LAWRENCE A. WOODS
Head, Research and Development
Purdue University Libraries

Applications of Microcomputers in Libraries

Five years ago it was predicted that microcomputers would take the library world by storm. As a matter of fact, this has not happened. Rather, there has been a steady, but quiet, grassroots movement introducing microcomputers not only into traditional areas of library automation, but into areas that previously have had only minimal impact from the electronic revolution.

There are four basic reasons for the slowness in developing library applications on microcomputers. The most important of these is the storage limitation at this stage of microtechnology. Systems people think in terms of kilobytes or megabytes of storage. Libraries are apt to think in terms of the number of characters in a MARC record or in a page of text 8½ by 11 inches. A kilobyte is 1000 characters, or about 2 MARC records. A megabyte is 1 million characters, or about 2000 MARC records. Similarly, a page of text 8½ by 11 inches is about 2 kilobytes, and a megabyte is about 500 pages of text. A typical microcomputer will have 32 or 64 kilobytes of main memory, and perhaps up to a megabyte of floppy disc storage, which could hold around 2000 MARC records. The present upper limit of hard disc storage for microcomputers is around 60 megabytes, which translates into 120,000 MARC records or 30,000 pages of text. Storage technology is changing rapidly and will not be a limiting factor within five to ten years.

A second limitation of microcomputers is the amount of space in which to run a program; this is called "core" in computer jargon. On a larger machine, someone with limited knowledge of programming eventually can make a program work. A microcomputer is not forgiving of inefficient programming. Often a program has to be written on a larger computer, compiled, and then read into the microcomputer. This is called "downloading."

A third factor that has hindered microcomputers from becoming widely used in libraries is the very success of microtechnology. The rate of change of technical breakthroughs has been so rapid that software producers have been reluctant to put large amounts of software development capital into a given state of technology which may be outdated in a couple of years.

Finally, software resource sharing has been minimal in the field. Because of their very nature, microcomputer applications have had a relatively low profile. The cost of the hardware is a small line item in most library budgets. The applications themselves have been largely back-room operations, and no good medium for software exchange has been developed. This problem is being remedied by the publication of several newsletters focusing on the use of microcomputers in libraries, and at least two monographs are being prepared on microcomputers in libraries.

Before proceeding with this discussion, let us look again at the definition of *microcomputer*. Some have defined it as a computer that has 4-bit "word" boundaries, or even 8-bit "word" boundaries. As a matter of fact, 16- and 32-bit microcomputers are becoming widely used. Phsyical size has been another qualifier. In fact, the term *desk-top computer* has come into vogue in some circles. Still another qualifier that has been used is price, using the figures $10,000 or $25,000 as an artificial boundary. For this paper, any machine using a microchip-based central processing unit (CPU) is a microcomputer. They range from 4-bit to 32-bit machines, and vary in price from $800 to $50,000 for a system.

One final disclaimer must be offered. This presentation is taken from work in progress on a monograph to be published by Knowledge Industry Publications and on a SPEC kit for the Association of Research Libraries Office of Management Studies. Some of the applications have not been thoroughly checked, and most have not been evaluated. The applications have been organized into four broad categories: technical processing, public services, management, and a category so broad I have called it "other."

Technical Processing

Acquisitions

Acquisitions is an area that has been slow to be automated. A fully automated acquisition system requires a complex interaction among several data files, and ought to be a data acquisitions system for the library's bibliographic files as well as a materials acquisition system. Several limited acquisition systems have been written on microcomputers.

An early attempt was the order printing system written by Richard Anable at SUNY-Binghamton on an Apple microcomputer. Related pro-

grams produced mailing labels from a vendor file and generated claim letters on request.

More recently, an expanded system was written on a Radio Shack TRS-80 I for the Glendora (California) Public Library by its director, John Jolly. He used ROM Level II Basic and a disc-operating system from Radio Shack called "Apparative." The TRS-80 I model has 48k of main memory and uses two 75k disc drives. The system is rounded out with a Qume Printer and a TRS-80 Line Printer III. The system accepts acquisitions data and prints the order forms, retaining the records on a disc file. Update, receipt and cancellation programs all access the online database. An in-process list is generated which tracks each item from date of order to two months after receipt. The vendor file has online update capability. Other programs running on the microcomputer include a list of city employees with salary, benefits and personnel management information. This program more than justified to the city the purchase of the TRS-80 I for the library.

