Ralph Shaw and the Rapid Selector

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Abstract

The Rapid Selector, developed by Vannevar Bush in the 1930s, represented an early attempt to automate document retrieval using photoelectric cells, microfilm, and high-speed photography. It was not until the late 1940s, however, that a librarian attempted to adapt the machine to assist in producing a major bibliographic tool, the *Bibliography of Agriculture*. As director of the library of the U.S. Department of Agriculture and member of the American Documentation Institute, Ralph Shaw understood the need for providing timely access to the burgeoning literature for a widely dispersed scientific and technical community. The Rapid Selector looked like a solution to the problem, but turned out to be a serious disappointment. Shaw's experience with the Selector affected his thinking about automation and led him to warn the profession against a too-ready belief in the promise of machine-assisted retrieval.

Introduction

In the 1930s and early 1940s the mix of scientists and librarians involved in the American Documentation Institute (ADI, the precursor of the American Society for Information Science) shared a concern for making the burgeoning scientific and technical literature accessible. Working together, they advanced microfilming as the technology to solve the dissemination problem and strove to publish timely alerting and indexing services to provide intellectual access to scientific information. For example, in the 1941–42 fiscal year, the Army Medical Library filled "6,208 orders from 1,198 customers requiring exposure of 3 miles of film" (Miles, 1982, p. 300). But World War II and Cold War demands on information handling raised the stakes and accelerated experimentation with new tools and methods. Machine-assisted indexing, storage, retrieval, and dissemination of scientific information became the ultimate goals. Librarians for the most part seldom could afford emerging technology, and opportunities to shape its development were limited. There were of course exceptions, and the subject of this paper is one of those. The technology in this case is the Rapid Selector, the first machine designed specifically for bibliographic retrieval. The librarian is Ralph Shaw, head of the U.S. Department of Agriculture (USDA) library at the time of his involvement with the Selector. The focus here will be more on Shaw than on the machine, and particularly on the impact that his experience with the Selector had on his subsequent thinking about automation. Because Shaw was a leader in the library profession, an educator, a prolific writer, and a frequent consultant and speaker, his opinions were widely known and had considerable influence.

The Rapid Selector

The Selector has been of interest to historians of information science because of its kinship to the Memex, Vannevar Bush's fantasy of a personalized scholar's workstation (Nyce & Kahn, 1991). Bush designed the first version of the Selector in the 1930s, combining photoelectric cells, microfilm, and high-speed photography. While he had a genuine interest in contributing to the solution of the literature control problem, his strongest motivation was to obtain sponsors and funding so that he could support his students and young engineers at MIT. For accounts of the lengthy and complicated history of the Selector, see Burke (1991, 1994), Nyce and Kahn (1991), and Buckland (1992).

The system was designed basically to store documents or abstracts together with coding on microfilm. Searching was done with an interrogating device, such as a punched card or paper tape. When photoelectric cells registered congruence between the inquiry code and the microfilm code, a camera would shoot the appropri-

ate frame and record it onto another film for reproduction and enlargement. Each document could be coded with multiple identifiers. Bush may have imagined a kind of indexing that would realize his dream of a mechanism that would allow association of topics from disparate areas. Both mechanical and conceptual failures dogged the machine throughout its various incarnations. Nevertheless, Bush continued to hope for another opportunity to produce a functional and commercially viable machine.

When Shaw entered the picture, it was in the hope that the Selector might be a more efficient bibliographic tool than his printed *Bibliography of Agriculture* and similar indexes. He was also concerned with the problem of providing access to the "tens of thousands of tons" of scientific and technical U.S. wartime publications that were being declassified, plus material captured from enemies. With expertise in photographic technology and bibliography, commitment to serving the needs of scientists, awareness of the explosion of scientific information in the post–World War II era, and a drive to innovate, Shaw could not resist the idea of a machine that used a combination of microfilm, electronics, and high-speed photography to store, retrieve, and copy bibliographic information. In 1946 he wrote to Vannevar Bush, referring to a 1940 document describing the Rapid Selector, and asked whether he could borrow the prototype. He explained that he wanted "to experiment with its application to the organization of knowledge in a great research library" (Nyce & Kahn, 1991, p. 114). Bush gave his consent, funding was obtained from the Office of Technical Services (OTS) of the Department of Commerce, and the machine was built under the supervision of engineers who had worked on the earlier model at MIT. The new Selector was delivered to the USDA library in 1949.

