Management of Trends in Agricultural Libraries

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ABSTRACT

THIS ARTICLE REVIEWS in a broad way, agricultural library trends of our time. Although a number of trends could have been selected, those included here were chosen for their deep and permanent impact on agricultural libraries. They have considerable significance for change in U.S. agricultural libraries and, therefore, for their management.

THE PURPOSE OF U.S. AGRICULTURAL RESEARCH LIBRARIES

> unless the basic concepts on which a business has been built are visible, clearly understood, and explicitly expressed, the business enterprise is at the mercy of events. Not understanding what it is, what it represents, and what its basic concepts, values, policies, and beliefs are, it cannot rationally change itself. (Drucker, 1973, p. 75)

U.S. agricultural research libraries have been built within the concepts of the land-grant university system. These concepts are put forth in the public laws of the United States:

> That the moneys *(from the sale of the grants of land given to the States by the Federal Government)*...be appropriated to support and maintenance of at least one college where the leading object shall be without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts...in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. (Public Laws of the United States, 1862)

In practice, the land-grant university was to be explicitly anti-elitist. It was, first, to provide instruction, including the classics, to "ordinary" people; second, to extend its knowledge base to those who

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could not qualify as students in the classrooms; and third, to make all human endeavors legitimate subject matter for scientific investigation and scholarship. Prior to the emergence of the land-grant concept in 1862, acceptable scholarship was largely confined to theology, history, arts and letters, law, and, from Germany, medicine. "The land-grants were to be better than Harvard and Yale under the values of democratic America" (McDowell, 1988). Throughout their history the land-grant colleges and universities:

> have emphasized the dignity of labor, the combination of liberal and practical education, social consciousness, a widening opportunity in the democratization of education, the potentiality of science, the freedom of education through secular control, the necessity for citizenship training, the regard for the student and citizen as individual, and the idea of a university serving all the people throughout their lives. (Eddy, 1956, p. 286)

The structure used to carry out the land-grant mission has three components: instruction, legislated by the Morrill Act of 1862; research, legislated by the Hatch Act of 1887; and extension, given recognition by the Smith-Lever Act of 1914. An additional important event in land-grant history was the Second Morrill Act (1890) which legislated not only an annual appropriation to land-grant colleges, but also the equitable division of the annual appropriations between white and black students. The act thus inspired and encouraged the establishment of a number of 1890 land-grant colleges throughout the South.

The libraries built to support this new democratic scholarship were bound to the same concept of anti-elitism as their parent institutions. Theirs is the responsibility for organizing and providing free access to the records of scholarship not only in the classics, but particularly in science applied to agriculture and to peoples' farm and home problems. This responsibility is unique to the land-grant university library. It is sometimes carried out by integrating the scholarly literature of the agricultural sciences, the life sciences, and the related social sciences with the literature of the other broad areas of knowledge—as at Michigan State University and Iowa State University—and sometimes by establishing a separate collection, building, and services—as at the Mann Library at Cornell University and the Steenbock Memorial Library at the University of Wisconsin-Madison. Either way, the responsibility is to serve as the U.S. agricultural research libraries.

The libraries hold sacred as their purpose, collecting and providing free access to the scholarly record by the people, about the people, for the people. Expressed differently, the collections of the land-grant libraries contain records of applied and basic research in the agricultural, life, and related social sciences. These collections support research, classroom instruction, extension service, and free use by all citizens of this nation.

In this responsibility, land-grant university libraries are joined by the National Agricultural Library (NAL) and its system of field libraries, an arm of the U.S. Department of Agriculture (USDA). The collaboration of the USDA and the land-grant universities is a matter of record, having its beginnings in the Adams Act of 1906. Generally, the basis for cooperation has been that the land-grants are concerned with the varying needs of their respective states, and the USDA's concern is with matters at the national level. It is generally conceded that, although the problem of relationship has not been easily solved, over the years the cooperation has proved productive.