A similar system was written for a larger microcomputer at Imperial Chemical Industries (ICI) in Great Britain. The ICI system was written on a Jacquard J-500, which has 128k of main memory and uses 250k discs. The software was written in ten days by a professional programmer.[1]

A still more complex system was written for the National Library of Medicine (NLM). The Integrated Library System (ILS) was written to run on several machines including an LSI 11/23, one of the larger microcomputers developed by Digital Equipment Corporation (DEC). A typical configuration to run the software includes the microcomputer, a video terminal, a printer, and disc storage of about 64 megabytes, costing around $50,000. It can be expanded to 4 CRTs, 256 megabytes, and has an online interface to an OCLC terminal. The software is written in MIIS/MUMPS and, since the project was federally sponsored, is available under a license from the National Technical Information Service (NTIS).

Another acquisition system currently under development is being written by John Blair at Texas A&M Medical Sciences Library. The system will run on five interlinked Micromation computers. In addition to acquisitions, it will handle the general accounting for the College of Medicine. A project is also underway to allow remote users to communicate with the reference desk by electronic mail to transmit materials requests and reference questions and to receive research results. A microwave link will replace traditional telephone lines.

Cataloging

Shared cataloging has been the most successful library automation effort, thanks to the early efforts of bibliographic utilities such as OCLC,

RLIN, UTLAS, and WLN. Microcomputers have found a place in the cataloging area also.

Informatic's MiniMarc System runs on a Computer Automation LSI 220 16-bit microcomputer.[2] The MARC database is received on 500 floppy discs. As records are called up and modified, they are transferred to the library's database. The program has been used extensively for conversion projects.

The National Library of Mexico has proposed an ambitious shared cataloging project to run on Ohio Scientific C3-B microcomputers. It is meant to use Ohio Scientific intelligent terminals and clusters of C3-Bs to handle authority files, a bibliographic file and a holdings file. The system will support interactive cataloging. Participants in the project are reported to be the Organization of American States, the National Council for Science and Technology, and the National University of Mexico.

Southern Illinois University has been a real hotbed of microcomputer activity. Using an Apple II+, programmers there have written a program to index a collection of 78rpm records—an interesting marriage of technologies! The microcomputer was purchased through SIU's Friends of the Library. A sorting program called "Data Cope" has been used successfully to sort the data on floppy discs into the desired order. The system is being expanded to incorporate a 10-megabyte Corvus disc.

The School of Library and Information Science at the University of Missouri, Columbia, has written programs in Level II Basic for the TRS-80 to track the progress of titles through the technical processing units of a local public library.

Card Production

Card production is not a complex operation once the data have been collected. Libraries have used machine-produced cards for a number of years, beginning with early MTST applications using IBM Selectric typewriters, and continuing with the card-production services of national bibliographic centers. Several microcomputer systems have emerged for this application.

Warner-Eddison Associates of Cambridge, Massachusetts, has developed a system which runs on a DEC microcomputer, the PDT 150, and is called Inmagic. The microcomputer has 56k of main memory and can use a variety of peripheral storage devices. The software, primarily a database management system for MARC records, is written in Fortran IV. In addition to providing online access and retrieval with Boolean searching, Inmagic produces catalog cards, spine labels, cards, pockets, accession lists, subject bibliographies, and management reports. Cost of a microcomputer-based turnkey system starts at about $1800. A 5000-record system sells for about $7200 and runs on a small minicomputer.

Information Technologists, a consulting firm specializing in microcomputer-based library automation in the Washington, D.C., area has demonstrated catalog card production using standard "off-the-shelf" software modules. Using a North Star Horizon microcomputer they produced a book catalog for a private law library.

The Brighton Postgraduate Medical Center in Great Britain uses a microcomputer-based word processer, the BDP 90-02, to produce catalog cards for a cataloging cooperative of twelve libraries in the South East Thames Regional Health Authority.[3]

Data Entry

Data-entry applications for microcomputers have been popular because of portability of the hardware and freedom from the scheduling conflicts that often typify time-shared data collection systems. Collection of the data is simpler than managing and retrieving the data; hence many have opted for using microcomputer-based systems for data collection and then passing the data to a larger machine environment for manipulation, storage and retrieval.