Shaw's Background

One could forgive Shaw thinking of himself as the right man in the right place at the right time. He developed his interest in scientific information when he worked for the science and technology department of the Cleveland Public Library while attending college at Western Reserve University (biographical information is taken from Stevens, 1978, and Turner, 1983). After obtaining a bachelor's of science in library service at Columbia in 1929, he became chief bibliographer of the Engineering Society Library. He went on for a master's degree at Columbia, writing his thesis on engineering books that were available in America before 1930. In 1934 his translation of Georg Schneider's *Theory and History of Bibliography* from the German was published by Columbia.

During a four-year term as a public library director (1936–40) Shaw began to apply photography to library operations. The result was the Photocharger, a machine for circulation control, although the concept of transaction charging was what Shaw took pride in, rather than the machine that facilitated it (Shaw, 1939; Hines, 1975, p. 9). His interest in photography for management tasks found ample expression when he assumed the directorship of the USDA library in 1940. As recounted by Hines, he streamlined the production of the major index to agricultural information:

> In order that researchers in the field would be helped rapidly to find out what existed so they could request it, Shaw used photography and lithography to produce the *Bibliography of Agriculture*. It was produced by photographing the original typed index cards, laid out shingled on page layout boards. It was a typical Shaw product. It looked like hell, it was done by a tiny staff, but it often left the printer for the subscriber within five days after the last article indexed had been received, and it covered a hundred thousand items a year. The *Bibliography of Agriculture* in those days neatly combined current awareness and retrospective searching values before the term for the first had even been thought of. (1975, p. 7)

Hines goes on to describe Shaw's other uses of photography over the course of his career, ranging from a photostat device that simplified clerical routines before the advent of photocopying, to the use of miniprint to produce publications otherwise too expensive to publish. The photostat machine, called Photoclerk, was developed for use at the USDA library, but Shaw involved eleven other libraries in an experiment to test applications (Shaw, 1953). In reporting on this project, he highlighted not only the savings but also the improvements in management that resulted: "The very existence of an experiment made it necessary to think through policies, programs, and procedures, for . . . this frequently led to broadening of programs or changing of procedures without the use of the camera" (1953, p. 15).

Shaw was by no means the first to apply photography to library operations. The Engineering Society Library, where he worked for seven years, used photostats as early as 1912 (Farkas-Conn, 1990, p. 33). What was creative about Shaw, however, was his ability to take a systems view and to see how a tool could contribute to

his ideal of "scientific management." Much taken with Frederick Winslow Taylor, an early-twentieth-century management theoretician, and others who promulgated this approach, he compared it to operations research (Shaw, 1954). He made it a basic principle to scrutinize the purpose of policies and programs and to collect data on the routines and procedures in order to determine their effectiveness and efficiency. One of his famous aphorisms was "do not do efficiently that which does not need to be done" (1958, p. 5).

When he took over the USDA library in 1940, microfilm became another aspect of photographic technique in which he developed expertise. He inherited an arrangement that his predecessor, Claribel Barnett, had made in 1934 (Farkas-Conn, 1990, pp. 41–42) with Watson Davis and others who saw the promise of microfilm in advancing scholarly communication. Barnett's interest grew out of the need to improve upon interlibrary loan and facsimile copies as the primary means to serve the information needs of widely dispersed users at agricultural experiment stations and laboratories. With the introduction of Bibliofilm, as the service came to be called, the library reached beyond its own collection to find, film, and deliver the required document to the user. In the first six months of the project over 150,000 pages were filmed, despite the fact that the service was not promoted and current literature awareness was minimal. The service remained at the USDA until 1941, when Bibliofilm as a part of Science Service and ADI ceased as a centralized operation. While Shaw was director from 1940 to 1954, the USDA library continued a modified relationship with ADI, as well as providing the service for its own clientele (Farkas-Conn, 1990, pp. 88–89). In addition, in 1946, the library cooperated with the American Chemical Society to provide copies of articles in *Chemical Abstracts,* a project that was said to be "of inestimable value in the promotion of research in chemistry" (Mohrhardt, 1957, p. 76). Mohrhardt states that to improve the efficiency of these substantial filming operations, Shaw introduced a camera in 1943 that could be used in the stacks, thus eliminating the need to pull and reshelve materials. This involvement with massive copying probably led him to select copyright as the topic of his dissertation at the University of Chicago, which he completed in 1950.