TRENDS IN U.S. AGRICULTURAL LIBRARIES

Toward a New Paradigm of Librarianship

Forty years ago a technological revolution took place when the first ENIAC (Electronic Numerical Integrator and Calculator) was turned on. Built at the University of Pennsylvania, its cabinets were nine feet high and weighed thirty tons. It occupied the space of a small gymnasium, was fickle in its performance, and used so much electricity, it is said, that "the lights of Philadelphia dimmed when the ENIAC was turned on" (Forester, 1987). But it was the first revolutionary electronic digital computer capable of performing thousands of calculations per minute.

Today, the United States is being revolutionized by the impact of powerful computers and telecommunications. The driving force of the technology is its power to generate types of information which heretofore have been unthinkable, store information in small spaces, retrieve and manipulate it with dazzling speed, and transmit it to a distant location within seconds.

This high technology is producing a society in which information, or knowledge capital, is emerging as a key economic resource. In its report, *Global Competition: The New Reality* (1985), the President's Commission on Industrial Competitiveness concluded that success in international trade strongly depends on science, technology, and the control of information. Brandin and Harrison (1987) in their book *The Technology War* say:

> The Technology War is about the worldwide race to capture the lead in the strategic technology: information technology. Those that prevail in this war will control the resources of the world; they will control their Lebensraum; they will be the next global powers....Information wealth is becoming a new type of capital known as knowledge capital. (p. v)

In short, those with access to, and control of, information will be the power brokers of the future. They will possess information capital, the new strategic commodity. If any nation is to remain internationally competitive in the information age, it must concern itself with developing in its citizens, scholars, and leaders the capability of managing and using information.

This is not a new concept in the United States; it was the very reason for the establishment of the land-grant university. The need for the people to have access to information was seen as the essence of a democracy. Access to information, however, has been based in the print tradition and, today, information is produced increasingly by the computer, stored in electronic form, and distributed via telecommunications. The technology has infused information with a new power and a new level of significance. Information has become a strategic commodity in the global economy. The Japanese and European governments, and a host of other nations, have perceived the need for a competitive edge in information technology. The need of the people to exploit information is still a matter of supporting a democratic way of life, but today it is also at the heart of any nation's ability to remain as a competitor in the global economy. As we move toward the twenty-first century, we will have to shift perceptions and abilities from information in traditional print format to information in electronic form.

Within land-grant universities, librarians, traditional custodians of scholarly information, are faced with an anomaly. Information is being generated in electronic form. The model of theories, practices, and standards used to provide access to knowledge has been based in the print tradition; librarians will have to adopt new theories and practices for providing users with electronic information. A new paradigm is needed. Thomas Kuhn's (1970) conceptual framework of paradigms would suggest that the profession is experiencing a paradigm shift.

In particular, land-grant libraries of the United States have a special responsibility of assuring access to knowledge for scholarly users, and for ordinary people seeking solutions to their problems at work and home. Libraries do not have the option of saying that their mission is to provide access to the records of civilization—as long as those records are in print form. And yet they have. Historically, universities, using computer files, have created data archives to store magnetic tapes and data documentation. The archivist consults the user who needs the data and then extracts the desired subset. Other machine-readable forms of information have been acquired and held by computing centers because of their experience with systems needed to access the data. In both arrangements a precedent was set; machine-readable information was different from print and libraries as a rule did not handle it.

Initially, databases often duplicated print sources, but, increasingly, machine-readable sources have become the unique medium for information. As long as data remained available in both print and electronic form, use of computerized data was a matter of preference. Now that critical sources of research data appear only in electronic formats, use of the computer for access to research information has become a necessity.

In the agricultural and biological area, database growth is tremendous and might well be leading other scientific disciplines. For example, several agencies within the USDA, including the Crop Reporting Board, the Economic Research Service, and the Foreign Agricultural Service, generate and sell data on floppy diskettes and magnetic tape. The department releases data concerning volatile prices, online, through the EDI system of the Martin Marietta Company. The Department of the Interior's Fish and Wildlife Service, as well as the Bureau of Land Management, generates habitat and ecological data in electronic form. The National Library of Medicine and the Department of Energy co-sponsor a compilation of genetic sequences which is processed on a computer at the Los Alamos National Laboratory and then released to the public through a private contractor (IntelliGenetics) as the *GenBank* database. At the international level, the United Nations' Food and Agriculture Organization (FAO) issues several types of data on magnetic tape, including production and trade statistics.