Information Access Corporation has been using Apple II microcomputers for database input for their Business Index and Legal Resource Index files. Brodart purchased a number of SOL microcomputers for COM catalog shelflist conversion projects. One notable project was for the Los Angeles County Public Library. Although the SOLs are no longer manufactured, Brodart has made them available to replace the OCR update procedures that are now used by many of Brodart's COM catalog customers.

The University of California at Davis is using a DEC LSI 11/2 to build a cataloging database. The system uses a vendor-developed text-editing package and a locally developed key-entry package. It uses DEC's RT/11 operating system and is written in Fortran and Macro Assembler.

The University of Illinois Library is using a Four Phase microcomputer programmed in Vision for general data entry. This system uses 2.5 megabytes of fixed-disc storage and a comparable amount of removable disc storage.

The School of Library and Information Science at the University of Missouri, Columbia, uses a DEC LSI 11/23 to build an in-house automated reference database with three input terminals and dual floppy discs. The sytem runs on software purchased from Charles River Data Systems. Although the main database now resides on an Amdahl mainframe, the library school hopes to transfer the entire operation to the LSI microcomputer.

The University of Nebraska is using a Mohawk Data System, Series 21 for data entry to a batch acquisition system. The computer has 48k of core

memory and uses two eight-inch floppy diskettes with 500k of storage. The CPU for the system is a Z80-based Intel microcomputer and uses Mohawk's Formatted Data Entry Package.

The University of Tennessee is using an IBM 5280 to collect data for its library database, which resides on the university's DEC 10 system. The 5280 provides prompts by field for data entry, and uses floppy-disc mass storage. It has a communications interface to transmit the recorded data and can support multiple terminals.

Serials

Serials control represents the most complex automation challenge in the technical processing area. Even though few really good systems have been written, even on larger machines, microcomputers have begun to have an impact.

Gerald Lundeen, from the Graduate School of Library Studies at the University of Hawaii, reports that he has written a program to generate routing slips for journals received at the GSLS Library on a TRS-80-I. The Integrated Library System at the National Library of Medicine (described earlier) has a journal control subsystem. The master bibliographic file is MARC-compatible, according to NLM, and includes online check-in and routing-slip generation. The system does not yet offer binding control.

Public Services

The public services area was one of the first areas of the library to feel the impact of automation, notably in early circulation system projects. It is in the public sector that microcomputers are likely to have their biggest impact, especially in the home-library interface and in the development of "user-friendly" interfaces to complex databases.

Circulation

The ILS system at NLM includes a circulation subsystem. Its developers emphasize that it is a "collection control" system, not just a circulation control system. In more general terms, it is an "inventory" system, not an "absence" system. It has all the standard features of systems running on larger machines, including bar-code labels and light pens. A unique feature of the sytem is the ability to check items temporarily into a named *cart* and later discharge them onto the shelf (when the cart has been emptied) with a single wand stroke. It attempts to specify the exact whereabouts of all books at all times. Planned expansion of the system will include online catalog access and a portable data-entry system for "shelf-reading" inventory.

The Standard Telecommunications Laboratory in Great Britain has a circulation system for a slide collection which runs on an Exidy Sorcerer.[4] The microcomputer has 32k of main memory and uses two 125k discs. The system, written in-house by a librarian, manages the 10,000-item slide collection. It is an absence system, and data are keyed in at the point of transaction.

The Oak Ridge (Oregon) Public Library has a similar system running on an Ohio Scientific C2-8 PDF. It uses a database management package purchased from Ohio Scientific to manage an annual circulation of 17,000. The librarian, who is the only staff member, was being "drowned" in paperwork, and is now free to manage the collection and handle reference questions.

A number of circulation systems running on larger machines use microcomputers in support roles. Typical of these is the system at Oberlin College. The main system, written originally for Bucknell University, runs on the campus Sigma 9 mainframe. The Intel 8080 microcomputer serves as a front end for the system, and acts as a backup when the Sigma is down. The Intel handles the user interface, formats the transactions for the Sigma, and handles traffic control between seven terminals and the mainframe. The microcomputer uses 48k of main memory and is presently using floppy-disc storage. There are plans to expand the system to Winchester-type hard discs in the future.

