years saw major changes—most notably, large commercial STM publishers appeared. They signaled a new bottom-line driven kind of publishing that ran counter to many of the more "genteel" traditions of scholarly association and book publishing "industry." By the 1963 there were over 1,500 A& I services and MEDLARS appeared signaling things to come. It would go online in 1971, renamed MEDLINE. Through these first decades, academic libraries and the library vendor community had adopted and adapted to the use of computing. Indeed, libraries were often campus leaders in computing. As in computing, the adoption of standards was critical—AACR I 1967, MARC 1968, ISBN 1969, ISSN 1973 and OSI/Linked Systems Protocol developed in the early 1980s and turned over to NISO in 1984 (ultimately the Z39.50 protocol). Equally important, OCLC was established in 1966 and went online in 1971. There was a panoply of efforts to automate library processes, including attempts to build function-based systems (e.g., circulation and acquisitions) as well as integrated systems for all basic library functions. As one who experienced these developments, I would say that the majority were failures. But there were enough successes (from the commercial vendors and universities) appearing on the market in the early 1980s that libraries began to have choices in an expanding if small sector of the automation market.[3] Impressive as all of this activity was, it did not represent a fundamental change of direction. It represented the introduction of mechanization into the operations of institutions existing in 1910.

But as is often observed with the introduction of computing into new environments—it opens new and unforeseen opportunities and has unpredicted consequences. There are three incidents in my personal experience that stand as hallmarks for me of this fact. In each I had a simple question—in 1981, why should I buy a PC; in 1986 exactly how can I use this Bitnet mail account; and in 1992, how can I use this MOSAIC interface that they just put on my workstation? Common experiences and questions no doubt! These are also significant because between the first and the second a new kind of computing appeared. Distributed computing emerged in the last half of the 1990s, born largely of the efforts of three private universities—Stanford, Carnegie Mellon, and MIT—in partnership with major commercial players in the late 1980s. The landmark Mercury project at Carnegie Mellon by 1992 had demonstrated that "client-server" had a future for libraries. Commercial ILS vendors quickly adopted the model and struggled with how to make it work. It has taken ten years to find the answer. But there was more than

this to it—this new kind of architecture was changing scholarly information, research, and instruction more fundamentally.

The appearance of wide area networks and client-server architecture presented an opportunity for a new kind of distributed computing—and the World Wide Web was the result. Tim Berners-Lee wrote the Web software in 1990—the rest is, as they say, history. The lingo "full-text" had rattled through the professional literature for ten years. Now, it took on real meaning. All the players in the scholarly information market scrambled to figure out what it meant—from very different perspectives. Commercial, association and university press publishers mounted efforts to preserve their product positions. They were successful—e-journals, online A& I, online reference, and full-text databases were the result. The jury remains out on e-books, largely because of the effectiveness of the print book as an "access device" that is hard to replicate as a computing peripheral. The transformation was in a new reality—information historically presented in print form was now potentially available (that is not to say accessible) to anyone with a PC on the WWW. To make it accessible meant that standards and protocols were developed. The list is ponderous, but a few examples may suffice—PDF, SGML (and subsets like HTML and XML), various DTDs, open URL and a host of other NIST, NISO, ISO and industry standards. Concomitant advances in software and hardware—from robust clients and browsers to server "side" systems; from chip design to storage media—were also key developments. So promising are these that the idea of Memex is really within reach, but for one vexing set of problems.

The appearance of large-scale STM publishers after WW II was now reflected in a new round of consolidation—immense new international "information" businesses controlling much of the publishing market and dwarfing their historic antecedents in the print world. Indeed, it is often hard to tell what business they are in, except to say they are media conglomerates. This business consolidation, not coincidentally, saw the culmination of a long evolution in the control and purpose of intellectual property rights. I have stated my view on this rather strongly before.[4] It is a commonly held view that the evolution of copyright in the intellectual property regime since 1901 has been in response to change in technology and gradually has strengthened the rights of copyright holders and reduced those of the reading public. This can be easily seen in the terms of DMCA, WIPO, UCITA and the very policies of the Library of Congress. It is the obstacles presented by the gradual erosion of user rights (represented by legitimate scholarly use, fair use, classroom use, etc)—not those of technology—that will be the greatest challenge to building Bush's Memex, or to use the current notion a virtual "personalized information environment" that draws from digital libraries. To complicate matters, as a major producer of new knowledge, faculty (and as a result universities) are bound into the system, which may actually begin to inhibit the advance of research.