The application of computer and telecommunications technology to research information changes the means of storage and the mode of access to research data. However, it does not change the mission of the land-grant library. In the future, these libraries will have no alternative but to collect major portions of the records of scholarship in electronic form. The real issues, then, are how libraries can make the transition to the electronic storage and dissemination of research data effectively, and how they can best serve patrons with new information technologies. The operating premise is that scholarly information in electronic format must be incorporated seamlessly into the library's collection.

The scenario for which the library is responsible is that of users at workstations (where workstation is each user's microcomputer) accessing data and the full-text of literature regardless of their location, and downloading, manipulating, and integrating pertinent segments into personal databases. The locus for the user's access to scholarly information will be outside the four walls of the library—i.e., in offices, laboratories, and homes. The library must also ensure that a wide variety of resources is accessible, that their availability is publicized to users in an intelligible way, that the data resources are usable, that the user's workstation can perform certain functions well, and that the telecommunications systems have sufficient bandwidths to support the sharing of information resources among institutions across the state, the nation, and the world. Implementing the electronic library requires focusing on users at their workstations.

Today these users are all busy with a variety of activities at their workstations. If, for example, the user is an extension agent, he or she may be using files of extension news and activities, sending electronic mail, reading bulletin boards, using county and city data online, or downloading parts of a file on pest management to pass on to the farmer. If, however, the user is an instructor, he or she may be using the workstation to create courseware to be loaded onto a local area network for use by students, or searching a bibliographic database to update class reading lists, or creating a database of student profiles from an administrative information file. If the user is a researcher, he or she may be checking a new gene sequence in the GenBank on the local mainframe, or running a SAS program to analyze data, or downloading citations and abstracts into a personal bibliographic file, or sending the latest version of a manuscript to a colleague, or simply managing grant funds.

What these users have in common is the fact that these activities are handled by computers and telecommunications. Often, however, the activities are being carried out by individuals independently of each other which results in duplication of resources and a lack of compatability of hardware, software, and networks. It is essential that users at their workstations be supported by a systematic order of things.

In this electronic world of the user, it is clear that the electronic library will be but one component and this component cannot be planned and provided separately from the total information processing environment of the users. Overall, the system of hardware, software, and communications networks needs to:

—link county extension offices, campus faculty, and administrative units to each other and to national and international networks;
—accommodate a variety of tasks carried out by faculty, students, staff, administrators, and extension agents;
—support the systematic organization of, and access to, bibliographic, numeric, demographic, and full-text databases for online access;
—permit the sharing of information resources across the state and national networks;
—support the storage and transmission of administrative information;
—support workstations with adequate speed, storage, and resolution for a variety of information activities including use of audio and graphics;
—provide a user interface which is "intuitive, consistent and standard... in which the user has illusion of total control...the response time is always fantastic." (King, 1988, p. 164)

In conclusion, some illustrations of the effects of the computer technology revolution are offered—Mann Library at Cornell University was the site for the case study.

—Staff throughout the library depend on the smooth functioning of a technical infrastructure of workstations, networks, large computers, and software for the performance of daily work and for the delivery of essential library services.
—Reference staff include a computer files librarian, an interface and database designer, a computing statistician, two programmers, and three information literacy specialists.
—All staff handle electronic information, but 50 percent of the staff are predominantly responsible for electronic information.
—All staff members attend workshops on such topics as campus mainframes, the library's computing environment, SAS, and dBase.
—Research and development projects in the library explore applications of emerging information technologies in the control and delivery of scholarly information in electronic form.

—Recent advances in mass storage and display technology are used for the control and delivery of electronic full-text with graphics.
—Catalogers question the constraints of the MARC record for an online environment and information in electronic form; a cataloger's job description requires knowledge of the principles of relational databases.