From 1944 to 1946 Shaw was on leave from the USDA library and served in the Army Air Force Medical Department. Recruited to the Army Medical Library, he worked with Francis St. John to reorganize and streamline operations in time to meet the extraordinary demands for medical literature made upon the library by the military during the war, reaching over 6.5 million pages of microfilm in 1945 (Miles, 1982, pp. 295, 301). Shaw had met Vannevar Bush by 1945 at the latest, when he advised Bush, then chairman of the Office of Scientific Research and Development, to persuade the government to establish an agency that would deal with the mountain of technical and scientific information generated by both the Allies and their enemies (Farkas-Conn, 1990, p. 111). Bush succeeded, and the Publication Board (on which Shaw served) was established under the auspices of the Department of Commerce's Office of Technical Services, headed by John C. Green. It was their mutual interest in the dissemination of "the prodigious store of useful knowledge developed during the last five years under the stress of emergency conditions" (Shaw, 1946, p. 105) that brought Shaw and Green together in pursuit of a machine that would help in the task.

Because Shaw knew ADI's Watson Davis and others who shared the conviction that microfilm was the solution to the storage and dissemination of information, he may have heard of the original Selector well before he found the 1940 document and approached Bush for permission to borrow the prototype. As recounted by Farkas-Conn (1990, p. 19), Davis met Bush in 1932, and the idea for a machine very like the one that became the Bush Selector may have originated in Davis's circle. Burke (1994, p. 43) believes that the basic Selector concept was already in Bush's mind in the early 1930s. In any case, by 1946, the original machine, which had been put on mothballs in 1940 and—according to Bush—had been cannibalized, would have had to be rebuilt if the money could be found (Burke, 1994, p. 334). It was at this point that Shaw's connection with John Green and his Office of Technical Services proved fortuitous, as Green was the key to financing the machine.

Shaw and the Rapid Selector

One suspects that Shaw's curiosity about the Selector, together with the urgency of dealing with unprecedented quantities of information, clouded his usually systematic approach to experimentation. He must have been aware of the specifications of the earlier machine, if not of all the mechanical problems, and should have been able to anticipate the time and cost factors intrinsic to the machine's design. His enthusiasm led to publications describing the Selector before it had been rigorously

tested (e.g., Shaw, 1949a; 1949b). By the time Shaw delivered the 1950 Windsor lecture, "Machines and the Bibliographical Problems of the Twentieth Century," he had begun to think not only about the cost-benefit aspects but also about the need for a systems approach: "Until we know what we are trying to achieve, how, why, and for whom, and the amount of effort which may justifiably be assigned to the solution of these problems, it will not be possible to design machines to solve the mechanical problems, nor will it be possible to use existent machines intelligently" (Shaw, 1951a, p. 70).

Meanwhile, building the Selector had turned into a cliff-hanger. The economic, engineering, political, and patent problems are described in detail in Burke's *Information and Secrecy* (1994, chap. 13). It took personal intervention from Vannevar Bush to prod his protégés at the engineering firm that held the contract to complete the project. Burke (1994, p. 345) suspects that the engineers may have realized that the Selector design was already obsolete and stalled in order not to embarrass Bush. Ironically, Bush prevailed, and the machine was delivered to Shaw at the USDA library in 1949, where it failed to work. To add to the dismay, the patent office discovered the claim of Emanuel Goldberg, who had patented a design very similar to that of the Bush machine in 1931 (on Goldberg, see Buckland, 1992). Shaw also became aware of the claim when Goldberg, having learned of the Rapid Selector's debut at the USDA library, paid a visit (Buckland, 1992, p. 58). Shaw gave recognition to Goldberg in some of his writing after that, notably in the Windsor lecture (Shaw, 1951a, p. 58). Bush, however, never acknowledged Goldberg, although it is known that he had been informed about him (Zachary, 1997, p. 265).