There are a number of backups for the Computer Library Services, Inc. (CLSI) circulation system that have been written on Apple II+ microcomputers. Two examples of these are those in use at Johns Hopkins University and at the University of California, Santa Barbara. The Johns Hopkins system uses a Winchester-type hard disc and a Sony Triniton terminal. The Santa Barbara system was developed by Computer Translator, Inc., Provo, Utah, and uses Apple-Soft, Integer Basic, and a Paper Tiger printer. In addition, they are using a word-processing package from Apple for other library applications.

Cincinnati Electronics reportedly has a scaled-down version of their Classic system which runs on a microcomputer as an absence-based circulation system.[5]

Media Centers

An early application of microcomputers in media centers was the Children's Media Database developed by Ted Hines on an Apple II+ at the University of North Carolina, Greensboro.

A commercial turnkey system for media centers has been developed by Research Technology, Inc. The film-booking system, called AMMS (Automated Media Management System), runs on a General Automation 220. It boasts 64k of main memory and 10 megabytes of disc storage. With a single

video terminal and a printer, the system and software sell for just under $50,000. The software is written in Pascal, and the system can be expanded to four terminals.

The Health Science Library at St. Luke's Methodist Hospital in Cedar Rapids, Iowa, has been doing development work on an Apple II+. In addition to an audiovisual inventory system, staff are using the Apple to generate book orders and keep interlibrary loan statistics, and they are developing CAI programs for user orientation and continuing education activities at the hospital.

The School of Library and Information Science at Indiana University has developed a media equipment control system on a Vector Graphics microcomputer. Additional research investigating possible uses of the microcomputer in small Indiana libraries is currently underway.

Reference

UCLA has been experimenting with its REFLES system—Reference Librarian Enhancement System. Designed to run on several different microcomputers, it contains a database of search strategies and ephemeral data. Richard Marcus at the Massachusetts Institute of Technology reportedly has been investigating the possible uses of the microcomputer in reference services.

Current Awareness

The Cincinnati Country Day School Library has been creating subject bibliographies using a program developed in-house on an Apple II+. Work there is progressing on an acquisition system, which will also run on the Apple.

Interlibrary Loan

The University of Missouri, Columbia, has developed a program on a TRS-80 which the local public library uses as a Telenet host. The program enables the library to communicate with other libraries within the local and state library networks regarding interlibrary loan requests and general electronic mail messages.

Database Front-End Processer

Database searching has been an area primarily dominated by professionals because of the complexity of retrieval. The variety of command languages from one system to another has made searching by the end user very difficult. Several alternatives using microcomputers have recently been developed.

Ol'Sam (On-line Database Search Assistance Machine) has been developed by the Franklin Institute Research Laboratories. It runs on a North

Star Horizon microcomputer or other Pascal microsystems. The North Star configuration uses 64k of main memory with 36k of floppy-diskette secondary storage. The system can multiplex the work of two searchers through a single telephone line. It uses a common query language for DIALOG, SDC and NLM. It includes CAI programs that teach online searching offline to save line charges. The system maintains an administrative log of all search activity, and monitors strategy patterns in order to suggest more productive strategies.

The Computer Corporation of America has announced the availability of its Chemical Automated Search Terminal (CAST) System, which is designed especially for chemical information centers. It consists of a CCA microcomputer with 64k of main memory and dual floppy-disc drives. It includes a 1200 baud modem and a printer. The system can access MEDLARS, ICC Chemical Information System, DIALOG, ORBIT, and customized databases.

One of the most interesting microcomputer-based front-end processers was developed at Dartmouth College in conjunction with an online catalog pilot project. The microcomputer used was a Terak 8510A with 24k of main memory and floppy-disc secondary storage. The system, written in Pascal, accesses a Bibliographic Retrieval Services (BRS) database of MARC records built from Dartmouth's OCLC tapes. The MARC records were mapped into standard BRS paragraphs. The Terak prompts the user responses and translates them into BRS commands. The retrieved records can be scanned, stored and manipulated.