Toward a Crisis in Publishing

More Money for Less of the Publishing. Libraries, generally, are in an era of spending increased amounts of money to collect a decreasing proportion of the scholarly record. This is felt particularly strongly by science and technology libraries. For example, in Cornell University's Mann Library which collects materials in the agricultural, biological, nutritional, and related social sciences, the acquisitions expenditures have increased 523 percent since 1970/71, but the cost of journals in these subject areas has increased by over 647 percent.

The phenomenon of spiraling journal costs, particularly in science and technology, is well documented. In particular, an ARL commissioned study on serial prices and costs provides a good exposé (Association of Research Libraries [ARL], 1989).

It is helpful in examining the nature of this trend to again use Mann Library as a case study. As a major research library in agriculture, biology, and the social sciences, Mann's buying power for journals has been affected by fluctuations in currency exchange rates, extraordinary price increases, and a phenomenal increase in the number of scientific journals.

About 48 percent of Mann Library's serials expenditures are for foreign journals. Price increases of greater than 20 percent were quite common in the period 1985-87. Fluctuations in the currency exchange rate are responsible for much of the decrease in buying power. Some key examples are provided in Table 1.

The net change in buying power of the U.S. dollar from 1970 to 1988 (March) ranges from -36.9 percent against the British pound to -84 percent against the French franc. The effect is exacerbated as the importance of European commercial journal publishers has increased over the last two decades.

Another effect on buying power is the increase in scientic journal prices. The subject areas in which Mann Library collects are among the most expensive and have been subject to the highest price increases. Table 2 ranks twenty-six subject categories by average price per journal title. The bulk of Mann's acquisitions dollars are spent in the categories "zoology" and "mathematics," etc. (which includes plant science, geology, and general science) which in terms of expense also rank third and fourth respectively.

Table 3 shows an annual rate of price increase for biology journals of 13.5 percent, the highest in the sciences. Since 1971, Mann Library has

TABLE 1
FOREIGN EXCHANGE RATES
1970-1987
(IN U.S. CENTS PER UNIT OF FOREIGN CURRENCY)

	Year	*Austria (schilling)*	*France (franc)*	*Germany F.R. (deutsche mark)*	*Japan (yen)*	*Netherlands (guilder)*	*Switz (franc)*	*UK (pound)*
	1970	3.87	18.09	27.42	0.28	27.65	23.21	239.51
	1975	5.75	23.35	40.73	0.34	39.63	38.74	222.16
	1980	7.73	23.69	55.09	0.44	50.37	59.71	232.58
	1985	4.88	11.23	37.27	0.42	30.39	41.14	129.74
June	1986	6.21	13.95	43.62	0.56	38.69	52.15	147.58
March	1987	7.75	16.52	55.01	0.66	48.69	65.75	161.82
March	1988	8.46	17.52	59.31	0.77	52.81	71.84	177.71
Value of U.S. dollar 1985-1988		-73%	-84%	-59%	-83%	-74%	-75%	-36.9%

Sources: 1970-1985, *U.S. Statistical Abstract.* Figures are annual averages (except 1986).
March 1987 and March 1988, *Wall Street Journal.*