Between 1949 and 1952, when Shaw gave up on the Selector, work on the machine continued. Shaw, Bush, and the National Bureau of Standards engineers made modifications and rebuilt parts of the machine in an attempt to save it, but these efforts did not make the Selector functional for Shaw's purposes. As reported by Bagg and Stevens:

> The major factor causing abandonment of the machine was that it was not designed to copy successive frames without delays that severely increased search time. Moreover, the limitation of the selection code area to six selection criteria per document frame and the limitation of the question to one criterion per run had seriously restrictive effects upon indexing and search, and therefore upon the practical use of the selector. (1961, p. 23)

In the opinion of another critic, Scott Adams, the Selector could not be effective because "Shaw had not grappled with the fundamental problems of indexing, so critical for information retrieval" (Farkas-Conn, 1990, p. 134). Adams, Shaw's colleague as one of the librarians recruited to serve during wartime at the Army Medical Library, was certainly qualified to make this judgment. His concern about the inconsistency of subject headings in the various publications providing bibliographic control of the medical literature led him to organize a conference on the problem in 1947 (Miles, 1982, p. 390). It was Shaw rather than Adams, however, who was appointed in the following year by Raymond Bliss, surgeon general of the Army, to serve on a Committee of Consultants for the Study of the Indexes to the Medical Literature Published by the Army Medical Library. Thanks to a research group attached to this committee, important progress was made in using punched cards to produce a subject heading authority list (Miles, 1982, p. 339). By the time the committee finished its work in 1950, the Rapid Selector may have been beyond the point where Shaw could have applied the research results to the machine's redesign. He might not have wanted to tinker with the indexing in any case, since he seemed to have a blind spot when it came to knowledge representation. Despite his association with many of those who were deeply involved in thinking about and developing indexing and coding schemes during this era, Shaw did not appear to have a solid grasp of the subject. Frederick Kilgour (personal communication, September 1998) and Winifred Sewell (personal communication, October 1998) confirm Adams's opinion of Shaw's failings in this regard. Sewell, who worked on revising medical subject headings to be used in the first computerization of *Index Medicus*, recalls that Shaw failed to understand the details of how MEDLARS (Medical Literature Analysis and Retrieval System) worked. Thus, it is understandable that Shaw's publications about the Selector focused on the mechanical problems and the length of time that it took to perform a search, while avoiding any in-depth discussion of the indexing and coding difficulties.

Perhaps for the first time, Shaw was faced with a major failure. What may have been especially galling was the realization that the problem with the Selector was not simply one of inadequate engineering or mechanics. Rather the neglect of what should have been the first step—a rigorous examination of indexing and searching in the machine context—was at least as much at fault. As there seems to be no contemporary record of

Shaw's thinking in regard to the indexing and coding scheme for the Selector at the time that he developed it, one can only speculate on the basis of what he wrote later. He stated that "a really important contribution to the advancement of science will result only if we can rethink the methods of organization of knowledge to take full advantage of the new technique . . . We need first to do some fundamental thinking and some operational research to determine what is really needed for the advancement of scientific communication" (Shaw, 1951a, p. 66). He most likely was thinking in terms of studying users rather than tackling subject access.

He goes on to talk about the feasibility of using uncontrolled vocabulary in the machine context, allowing for the development of new discoveries, as there is not the same limitation to the number of descriptors as in manual systems. Here he seems to be kowtowing to Vannevar Bush, who disliked the hierarchical, controlled systems used by librarians (Nyce & Kahn, 1991, pp. 117–118; Burke, 1994, p. 190). Writing elsewhere, Shaw saw Bush's vision of indexing by association essentially as fantasy:

> [Machines] do not now offer any promise whatsoever for elimination of the intellectual effort involved in bibliographic work; and fuzzy thinking about the creation of new knowledge by assembling unrelated data mechanically is probably responsible for a large part of the delay in applying machine techniques to the parts of the job they may be able to handle. Tools and machines of some types appear to be indispensable and have always been used for storage, selection, and reproduction of bibliographic materials. Those aspects of the problem appear to constitute the field of application of machines. Machines do not now, nor will they in the foreseeable future, handle the intellectual aspects of bibliography. (1951b, pp. 201–202)