Storage and Retrieval

Storage and retrieval systems differ from front-end processers in that they store and manage the information as well as retrieve it. These systems on microcomputers are limited by the storage capacity of microcomputer peripherals, but can still handle quite a respectable database.

Cuadra Associates has developed a system called STAR. It runs on an Alpha Micro, a 16-bit microcomputer with 128k of main memory, and secondary storage of 90 megabytes. Along with a video terminal and printer, the system sells for approximately $40,000. The system allows one to build a customized database. Retrieval by Boolean searching is available. A photocomposition interface allows the user to produce finished copy without an intermediate typesetting step. The system is expandable to eight linked microcomputers which can support a total of 2400 megabytes of disc storage, or close to 4.8 million MARC records.

On the other end of the scale, the California Library Authority for Systems and Services (CLASS) is making available a turnkey retrieval system using a TRS-80 II for about $5000.[6] The system is based on the Golden Retriever developed at Golden Gate University. A new version,

which will run on an Apple computer, reportedly is called Golden Delicious. The system is said to have great potential for circulation or management of small databases.

The Institute for Scientific Information's PRIMATE system also features a database management system which may be used for filing journal articles, memos, correspondence, documents, etc. It can store up to 10,000 records which can be retrieved by keyword. The system can also be used as a front-end processer for online systems such as SDC, BRS and Euronet.

Reserve Book Room

Southern Illinois University has used Apple II+ microcomputers to great advantage in the library's Reserve Book Room. Using Apple-Writer, which they purchased for $75, the staff sends form letters to the faculty requesting and confirming reserve lists. They also use the program to produce bibliographies and search guides for the Library Instruction Office. As items are recalled or requested, they are noted in the system. The output serves as a "high activity" book report, from which the subject librarian considers items in the collection for duplication. Currently being developed is a music reserve catalog, which will include a shelf list, a composer/title index and a course/instructor index.

General Use

Susan Hussie, from the Gretna (Nebraska) Public Library, reports that she uses her microcomputer to schedule activities held at the library. It keeps track of hours worked, vacation and sick leave for all employees. It prepares the budget, conducts the inventory, and prepares book orders. It handles interlibrary loan records, generates lists of fines for collection by the sheriff, and in its spare time, waters the grass and regulates the heat.[7]

Management

Although library management seems a natural for automation efforts, this area has not been influenced heavily by automated systems. Although management modules have been added to circulation and acquisition systems, among others, few stand-alone management systems have been written. Microcomputers are, however, finding their way into library front offices.

Word Processing

Word processing is occurring in libraries in all sizes of machines. A few examples of microcomputer applications are mentioned here.

California Stae University at Northridge is using an Apple II+ for word processing. The "write-on" software module from Apple has been

used successfully to prepare personnel budget projections. Visicalc has also been used for general ledger work in the fiscal office. The system uses a Hy-Type I printer.

Iowa State University is using a Xerox 800 with the vendor's word-processing software for general office production.

Ohio State University purchased a CPT 800 for word processing. It uses 64k of main memory, two eight-inch floppy discs and a Rotary V daisywheel printer. In addition to CPT's Word Processing Package, CP/M Basic is available so the machine can be programmed locally. The system has been used for general correspondence, production of exhibit catalogs, statistical reports for the circulation department, and fund reports for the acquisitions department. The system was purchased by the OSU Friends of the Library.

The University of Western Ontario uses a WD78 word processer with 16k of main memory to maintain personnel files, salary data and statistics. Programmed in Basic, Fortran and Dibol, the machine functions as a front end to the university's DEC 10 mainframe computer.

Southern Illinois University uses an IBM Display writer for general word processing.

Mailing Lists

The Standard Telecommunications Laboratory in Great Britain maintains a mailing list and generates mailing labels on an Exidy Sorcerer.[8] The system uses floppy-disc storage and a commercial software package.

Library Statistics

Southern Illinois University uses an Apple II+ and Visicalc to produce comparative and cumulative statistics for the library's circulation department. A monthly traffic count is maintained, as are the Higher Education General Information Survey (HEGIS) reference statistics. The staff reports that what was formerly a three-day project each month is now performed in forty minutes. Additionally, they are able to generate data that were impractical to collect manually.