TABLE 2
AMERICAN LIBRARY ASSOCIATION
LIBRARY MATERIALS PRICE INDEX COMMITTEE
SUBJECT CATEGORIES IN RANK ORDER

	Category	*1988*	*Rank (88)*	*Rank (72)*
	Soviet Translations	$592.22	*	*
1	Chemistry and physics	$329.99	1	1
2	Medicine	$180.67	2	2
3	Mathematics, etc.	$159.33	3	3
4	Zoology	$127.33	4	4
5	Engineering	$114.83	5	6
6	U.S. including Soviet	$105.45	6	8
7	Psychology	$100.57	7	5
8	U.S. overall	$77.93	8	7
9	Sociology and anthropology	$64.27	9	16
10	Home Economics	$54.73	10	10
11	Business and economics	$53.89	11	11
12	Journalism	$53.39	12	18
13	Library Science	$51.61	13	14
14	Education	$47.95	14	13
15	Industrial arts	$44.20	15	17
16	Labor and industrial relations	$44.06	16	25
17	Law	$43.33	17	9
18	Political science	$41.55	18	19
19	Agriculture	$33.56	19	24
20	Fine and applied arts	$32.43	20	20
21	History	$30.16	21	21
22	Physical education	$28.60	22	15
23	General	$28.29	23	12
24	Literature and language	$28.04	24	22
25	Philosophy and religion	$27.09	25	23
26	Childrens	$16.39	26	26

*Not separately indexed in 1972.
Sources: 1972 Brown, N. B. (1972). Price indexes for 1972: U.S. periodicals and serial services. *Library Journal, 97*(3), 2355-2357.
1988 Knapp, L. C., & Lenzini, R. T. (1988). Price index for 1988: U.S. periodicals, *Library Journal, 113*(7), 35-41.

tracked price increases of a representative sample or "market basket" of biological sciences journals. Table 4 shows these data. Mann's response to the problem of journal prices has been classic—i.e., cancel subscriptions, reduce expenditures on books, and devote a larger portion of the budget to serials, forego new subscriptions, except for the most essential purchases, increase the budget. Figure 1 provides a graphic indication of the degree to which research libraries are shifting acquisitions expenditures into serials subscriptions. This table and the accompanying explanatory text is from the ARL report cited in Table 3.

As a science library, Mann allocates a much larger proportion of its acquisitions budget to serials than to monographs. The highest proportion in recent years was 74 percent. Over the past four years it has gone up from 60 percent to 67 percent and will probably continue to climb under present conditions.

TABLE 3
ANNUAL RATE OF INCREASE
SCIENTIFIC JOURNALS

Academic Field	*Percentage of Increase*
Physical science	12.6
Technology	11.4
Medical	11.8
Earth science	12.1
Biology	13.5

Source: Association of Research Libraries. (1989). *Report of the Association of Research Libraries project on serials prices.* Washington, DC: ARL.

Mann's buying power has also been affected by the number of journals available. It has been estimated that there are currently over 100,000 science and technology journals published worldwide and that number increases by 2 percent annually. Commercial publishers in particular have taken to a practice called "twigging." This is the creation of new journals which deal with increasingly specialized narrow subdivisions of a subject area. These tend to spring up in the "hot" areas of science and have been a successful tactic in increasing market share in high impact science disciplines. This is at least partially driven by a problem in the system of scholarly communication and reward. To secure tenure and grants, academics are under pressure to publish—over 1 million articles in science and technology are published each year. Authors are demanding more outlets for their manuscripts. Commercial publishers have moved quickly to meet the demand for new publishing outlets and have aggressively pursued publication of high impact journals formerly published by nonprofit scholarly associations. In addition to the proliferation of publications, there is a heavy monopoly in the publishing industry, with a handful of publishers publishing a majority of the high impact titles.

The library market is vulnerable to these consolidation practices. The producers and consumers of the research—i.e., university faculty—are parties to the process as they strive to publish in the most significant journals. These journals are marketed to university research libraries which cannot afford them but which cannot afford to be without them if researchers are to be productive.

Many believe that the solution lies in changing the patterns of scholarly communication and reward, to reduce the number and increase the quality of publications, and to make noncommercial channels of communication the preferrred means of reporting research results. This will take years to implement and an unprecedented level of cooperation and communication among universities, scientists, publishers, and librarians.