While Shaw recognized the intellectual challenge of indexing, he was too much of a pragmatist and too grounded in his own experience as a librarian to be able to jettison traditional principles of classification and subject access in favor of new approaches. He was used to the model of the *Bibliography of Agriculture*, which allowed one to browse broad categories or to zero in on very specific subjects (Olivieri & Forbes, 1969, p. 451). The early volumes of the *Bibliography* illustrate the dependence on classification to offset rather rudimentary and somewhat careless indexing. Shaw emphasized speed in preparing and distributing the publication to the detriment of the quality of subject access. In a 1956 speech Shaw referred to the conflict between a desire to draw together concepts from disparate fields and the ability to scan categories within a field. He stated that in designing the indexing and coding for the Selector:

> The basic error was the assumption that we could run fast enough to avoid pre-classification; yet in terms of the total amount of material in a research library, this experiment showed the futility of running instead of thinking. There appears to be no reason for running all ancient history when we are looking for something in gamma-ray physics and an order of at least 1,000 times the net speed can be achieved merely by the roughest sort of pre-classification by broad subjects and periods. This would make it possible to use 50-ft cartridges instead of 2,000-ft rolls, and to change the search time from six-minute units to half-minute or one-minute units. This requires additional development work, but the principle has been established. (1958, p. 31)

Here he seems to be saying that it is unrealistic to expect the machine to permit efficient searching of a very large database containing unrelated subjects. He does not, however, clearly state the other problem with the particular version of the Selector that he had tested, which was that his indexing and coding scheme, together with the way the machine was constructed, required an exact match between an inquiry and the item indexed (Burke, 1994, pp. 189, 340; Jahoda, 1961, pp. 175–176). Because the "selected abstracts could not be re-run through the Rapid Selector . . . it could not be used for conducting a search whose scope might require more than one characteristic for definition" (Perry, Kent, & Berry, 1956, p. 53). Carl Wise and James Perry had made suggestions for improving the coding, while Calvin Mooers proposed his own Zatocoding (Jahoda, 1961, pp. 177–178). Shaw seems not to have reacted to these proposals, while Bush did not concede the critical nature of coding until the 1960s (Zachary, 1997, pp. 272–273).

In addition to his blindness in regard to indexing, another reason for Shaw's failures with the Selector was his departure from his own habit of looking at the total system, analyzing it in terms of purpose and effectiveness, discarding what was superfluous, and finding or creating the tool to do the job efficiently. The transaction system that he invented while at the Gary Public Library, the USDA library's Photoclerk, and the production method for the *Bibliography of Agriculture* arose from his identification of specific problems in particular systems that called for economical solutions. The Rapid Selector does not fit this pattern. It was someone else's

solution to a problem, and it is doubtful that Shaw would have placed faith in it had it not been backed by the highly respected Bush, who originally conceived it at MIT as a successor to an analog calculator for purposes of data retrieval. Exactly how the basic idea would be realized depended on who funded the machine (Burke, 1991). While the vision of the Memex probably hovered in the background, Bush never systematically studied how to build search-and-retrieval logic into the machine. He missed the opportunity to give it "and/or" searching capability, gave short shrift to problems of coding and indexing, and gave priority to making the machine run at the greatest possible speed (Burke, 1994, pp. 189–191), a priority that resonated with Shaw.

Once Shaw had hands-on contact with the machine, he concentrated on the mechanical rather than the intellectual problems. He produced two patents, one related to eliminating double exposures when two hits were too close together and the other to the camera used to create microfilm from varying-sized text together with standard-sized codes (Jahoda, 1961, p. 183; Shaw, 1950). While he continued to advocate use of the Rapid Selector for several years after its initial failure, he qualified his support by pointing out that in order for it to become useful considerable research was needed on how to organize information for machine sorting. He emphasized the need to consider the entire system time and cost (coding, preparation of the interrogating mask, developing the search results film) as opposed to allowing speed of sorting to tempt one into thinking of the machine as efficient. Having been beguiled himself by specifications for a machine that used what appeared to be familiar photographic technology and added the attraction of high speed, he could issue the warning with conviction.

The Aftermath

By 1953 Shaw was reminding librarians that the book was still the most efficient tool for storing and finding information; that machine solutions were proposed too glibly for solving exaggerated problems; and that it would take librarians, not outsiders, to develop a better bibliographic tool, electronic or not:

> So developing new tools will always be a part of our jobs. If they are to be electronic, well and good. If not, well and good. But each will have to justify itself by more than catchwords and will have to serve as more than a development project. If they do not, they are gadgets rather than tools. (1976, p. 494)

In this 1953 essay, "From Fright to Frankenstein" (reprinted in 1976), one can detect the bruised feelings of a man who has found himself caught up in another's "development project."

