Estelle Brodman and the first generation of library automation

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Objective: The purpose of this paper is to examine the contributions of Estelle Brodman, PhD, to the early application of computing technologies in health sciences libraries.

Methods: A review of the literature, oral histories, and materials contained in the archives of the Bernard Becker Medical Library at the Washington University School of Medicine was conducted.

Results: While the early computing technologies were not well suited to library applications, their exciting potential was recognized by visionaries like Dr. Brodman. The effective use of these technologies was made possible by creative and innovative projects and programs. The impact of these early efforts continues to resonate through library services and operations.

Conclusions: Computing technologies have transformed libraries. Dr. Brodman's leadership in the early development and application of these technologies provided significant benefits to the health sciences library community.

In an undated curriculum vitae from late in the career of Estelle Brodman, PhD, she listed her present interests, with the first one being ''Impacts of new technologies on methods by which scientists gather information and inspiration for research and teaching, and the relationship of the library as a communication center for this'' [1]. The manual typewriter, with carbon paper for copies, the rotary-dial analog telephone, and elegant handwriting constituted state-of-the-art desktop information technology for the first two decades of Dr. Brodman's career. As the computing era began to take shape, however, Dr. Brodman was quick to recognize its transformational potential for library operations. This paper will chronicle Dr. Brodman's leadership in the earliest days of computing, building a foundation for automation at the National Library of Medicine (NLM) and extending the technology model through the development of library applications and networks that would benefit libraries of all sizes. A comprehensive review of Dr. Brodman's information technology efforts is beyond the reach of a single article. Selected projects are provided to illustrate the challenges, accomplishments, and impact of her distinguished career.

Highlights

- From the earliest days of computing, libraries have explored the application of computing technologies to library operations. The career of Estelle Brodman, PhD, follows the development of these technologies where her contributions have had a major impact across health sciences libraries.
- At the beginning of the computing era, it was assumed that only the very largest libraries would be able to take advantage of these technologies. Dr. Brodman demonstrated that not only could a medium-sized medical library benefit from the technologies but could provide national leadership in their development and application.
- In one of the earliest examples of collaborative computing, predating data networking, Dr. Brodman demonstrated the power of collaboration with projects that included one of the first integrated library systems and an interlibrary loan network that provided the foundation for DOCLINE.

Implications

- Computing and networking technologies have clearly advanced; however, many of the challenges for libraries identified in the earliest work with these technologies remain. The collaborative strategies developed by Dr. Brodman continue to offer significant opportunities for success.
- Research and development in libraries is exciting and rewarding, contributing to the advancement of the profession and securing the position of the library in an academic or clinical care institution.

EARLY WORK

A wonderful convergence occurred with the beginning of Dr. Brodman's career and the very beginnings of computing. In her oral history, Dr. Brodman noted that while she was completing her doctoral degree and teaching at Columbia University ''Vannevar Bush's work ''As We May Think'' [2], predicting many elements of our technological environment including computers and networks in order to make knowledge accessible came out, and everybody began to be very excited about the possibility of that'' [3]. However, Columbia offered limited opportunities for advancement, and when she took the position of chief of the reference division at the Army Medical Library in 1949, she joined a remarkable team led by Dr. Frank

A supplemental appendix is available with the online version of this journal.

B. Rogers, where her early work with information technologies really began. It is worth noting that 1950 marked the first year that computers became commercially available.

At that time, Dr. Brodman described the Army Medical Library, which had a wonderful history, as ''sleepy, unimportant, confusing and confused'' [4]. Along with World War II and the growth of scientific publishing, an Army Medical Library study, whose contributors included Mary Louise Marshall and Janet Doe, had demonstrated the imperative of revitalizing the Army Medical Library [5]. Dr. Rogers was provided with the resources to transform the Army Medical Library into what would become NLM. Very early in that process, it was determined that the Army Medical Library's preeminent contribution to the practice of medicine, the *Index-Catalogue*, could no longer meet the demands of the biomedical community. Dr. Brodman's contribution to the demise of the *Index-Catalogue* was in her role as officer-in-charge for the Welch Survey project, an extraordinary initiative that established both the intellectual rationale and the technical foundations for what would become the Medical Literature Analysis and Retrieval System (MEDLARS) system at NLM [6]. This project provided Dr. Brodman with in-depth exposure to the potential, and to the limitations, of the very first computers, which had been highly secret technology during the war.