Mann Library annually reviews about 1,500 journals which are of

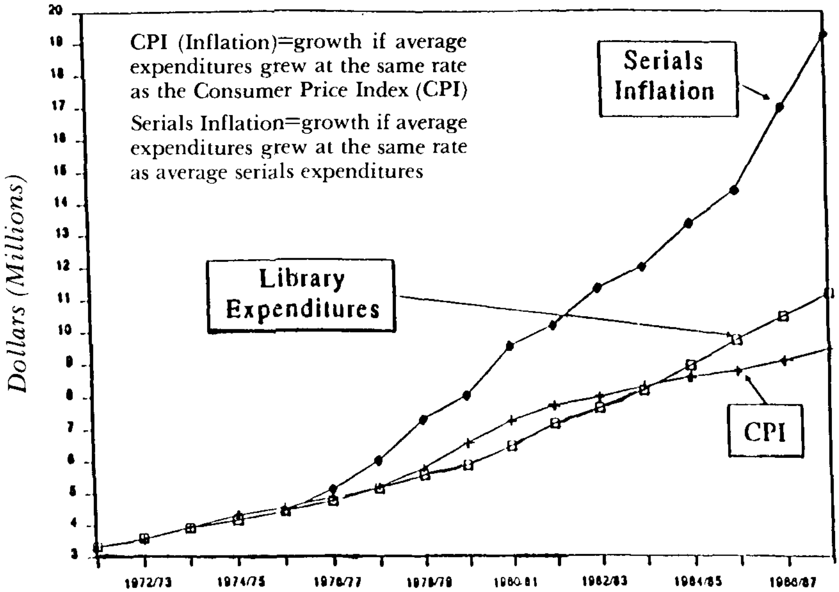
TABLE 4
MANN LIBRARY BIOLOGICAL SCIENCES JOURNALS
PRICE INCREASES OF A REPRESENTATIVE SAMPLE

Title	*1971*	*1989*
Applied and environmental microbiology	$40.00	$220.00
Biochemical journal	$108.00	$1,355.00
Biochemical medicine	$22.00	$224.00
Biochemica et biophysica acta**	$540.00	$4,786.66
Biological abstracts	$880.00	$5,290.00
Bulletin of environmental contamination and toxicology	$28.75	$299.50
Developmental psychobiology	$15.00	$189.00
European journal of biochemistry	$211.60	$1,643.00
Experimental cell research	$180.00	$960.00
International journal of psychoanalysis**	$12.50	$120.00
Journal of agricultural science	$39.00	$305.00
Journal of association of official analytical chemists	$17.50	$125.00
Journal of biological chemistry	$75.00	$490.00
Journal of experimental biology	$39.00	$685.00
Journal of general microbiology	$100.00	$670.00
Journal of ichthyology	$78.00	$505.00
Journal of molecular biology	$209.60	$1,368.00
Journal of neurochemistry	$72.36	$810.00
Molecular biology*	$115.00	$935.00
Parasitology	$46.00	$288.00
Perceptual and motor skills	$40.00	$189.00
Photochemistry and photobiology	$80.00	$420.00
Phytochemistry	$67.50	$580.00
Psychological reports	$40.00	$195.00
Psychosomatic medicine	$20.00	$195.00
Soil biology and biochemistry	$30.00	$330.00
Virology	$100.00	$768.00
Total cost for year	$3,206.81	$23,945.16
Percent change in total cost		646.7
Average cost/title	$118.77	$886.86
Adjusted for cancellations:		
Adjusted total cost for year	$2,539.31	$18,103.50
Percent change in adjusted total		612.9
Adjusted average cost/title	$105.80	$754.31

* cancelled beginning 1984
** cancelled beginning 1989
Total increase of cost of sample titles 1971-1989 = 646.7 percent
Total increase of cost of sample titles 1971-1989 (minus cancellations) = 612.9 percent

Mann Library annually reviews about 1,500 journals which are of potential interest to faculty and staff. The majority of the titles are new. Of these, an average of about 150 paid subscriptions are added each year. Three years ago Mann began to compile a desiderata file of new highly desirable but unaffordable journal titles. There are now 275 titles in this file costing over $38,000. The file does not include hundreds of additional titles rejected over the past three years which would be desirable but are simply beyond the budget; nor does it take into account the thousands of desirable titles rejected over the past two decades.