Some years later Shaw shows himself to have found some humor in his misplaced faith in the Rapid Selector and to be able to apply what he learned from that experience to documentation in general. At a seminar in 1958, following a review of equipment and techniques for information handling, he makes the point that while the machine could scan 100,000 items in four minutes, that number constituted only one year of the *Bibliography of Agriculture*. If one needed to search ten-year runs, one could do only about eight searches in a working day:

> If I do say it myself, the Rapid Selector was a wonderful machine. It was cute, the first one which ever did such wonderful things, and still I could only dig the answers to eight questions from the ten year run of the *Bibliography* [*of Agriculture*] in a day's work. And if any reference librarian couldn't do better than that, one of us would have to go, and it wouldn't cost $100,000 to replace us either. This is the sort of arithmetic you have to learn to apply in this game. The ability to run fast is not enough. (Documentation seminar, 1958, p. 28).

Because he so frequently cautioned librarians against blind faith in machines, he was often accused of being a Luddite. The most famous example occurred in an article by Jesse Shera, "Beyond 1984," published in the official journal of the American Library Association (ALA) in 1967. In it Shera quotes from Shaw's fourteen-year-old "From Fright to Frankenstein" essay, taunts him with the failed Rapid Selector (abandoned by Shaw in 1952), and accuses him of "triviality, error, and even charlatanry" (Shera, 1967a, p. 35). Shaw was so outraged he threatened to sue (Shaw, 1967a). In a rebuttal letter to the *ALA Bulletin* Shaw recites current uses of machines in the University of Hawaii library, which he directed at the time, and succinctly states his position once more: "It is just as stupid to hate machines as it is to love them" (Shaw, 1967b). Shaw never undervalued the usefulness of automation; in fact, in 1961, he urged research so that the National Institutes of Health could experiment with new methods of providing "medical intelligence," including the use of digital computers and other electronic equipment, although he advised that thorough systems analysis and investment in human intelligence be given priority (Shaw, 1961).

The 1967 Shaw-Shera spat did not come out of the blue. There had been friction between them since the

early 1950s, although they had been friends for many years, at least according to Shera (1967b). A number of conjectures can be made as to the cause of the friction, but the one that may be most pertinent to this discussion is the suspicion that simple professional competitiveness may have been the culprit (Tefko Saracevic, personal communication, September 1998). Shera was an early advocate of the use of machines for information handling (Shera, 1936). When he worked for the Scripps Foundation for Population Research, he became adept at using tabulating machines (Wright, 1988, pp. 11–12). But it was Shaw who had the dubious pleasure of testing the first electronic bibliographic machine, and it was Shaw who landed a lucrative grant in 1957 from the Council on Library Resources to produce the multivolume *State of the Library Art*. He then rubbed salt in Shera's wounds by attacking the machine that at last emerged from Shera's Center for Documentation and Communication Research at Western Reserve University (Documentation seminar, 1958, pp. 23–24; Shaw, 1963). This unfortunate conflict would be relegated to the realm of old gossip were it not for the fact that Shaw and Shera were major figures who, at least in the early days, were at home in the worlds of both librarians and documentalists. Had they combined forces, they might have reconciled differences between the two groups and perhaps speeded the development of automated retrieval.

Shaw, unlike Shera, seems not to have been much involved in the librarian versus documentalist debate, perhaps because he did not devote as much time to thinking about professional education issues, which had much to do with the disagreements (Williams, 1997). It may be that Shaw perceived the real split to be between the people who were devoted to the machines for the sake of the machine and those who saw the machines merely as tools in the provision of information service. Vannevar Bush, for example, was a visionary and a brilliant engineer, but he had no understanding of the organization of knowledge and little real sympathy for the social function of libraries. Shaw had no use for people who worked on creating new indexing schemes in the abstract, without reference to real collections of information (Shaw, 1963, p. 410). Nevertheless, even though he felt that good indexing depended on human intelligence, he supported doctoral work on automatic indexing (Susan Artandi's dissertation, 1963). In an article in *Science* he suggested that those newly converted to documentation lacked the user perspective and library service application. Here as elsewhere Shaw insisted that one should study information needs from the user's point of view and to think in terms of the total system of scholarly communication (Shaw, 1957; 1962; 1971). A reading of both his 1962 and 1963 *Science* articles today might lead one to conclude that he would have had no trouble seeing how the perspectives and skills of librarians, documentalists, and information scientists could be integrated for the benefit of users.