The task of building the "virtual library" is still the challenge. In the first place, the progress of automation in the last fifty years has transformed libraries as organizations.[5] Similarly, throughout the academy the use of information technology is providing new opportunities and challenges in research, instruction, and organization. The challenges libraries face have a direct parallel in the graduate programs that educate for the profession. They too are grappling with curriculum and their place in the academy.

The jury is out on both libraries and library schools (by whatever name), and the questions being asked are similar for both—what is our role in the emerging networked information environment? Or more specifically what is our role in knowledge management or content management (to use current terminology)? Answering this question is not the task of any one library, library school, library vendor, consortia, or association, but of the whole community.[6] Moreover, the answer will be found through a plethora of experimentation as this new information environment evolves. Ten years ago, the level of activity was low. I believe that today it is robust and widespread enough that we can begin to take an active role in shaping the future, even though we cannot quite see what a "library" will look like. Recently, the Association of Research Libraries appointed a Task Force on Collections and Access Issues. To a great extent, the draft charge it was given describes in a general way what must be done to fit academic libraries into the new scholarly information environment:

- Promote weaving the library into the Web (rather than the Web into the library).
- Articulate a shared vision on how the role(s) of research libraries might evolve and what is meant by various terms (knowledge management, content management, how we define library collections, etc.).
- Encourage rethinking of the roles of humans in selecting and cataloging information resources (traditional materials as well as websites, etc.) in light of machine-assisted search tools. Focus on how to enhance or redefine search criteria to improve search engines and resource integration tools.
- Track experiments that enhance information access via the Web to learn from them, especially *vis à vis* collaborations with faculty to develop content for teaching and learning. Share information and expand conversations to faculty, scholars, societies, and the commercial sector.
- Help develop staff to work productively in this environment of changing boundaries; promote tolerance for ambiguity and willingness to change, skills to work with faculty, etc.
- Synthesize existing research on information-seeking behavior of the academic community; assess what is most useful for research libraries; promote priority research agendas with researchers.[7]

I would add one important dimension to this work—a focus on providing the capability of end-users to weave the library into their own personal workspace. "Personal utilization" tools have been a serious part of the development of digital libraries since the first NSF Digital Library grants in the middle of the 1990s. It is time that they take a vital place in the development of basic library systems, because in the end this is what will serve the end-user and, not coincidentally, fulfill Vannevar Bush's dream.[8]

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Notes

1. Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).
2. Vannevar Bush, "As We May Think," *Atlantic Monthly* 176, no. 1 (1945): 101–08; and John von Neumann et al., *Planning and coding of problems for an electronic computing instrument, Pt. 1: Preliminary discussion of the logical design of an electronic computing instrument* (Princeton, NJ: Inst. for Advanced Study, 1946).
3. Joseph F. Boykin, "Library automation 1970–1990: From the few to the many," *Library Administration & Management*, 5 (Winter 1991): 10–15.
4. Charles B. Lowry, "Fair Use and Digital Publishing: An Academic Librarian's Perspective," *portal: Libraries and the Academy*, 1, no. 2 (April 2001): 191–96.
5. Charles B. Lowry, "Information Technologies and the Transformation of Libraries and Librarianship," *The Serials Librarian*, 21, nos. 2/3 (February, 1991): 109–32; and "Editorial Statement: 'The More Things Change. . .'", *portal: Libraries and the Academy*, 1, no. 4 (October 2001): viii–ix.
6. See for instance, Harry M. Kibirige and Lisa DePalo, "The Education Function in a Digital Library Environment: A Challenge for College and Research Libraries, *The Electronic Library*, 19, no. 5 (2001): 283–95.
7. Association of Research Libraries, Task Force on Collections & Access Issues, "Charge" (November 2001). Available: <http://www.arl.org/collectaccess/CAcharge.html> [May 31, 2002].
8. See for instance, Champa Jayawardana et al., "A Personalized Information Environment for Digital Libraries," *Information Technology and Libraries*, 20, no. 4 (Dec. 2001): 185–96.