Production of Information in Electronic Form. The publication of data and information in electronic form is a result of the revolution in



The figure was created using actual 1975-76 average budget figures multiplied by the same growth seen each year for serials expenditures

Figure 1. Overall ARL Library Expenditures and the Consumer Price Index

computer technology. Increasingly, information is being produced and stored in electronic form. Much of this electronic information has never before been available, and, even where it is also available in print, the retrieval, manipulation, and synthesis capabilities of the electronic media enable uses which are impossible or impractical with print formats. Users need these capabilities.

Today a proliferation of computer files is available. In 1985 there were 1,084 numeric databases listed in the *Computer Readable Databases Directory* (1989). In 1988 the directory listed 1,278 numeric databases—an 18 percent increase in three years. In 1985 the directory listed 535 full-text databases and in 1988 1,285—a 140 percent increase in three years. In 1978 the online information industry generated over $500 million in revenues. In 1987 its revenues were over $3 billion—a 500 percent increase. In 1983 the civilian departments in the federal government distributed 1,461 information products electronically. In 1987 they distributed 6,261 products electronically (U.S. Congress, Office of Technology Assessment [OTA], 1988).

This new form of publishing and this new genre of information demands "add-on" dollars to the acquisitions budget. The costs of electronic resources can be examined by again using Mann Library as a case study.

Costs of Electronic Resources

Microcomputer Software. The software collection in Mann Library provides a good example of the demand for electronic resources. In 1988/89, the software packages circulated 47,376 times. This phenomenal use level of a small collection represents a higher annual circulation count than book circulation counts in seven of the seventeen Cornell libraries. The use per title is the highest of any collection on campus. The average cost per title of a stand-alone software package is $250. Software packages which will be used on a local area network cost an average of $750.

CD-ROM (Compact Disk-Read Only Memory). Mann's investment in compact disc products has proven extraordinarily cost effective. A research project to gauge the use of CD-ROM databases revealed an average of 318 uses per month of an agricultural database. This averages out to about $1 per search compared with an average online search cost of $15.29. The purchase of CD-ROM databases has dramatically increased the use of these databases by democratizing the access. Thousands of students who could not afford to pay for online searches are now searching these databases without charge in Mann Library. Mann currently has a desiderata file of CD-ROM purchases totaling over $25,000 per year.

Computer Files. These include both bibliographic databases and non-bibliographic files including numeric, full-text, directory, statistical, graphic, and transactional data. The files are commonly on magnetic tape, but may also be available on a floppy disc or CD-ROM. Examples of bibliographic data files mounted on the campus mainframes are AGRICOLA (1980-present) and subsets of BIOSIS (1985-present) in nutrition, entomology, and genetics.

The costs of mounting bibliographic databases are high. For example, the cost of acquiring the *Life Sciences Collection* to mount locally for unlimited use by faculty and students is $60,795 per year not including computer storage cost. The cost of acquiring the last eight years of *Science Citation Index* for local access, exclusive of computer storage, is about $150,000 per year.

Mann is presently conducting research to examine under which circumstances the local loading of bibliographic files is cost effective. The AGRICOLA database and three BIOSIS subsets have been loaded on a campus mainframe and are searchable in offices and laboratories using BRS software.

Using AGRICOLA as the example, costs are listed for: local loading of AGRICOLA for multiple access from offices and laboratories (see Table 5), compact disc based workstation access in the library (see Table 6), and remote online access through BRS and DIALOG (see Table 7).

As is clear, costs and use may not justify purchase of computerized information for loading locally on campus facilities; providing access to files stored elsewhere can be the most cost-effective means of making

TABLE 5
COSTS OF LOCAL ONLINE ACCESS
AGRICOLA (3 YEARS)