Conclusion

Shaw's gamble on the Rapid Selector was not a total loss. As Mohrhardt suggests, "The project was as valuable in pointing out what could not be done efficiently with machines as it was in demonstrating the uses of non-book storage devices" (1957, p. 76). Because of the enormous interest in machine applications at the time, the experiment garnered a great deal of attention and gave Shaw a platform from which he could expound his views. While he was not inclined to blame himself publicly for any of the Selector's failings, he did attempt to prevent others from falling into similar traps. When he warned against accepting machine solutions without adequate preparatory systems analysis, he was implicitly confessing that he had not practiced what he preached. He may never have admitted his shortcomings in the area of representation of knowledge, but at least he recognized and proclaimed consistently the primacy of the intellectual effort required to make the content of scientific literature accessible. He himself did not have the type of mind or the patience to address this aspect of the information problem, nor did he have much tolerance for those who took to it as an abstract exercise. But, writing in journals such as *Science*, he reached an audience that stood to gain from improved access to scientific information, and he explained and promoted the role of librarians and documentalists in that process.

Shaw died in 1972 and thus did not have the opportunity to see the early machine-assisted bibliographic systems evolve into the sophisticated information retrieval of today. It is tempting to speculate that had he lived long enough he would have been among the first to test the efficiency of online searching against manual methods. The saga of Shaw and the Rapid Selector has taught us several lessons: to understand better the interlocking needs and purposes of information users, providers, and systems designers, and to evaluate new technology from that perspective; to avoid confusing tools with systems; and to stay off bandwagons until we know whether they will get us to where we want to go.

References

Artandi, S. S. (1963). *Book indexing by computer.* Unpublished doctoral dissertation, Rutgers University, New Brunswick, NJ.

Bagg, T. C., & Stevens, M. E. (1961). *Information selection systems: Retrieving replica copies: A state of the art report* (National Bureau of Standards Technical Note 157). Washington, DC: Government Printing Office.

Buckland, M. K. (1992). Emanuel Goldberg, electronic document retrieval, and Vannevar Bush's Memex. *Journal of the American Society for Information Science, 43*, 284–294.

Burke, C. (1991). A practical view of Memex: The career of the Rapid Selector. In J. M. Nyce & P. Kahn (Eds.), *From Memex to Hypertext: Vannevar Bush and the mind's machine* (pp. 145–164). San Diego: Academic Press.

Burke, C. (1994). *Information and secrecy: Vannevar Bush, Ultra, and the other Memex*. Metuchen, NJ: Scarecrow.

Documentation seminar, Montreal (1958). New methods and techniques for the communication of knowledge, directed by Ralph R. Shaw, January 20–21, 1958, McGill University. *Proceedings of the Documentation Seminar.* Ottawa, Ontario: Canadian Library Association.

Farkas-Conn, I. S. (1990). *From documentation to information science: The beginnings and early development of the American Documentation Institute–American Society for Information Science*. Westport, CT: Greenwood.

Hines, T. C. (1975). Shaw and the machine. In N. D. Stevens (Ed.), *Essays for Ralph Shaw* (pp. 6–14). Metuchen, NJ: Scarecrow.

Jahoda, G. (1961). Electronic searching. In R. R. Shaw (Ed.), *The state of the library art* (Vol. 4, part 4, pp. 137–317). New Brunswick, NJ: Graduate School of Library Service, Rutgers University.

Miles, W. D. (1982). *A history of the National Library of Medicine: The nation's treasury of medical knowledge.* (NIH Publication No. 82-1904). Washington, DC: U.S. Government Printing Office.

Mohrhardt, F. E. (1957). The library of the United States Department of Agriculture. *Library Quarterly, 27,* 61–82.

Nyce, J. M., & Kahn, P. (1991). *From Memex to hypertext: Vannevar Bush and the mind's machine*. San Diego, CA: Academic Press.