Personnel

Southern Illinois University Library is also maintaining a personnel list on its Apple II+. From it are generated internal telephone directories, mailing lists, and a library committee list which includes dates and terms of office. Plans are underway to expand the use of the machine to maintain a number of indexes for library materials. The work is being done with a purchased database management software package.

Friends of the Library

The Saint Louis County Public Library maintains an address list of book donors on its microcomputer. The staff sends acknowledgment letters and meeting announcements to those on the file. A list of library periodical subscriptions is also being maintained.[9]

Other Applications

Research

The microcomputer is a good tool for research, since it can be set up for a project without the extensive and expensive site preparation that larger machines require. The cost of the microcomputer can be included in the grant proposal, and in fact, research on microcomputers is quite attractive to many granting foundations.

Clarion State College in Pennsylvania has set up a microcomputer laboratory with Radio Shack TRS-80s to develop circulation, reference files and union lists for small- and medium-sized rural libraries.[10]

Library schools in Great Britain are doing a great deal of research with microcomputers in the areas of teaching library skills and user interfaces. For example, the College of Librarianship, Wales, is using a Hewlett-Packard 2645A and a microcomputer with floppy discs to teach subject indexing and to construct subject indexes.[11]

The University of Manchester has received a British Libary grant to research the use of microcomputers to simplify the searching of online systems. The work, which is being done in the Computation Department of the Institute of Science and Technology, consists of an automatic translation between the command languages for Euronet, DIALOG and SDC. The interface includes simplified user dialogs, help modules and tutorials. Dr. P.W. Williams is the principal investigator.[12]

At Aston University, a project team headed by Steven Jamieson is using a specially developed microcomputer to develop and test sophisticated retrieval techniques, incluidng relevance-weighting of terms. When perfected on the microcomputer, the techniques will be used at City University, London, to search MEDLINE on BLAISE.[13]

The Central Information Service (CIS) at the University College, London, has done extensive work on microcomputers.[14] Researchers there have simulated DIALOG on a Commodore Pet to teach online searching inexpensively. The program includes a computer-assisted instruction course on search strategy. The software is available from the school on a cassette.[15] A similar program is being written for the Apple. Other applications at CIS are a survey analysis program similar to SPSS, and a mailing list program. "Word Craft," a package developed by Dataview Microcom-

puter Systems, is being used for word processing. CIS has also written simulation programs to teach the creation of accession lists, a MARC editor, and a simulated circulation system.

The University of Sheffield and the University of Pittsburgh are also reported to be using a DIALOG simulation on a Commodore Pet.

OCLC's Channel 2000 project, with the Home Delivery of Library Information program, used a Motorola 6800 microcomputer. The system used a standard telephone set for communication, a standard television set as a monitor, and a keypad for data input. The 6800 can display graphics as well as text. Automatic log-on and log-off capability was built into the microcomputers. The system provided access to mainframe files that included an encyclopedia, library service news, catalog access, community information, and financial services.

Electronic Mail

Edunet, a subsidiary of Educom, has announced the availability of its EASY network access system. Developed at the University of Wisconsin, the system uses an Apple II+ microcomputer. The Apple acts as an interactive terminal to upload files from diskette to Edumail and download messages to its diskette to be examined offline. Connect time on Telenet is reduced drastically, thereby cutting the costs of electronic mail on the system.[16]

Microcomputers as Media

Perhaps the most visible front-office use of microcomputers in libraries is the use of microcomputers as media. The Palo Alto (California) Public Library purchased several microcomputers through its Friends of the Library group for use in the Children's Room. The library stacks programs on cassettes for use in the machines, and has reported heavy and enthusiastic use. The library also is participating in a computer literacy project in the community.[17]

Ohio State University has installed coin-operated Ataris in its Browsing Room and West Campus Learning Resources Center. Each location has an Atari 800, a color monitor, a cassette deck, and prerecorded software. The vendor supplying the microcomputers, Computer Bus, collects the first $25 of income per machine each week, and the library receives the balance. The vendor supplies $150 of software for each machine, and has Commodore Pet microcomputers available, as well as the 400 and 800 Atari models. The user pays twenty-five cents for a 15-minue block of time.