LIBRARY–INFORMATION TECHNOLOGY INTERFACE

In 1961, Dr. Brodman left NLM and was appointed director of the Washington University School of Medicine (WUSM) library. Interestingly, the library at Washington University was in a similar state of disrepair, as had been the case for the Army Medical Library. Again, while significant effort was needed to revitalize the library, it also provided a comparable opportunity to explore the use of information technologies. Dr. Brodman realized early on that most medical libraries could not afford the computers and necessary staff for supporting their automation needs. She recognized, however, that many medical libraries were in institutions in which computer systems were already in use for other purposes and that the library could achieve its goals by partnering with these existing computer groups [7]. Dr. Brodman knew that a successful partnership was possible only if the library staff involved with the automation project had a basic understanding of computers so they could effectively communicate with the computer professionals. In 1964, Dr. Brodman required that all library staff receive instruction in data processing, and some were sent to programming classes to ''speed some of the experimental work of the library, which must now wait until a Computer Center's programmer is available'' [8]. In 1965, the library newsletter announced that librarians and programmers would be cross-trained for ''swapping jobs'' [9]. In the few short years that Dr. Brodman had been with the WUSM library, she had made significant progress toward blurring the boundary between librarians and information technology professionals.

Around the same time that the cross-training program was being implemented, the library began offering technology consultation services. The library newsletter from March 1965 noted a program to ''advise on machine methods for storage and retrieval of documents for individuals with files of their own'' [10]. Although it is not clear from the records how extensive or well used this service became, it illustrates the view that computers were becoming increasingly important to management of information and therefore, to librarians as information management professionals. In this case, however, librarians were not only helping people manage their information, they were taking with them knowledge of information technology that they would share in the process.

Under Dr. Brodman's leadership, the library at WUSM began to play a national role in promoting automation in libraries. In September 1963, the library hosted its first of several annual three-day symposia on ''Machine Methods in Libraries.'' These conferences proved to be extremely well received, and the first was attended by ''forty-four librarians and machine experts from other places representing 19 states and Canada'' [11]. Topics presented at the symposium included ''history and philosophy of machines as library aids, unit record machines, computer systems, communication between man and machine, and library problems in automating large collections'' [12].

At about the same time, Dr. Brodman applied for and received a five-year NLM grant to train biomedical computer librarians. Although the grant award was announced in July/August 1965, funding cuts at NLM delayed the program start until late in 1966. The training program supported three predoctoral fellows to work with the library and Washington University Computer Center and to attend classes in computer technology and seminars in computer librarianship. The library was rapidly becoming an incubator for the application of information technology.

PERIODICAL HOLDINGS IN THE LIBRARY OF THE SCHOOL OF MEDICINE (PHILSOM)

Early in her first year at WUSM, Dr. Brodman prepared a development plan that included ''publication of the Library's serial records and monograph holdings in book form, automatic check-in of journals and updating of records, compilation of a subject listing of currently received titles and accounting tabulations for budget and acquisitions purposes'' [13]. The progress of this ambitious development agenda, as well as other investigations, was documented in a series of sixteen articles in the *Bulletin of the Medical Library Association*, ''Mechanization of Library Procedures in the Medium-sized Medical Library,'' which appeared over a period of twelve

years. The Appendix (online) provides a listing of the articles that appeared in this series.

The first article in this series addressed ''The Serial Record'' and documented the rationale for the Periodical Holdings in the Library of the School of Medicine (PHILSOM) development effort. Interestingly, the growth in the literature of the biomedical sciences was exerting significant pressures on research, clinical practice, and libraries. Serious staffing shortages were also being encountered in libraries at a time of significant increases in demand for services—as a result, enhancing operational efficiencies was a priority. At this early stage in the development of automation, only the large, national libraries had the resources to explore these technologies. However, the Washington University efforts were initiated with the hope that providing ''the example of one small library experimenting in one segment of the problem would lead other, similar libraries to start experiments on other segments and thus aid all by multiple approaches.'' Dr. Brodman and colleagues note in this introductory article, with a sort of backhanded optimism, that ''A solution to the entire problem appears remote; nonetheless, the staff of the Washington University School of Medicine (WUSM) Library felt that such steps should be undertaken as were presently possible'' [14].

The first library application, the serial record, may have appeared to be a largely repetitive task suitable for a library automation application, but it proved to be one of the most challenging. At that time, a library's journal collection was managed manually, with each title represented on a paper card contained in a large cabinet, collectively referred to as the Kardex. The journal title's brief bibliographic history was listed on the card. Each time an issue was received, it was manually checked off on the card. Acquisition and bindery information might also be included. What was often a very large cabinet was usually located either behind a circulation desk or in the technical services department. All inquiries concerning a journal required staff mediation.