Olivieri, B. L., & Forbes, J. B. (1969). Bibliography of agriculture. In A. Kent & H. Lancour (Eds.), *Encyclopedia of library and information science,* Vol. 2. New York: Marcel Dekker.

Perry, J. W., Kent, A., & Berry, M. M. (1956). *Machine literature searching.* New York: Interscience Publishers.

Shaw, R. R. (1939). Gary charging system. *Library Journal, 64*, 198–199.

Shaw, R. R. (1946). The Publication Board. *College and Research Libraries, 7,* 105–108.

Shaw, R. R. (1949a). Photoelectric librarian. *Electronics, 22*(9), 122, 158, 160, 164, 166.

Shaw, R. R. (1949b). The Rapid Selector. *Journal of Documentation, 5*(3), 164–171.

Shaw, R. R. (1950). High speed intermittent camera. *American Documentation, 1*, 194–196.

Shaw, R. R. (1951a). Machines and the bibliographical problems of the twentieth century. In *Bibliography in an age of science* (pp. 37–71). Urbana, IL: University of Illinois.

Shaw, R. R. (1951b). Management, machines, and the bibliographic problems of the twentieth century. In J. H. Shera & M. E. Egan (Eds.), *Bibliographic organization; Papers presented before the fifteenth annual conference of the Graduate Library School, July 24–29, 1950* (pp. 200–225). Chicago: University of Chicago Press.

Shaw, R. R. (1953). *The use of photography for clerical routines: A report to the American Council of Learned Societies.* Washington, DC: American Council of Learned Societies.

Shaw, R. R. (1954). Introduction (issue on scientific management in libraries). *Library Trends, 2*, 359–360.

Shaw, R. R. (1957). Documentation: Complete cycle of information service. *College and Research Libraries, 18*, 452–454.

Shaw, R. R. (1958). Mechanical storage, handling, retrieval and supply of information. *Libri, 8*, 1–48.

Shaw, R. R. (1961). *A medical intelligence program for the National Institutes of Health.* New Brunswick, NJ: Rutgers University Graduate School of Library Service.

Shaw, R. R. (1962). Documentation and the individual. *Science, 137*, 409–411.

Shaw, R. R. (1963). Information retrieval. *Science, 140*, 606–609.

Shaw, R. R. (1967a). Letter from Shaw to Mary Gaver, dated February 12, 1966 [actually 1967], ALA Director's Subject Files, Record Series 2/4/6, American Library Association Archives, University of Illinois Archives, Urbana, IL.

Shaw, R. R. (1967b). Beyond 1984—a reply. *ALA Bulletin, 61*, 231–232.

Shaw, R. R. (1971). *Pilot study on the use of scientific literature by scientists*. Metuchen, NJ: Scarecrow Reprint Corporation.

Shaw, R. R. (1976). From fright to Frankenstein. In D. J. Ellsworth & N. D. Stevens (Eds.), *Landmarks of library literature: 1876–1976* (pp. 487–495). Metuchen, NJ: Scarecrow.

Shera, J. H. (1936). The college library of the future. *ALA Bulletin, 30*, 494–501.

Shera, J. H. (1967a). Beyond 1984: What's past is prologue. *ALA Bulletin, 61*, 35–47.

Shera, J. H. (1967b). Letter from Shera to Ruth Warncke, dated January 30, 1967, ALA Director's Subject Files, Record Series 2/4/6, American Library Association Archives, University of Illinois Archives, Urbana, IL.

Stevens, N. D. (1978). Shaw, Ralph Robert (1907–1972). In B. S. Wynar (Ed.), *Dictionary of American library biography* (pp. 476–481). Littleton, CO: Libraries Unlimited.

Turner, I. B. (1983). Ralph Shaw. In W. A. Wiegand (Ed.), *Leaders in American academic librarianship: 1925–1975* (pp. 289–319). Pittsburgh, PA: Beta Phi Mu (distributed by the American Library Association).

Williams, R. V. (1997). The documentation and special libraries movements in the United States, 1910–1960. *Journal of the American Society for Information Science, 48*, 775–781.

Wright, H. C. (1988). *Jesse Shera, librarianship, and information science.* Provo, UT: School of Library and Information Sciences, Brigham Young University.

Zachary, G. P. (1997). *Endless frontier: Vannevar Bush, engineer of the American century*. New York: Free Press.