Other libraries providing microcomputers for public use include the Chicago Public Library (Commodore Pet), State of Minnesota Department of Education (200 Apple II+s), the Portage, Michigan, school system (20 Commodore Pets), Menlo Park (California) Public Library (TRS-80s,

Ataris and Commodore Pets), Plattsburgh (New York) Public Library (Apples), Columbus (Ohio) Public Library (9 microcomputers in the main library and 7 in branch libraries).[18]

Microcomputers in School Media Centers

The Pennsylvania Department of Education has encouraged the purchase and use of microcomputers in school media centers. It sponsors an annual Management Awareness Day focusing on microcomputers, and publishes *A Guide to Microcomputers*[19] and *A Guide to Microcomputer Software*[20] for teachers and administrators within the system.

The American Association of School Librarians sponsored a technical session at the 1981 ALA Midwinter meeting in Washington, D.C., on new technology in school media centers. Microcomputers were at the forefront of the discussion. Follow-up meetings are planned for subsequent ALA meetings.

Future Developments

In the area of hardware technology we can expect better and less expensive peripherals. The cost of peripherals can now easily exceed the price of the microcomputer. Fast, inexpensive dot matrix printers will replace the slower, expensive impact printers now typical in a microcomputer configuration. Bubble memory and videodisc technology will push back the storage barriers. The development of larger and faster core memory will speed the processing capability of the microcomputers themselves. Better and more strongly supported languages and operating systems will emerge, such as "Unix," "C," "Ada," and "Forth."

The most important breakthroughs will be in the area of reliable networking. Already, public libraries such as the Pikes Peak Library in Colorado Springs have many users accessing the library system on their own home microcomputers. As network protocols are worked out, we will have access to a truly national resource on our own personal computers in the comfort and privacy of our living rooms.

REFERENCES

1. Winfield, R.P. "An Informal Survey of Operational Microprocesser-based Systems." *Program: Automated Library and Information Systems* 14(July 1980):126.

2. Simpson, George A. *Microcomputers in Library Automation*. McLean, Va.: MITRE Corp., 1978, p. 20.

3. Winfield, "Informal Survey," p. 126.

4. Ibid., pp. 121-26.

5. Simpson, *Microcomputers*, p. 17.

6. *Advanced Technology Libraries* 9(July 1980):7.

7. Kloepper, Dan. "Maxi-Mini-Micro: Microcomputers in Libraries, 15 November 1982." *Nebraska Library Association Quarterly* 8(Winter 1977):30-32.

8. Winfield, "Informal Survey."

9. *Information Retrieval and Library Automation* 16(1980):4.

10. "Computers for Rural Libraries." *LJ/SLJ Hotline* 10(2 March 1981):4.

11. "Using Terminals with Text Editor Facilities for Teaching Index Construction." *British Library Research and Development Newsletter* 20(May 1980):6.

12. "Enhancement of On-line Information Retrieval Using a Microprocesser-Assisted Terminal." *British Library Research and Development Newsletter* 20(May 1980):2.

13. "Interactive Information Retrieval Through an Intelligent Terminal." *British Library Research and Development Newsletter* 20(May 1980):1.

14. Vickery A., and Brooks, H. "Microcomputer, Liberator or Enslaver." In *Fourth International Online Information Meeting, London, 9-11 December 1980*, pp. 387-96. Oxford, Eng.: Learned Information, 1980.

15. "CIS Software Series." *FID News Bulletin* 30(July/Aug. 1980):60.

16. "EASY Cuts EDUMAIL Costs." *Edunet News* 23(Spring 1981):6.

17. "Personal Computer in the Children's Room." *LJ/SLJ Hotline* 10(2 March 1981):4.

18. Lundeen, Gerald. "The Role of Microcomputers in Libraries." *Wilson Library Bulletin* 55(Nov. 1980):178-85.

19. Douglas, Shirley, and Neights, Gary. *A Guide to Microcomputers*. Nazareth, Pa.: Colonial Northampton Intermediate Unit, 1980.

20. _____ . *A Guide to Instructional Microcomputer Software*. Nazareth, Pa.: Colonial Northampton Intermediate Unit, 1980.