Referred to as PHILSOM and Periodical Holdings in the Library of the School of Medicine by Subject (PHILSOMS), these early automation projects attempted to extend access to the library's serial records. The objective of PHILSOM was to generate a listing of the journal titles, volumes, and issues in the library's collection and for PHILSOMS to generate a list of journal titles by general subject. These efforts grew into a comprehensive serials management system that included daily or monthly listings of journal issues received by the library, journal issue check-in, missing issue reports, acquisition records, and bindery notification. This project was especially ambitious given the technical limitations of the technology and the management complexities presented by journal publishing.

The technology constraints were formidable. As an example, a standardized computing language, COmmon Business-Oriented Language (COBOL), was desirable, but the library did not have access to a computer system that met the required memory size of 8,192 bytes [15]. All data entry and management were accomplished via the use of 80-column punch cards, which posed very significant space limitations. The basic record for each journal issue was contained on a single card that included a 5-digit identification number, a code indicating whether the title was indexed in *Index Medicus*, an abbreviated title, subscription price, a source code, current volume number, current issue number, publication frequency, number of issues in a volume, and subject code. Needless to say, compressing this much information into very limited space involved the use of a range of codes, representing a variety of information.

While the technical challenges were significant, serials management issues are a special source of frustration for automated systems and were not nearly as apparent when the Kardex was behind the circulation desk or tucked away in technical services. The propensity of journals to change titles, publication frequency, number of issues published, special issues, supplements, and so on added significantly to the challenges of automating the recognition, data coding, and data processing of serial records. Despite the technical obstacles and the management issues, PHILSOM development proved to be an important advancement in library automation. Extending access to library records, even if it was on stacks of printouts, was a major improvement over the mediated requirements of a Kardex. Tracking subscriptions, missing issues, and bindery notifications was also significantly enhanced. As is the case in many automation efforts, surprising side benefits were are also realized. PHILSOM, for example, provided accurate serials statistics—tracking the number of current and noncurrent subscriptions, number of issues received, and number of bound volumes—enhancing library operations. Like many other library automation projects, it was difficult to accurately determine the real costs of the system and whether the goals of operational efficiencies had actually been realized. The distributed nature of the PHILSOM experiment made the costs very difficult to determine [16].

LIBRARY NETWORKS

As the PHILSOM system developed, these efforts began to realize the team's original objectives of encouraging libraries to explore the use of computers to enhance library operations. The very significant costs of computer access resulted in inquiries about shared use of the PHILSOM system. These inquiries led to system modifications supporting networked operations for multiple library partners as well as cost models for providing services for network members. The institutions that made the initial inquiries decided not to pursue the system when confronted with the costs; however, in 1970, Dr. Brodman was successful in recruiting the University of Utah and the University of Missouri to implement the system and become the first libraries in the PHILSOM Network. The technologies of the time—punch cards, mainframe

computers, line printers—presented major challenges in developing and managing a network.

The development of the PHILSOM Network addressed the challenge of each individual library maintaining its own complex bibliographic and operational serial information system. With multiple libraries identifying the numerous changes that are encountered in serials records (title changes, publication frequency changes, new titles, just to name a few), the quality of the PHILSOM system was improved. Real efficiencies were gained by eliminating duplication of effort. However, there was a major obstacle that was never really overcome. The PHILSOM system was originally designed to address the needs of the library at Washington University. All subsequent system implementations required that the library installing the system adjust its local operations. Every institution that joined the network, which eventually totaled eighteen libraries, experienced the difficulties involved and the challenges presented by procedural and organizational change [17,18]. While the system implementations were difficult, the operational results did accomplish the often elusive goals of enhancing library operations and reducing costs [19]. The network was also successful in introducing network members to the power of technology-based collaboration, which might not have been fully appreciated at the time but certainly proved to be valuable in future projects. Finally, in her article ''Backing into Network Operations,'' Dr. Brodman observed that ''Patience, continual work and strong martinis will always be needed by those running library cooperative networks'' [20].

OCTANET

Important outcomes are not always anticipated in a development project, and this was certainly the case with the PHILSOM Network. The original system and the later development of the network were intended to support the management of serials records. As libraries joined the network, a combined listing of all titles, holdings, and related information was generated to assist network members in entering new titles, limiting the duplication of effort in preparing accurate bibliographic information. Interestingly, this feature of the PHILSOM system and service of the PHILSOM Network is only barely recognized in the publications describing PHILSOM. However, astute interlibrary loan staff quickly recognized the value of up-to-date (at least within thirty days) and detailed journal holdings. This union list was particularly useful in the Midcontinental Region of the NLM's Regional Medical Library Program (MCRMLP), where six of the eight resource libraries, which provided the majority of interlibrary loans, were PHILSOM Network members.

An upgrade of the PHILSOM system that made online access possible provided an opportunity to exploit the potential of the PHILSOM union list for interlibrary loan. At Dr. Brodman's direction, a proposal to support software design and, most importantly, telecommunication costs was submitted to the MCRMLP and approved in July 1981, and the development work was completed in March 1982. The resulting system, OCTANET, took full advantage of online access to serials records with the capability of searching for a specific volume and issue, a capability not found in other online interlibrary loan systems. However, the most powerful design feature was a five-level mapping algorithm, which provided a hierarchical routing of interlibrary loan requests [21]. This automated interlibrary loan system provided the foundation for the implementation of a national interlibrary loan network, DOCLINE, by NLM in 1985 [22].

Once again, the OCTANET development project included a feature that proved to have unexpected benefits. In the development plan, the very last objective was to improve communication among the network participants. It was anticipated that a messaging feature would be useful for interlibrary loan referrals. However, this messaging feature turned out to be much more, providing electronic communications among libraries in the MCRMLP. This service introduced network libraries to what would become an essential network resource, email.

INTEGRATED SYSTEMS

By the late 1970s, much of the original automation work done at the WUSM Medical Library was beginning to show its age. The shortcomings of the punch card–based circulation system, upcoming changes in cataloging records, and continued reliance on the library's manual card catalog for monographs led to a 1979 report recommending a new system. The resulting system, known as the Washington University School of Medicine Library's Bibliographic Access and Control System (BACS), was the logical extension of Dr. Brodman's vision of computerized library management [23]. It integrated into one system the circulation and bibliographic access functions for monographs and the serials control system (PHILSOM), while it offered advanced online search features to library patrons. Although BACS was created from a clean slate in the Massachusetts General Hospital Utility Multi-Programming System (MUMPS) programming language, it was based on Dr. Brodman's conceptualization and the workflow models of the previous systems. These have stood the test of time. BACS is still the integrated library system at WUSM's Becker Medical Library. It has seen several enhancements to incorporate new features and an Internet-friendly web interface, but the principal workflow elements remain.

The successful development of BACS and its longevity underscore the importance of the close partnership between librarians and information systems professionals fostered by Dr. Brodman. Library staff members worked hand-in-hand with WUSM Medical Computing Facility programmers to establish system requirements, set priorities, and communicate technical details back to other members of the library staff. Even though the library and computing groups

were organizationally different entities, they worked as one to build the system. Over time, this organizational boundary has evaporated and information technology professionals have become routine library staff members. This is a true testament to the clarity of Dr. Brodman's vision.

RISKS AND REWARDS OF LIBRARY RESEARCH

An extensive record of publication documented the investigation of computer applications at Washington University, and, of these efforts, none provoked more attention than an article that documented a failure. In 1969, an article by Doris Bolef, Lynda Van Wagoner, and Dr. Brodman described an attempt to replace the library's card catalog with a computer-generated book catalog [24]. This ambitious project was designed to integrate acquisitions and cataloging processes with a larger objective, enhancing access to library resources. In the article, the authors described the problems that systems developers encountered—hardware problems, personnel, design issues—but fundamentally the goals of the project were simply beyond the capabilities of the technology of the day. The authors were subjected to a surprising amount of comment and criticism for what was perceived as an attack on the exciting work of automation in libraries.

Not surprisingly, Dr. Brodman did not fail to respond. In ''Reactions to Failures in Library Automation,'' she provided a spirited description of the value of reporting negative results. While clearly annoyed with the criticism, she presented a wonderful explanation of the value of research and development in libraries. She noted that ''Old and established disciplines tend to have an underpinning of sound knowledge of the fundamental laws of their fields … In a new field, however, these fundamental laws are still unknown, and most research must be focused on uncovering them. This is the most arduous, most frustrating, but most exciting, fulfilling and rewarding part of research and development'' [25]. In expressing her enthusiasm for research and demonstrating that enthusiasm through the record of success at her library, Dr. Brodman established an expectation in her library, and in the profession, that research was fundamental. Thereby, she secured for the health sciences library a legitimate claim to a position in the academic community.

CONCLUSION

At the beginning of the computer era, Dr. Brodman recognized the potential of these revolutionary technologies. Her efforts demonstrated their value to libraries of all sizes and the opportunities they offered for applied research. Finally, she cogently summed up her thoughts about the state of library automation and her conviction that librarians were apt proponents for technology in the third edition of the *Handbook of Medical Library Practice* (1970):

> Automation in medical libraries, although it has gone far, is still in the period of growth and development, and, therefore, great changes can be expected for many years to come…Experience has shown the practical drawbacks to its adoption, and familiarity with it has shown that the general understanding of it, and especially the ability to use it, does not require talents greater that those found in most librarians. [26]

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