Item	*Amount*
Magnetic storage	$35,000
*Search-and-retrieval software license	
Year 1 license	$19,000-52,000+
Year 1 maintenance	$1,800-4,950+
Year 2	$2,400-6,600+
Year 3	$2,400-6,600+
Total	$25,600-70,150+
**Database acquisition (NTIS charges)	
Year 1	$5,000
Year 2	$1,500
Year 3	$1,500
Total	$8,000
***Database processing (BRS Onsite charges)	
Year 1	$10,000
Year 2	$6,000
Year 3	$6,000
Total	$22,000
†Database use (NAL charges)	
Year 1	$5,000
Year 2	$5,000
Year 3	$5,000
Total	$15,000
Grand total	$105,600-150,150 plus computer

*Search-and-retrieval software based on current BRS/Search pricing
**Database acquisition fees based on current NTIS charges
***Database processing fees based on BRS "Onsite" program
†Database use fees based on NAL's charges to land-grant institutions

TABLE 6
COSTS OF COMPACT DISK BASED WORKSTATION ACCESS
AGRICOLA (3 YEARS)

Hardware	*Amount*
PC-AT compatible micro with fixed disk	$2,000
CD drive	$850
Printer	$450
Workstation furniture	$500
Total	$3,800
Data	*Amount*
Archival disks	$1,000
Year 1 subscription	$950
Year 2 subscription	$950
Year 3 subscription	$950
Total	$3,850
Grand total	$7,650

the information available. Mann currently spends about $36,000 per year to subsidize access to remote databases for faculty and students. Given the growth in number and importance of databases and the impracticality of mounting them all locally, this expenditure could easily double over the next four years. Examples of nonbibliographic computer files purchased are:

—Geoecology Data Base (environmental data)
—GenBank (genetic code sequence library)
—Census of Agriculture
—Foreign Production, Supply and Distribution of Agricultural Commodities (1947-1988)
—Climod (weather data)
—Farm Land Value, 1982.

Hundreds of new computer files are becoming available each year in the subject areas of agricultural libraries. The growth in computer files can be documented by an analysis of *Computer-Readable Databases: A Directory and Sourcebook* (1989). This source lists 1,184 files in Science/Technology/Engineering and 433 files in health and life sciences. The *Agricultural Databases Directory* (Williams & Robbins, 1985, which is already four years out of date, lists 428 databases in the field of agriculture alone. Libraries are still at the beginning of what will be a phenomenal growth in database publishing and use of electronic information resources.

Mann collects computer files in the same subject areas as the print collection—i.e., agriculture, life sciences, some social sciences, and medicine. The range of prices has been from $150 to $10,000. Government tapes have cost around $200 but the price is increasing and will range from $1,000 to $6,000. Table 8, based on projections at Mann Library, indicates budget increases needed to purchase electronic formats at appropriate levels.

Inaccessibility of Electronic Data

Federal Data. The federal government collects and distributes vast quantities of information within the general collection areas of agriculture and the life sciences and the related social sciences, including education and nutritional science.

The Department of Agriculture is one of the largest producers of electronic information in these areas, but the Bureau of the Census probably produces more total data on computer files than any other government agency. Many other government agencies produce computer files, varying widely in number, kind, and quality of databases available. Mann attempted to learn more about data availability by selecting six files listed in Zarozny (1987) which seemed likely to be of interest to patrons. Inquiries were sent to the source agencies asking

TABLE 7
COSTS OF REMOTE ONLINE ACCESS THROUGH BRS AND DIALOG AGRICOLA (3 YEARS)

Year 1	$2,755
Year 2	3,168
*Year 3	$792
Total	$6,715

*Year in which AGRICOLA on CD was installed.

TABLE 8
INCREASE NEEDED IN ACQUISITIONS DOLLARS FOR PURCHASE OF ELECTRONIC RESOURCES (EXPRESSED IN 88/89 TERMS)

Resource	*Dollar Increase*	*Percentage of Total Acquisitions*
Microcomputer software	12,000	1.4
CD-ROM	25,000	2.9
Computer files	120,000	14.3
Access	36,000	4.3
Total	193,000	22.9

about access to those specific files and requesting a list of all other computer files. The agencies were: the Office of Migratory Bird Management of the Fish and Wildlife Service; U.S. Geological Survey, Coastal and Estuarine Assessments Branch; and the National Oceanographic Data Center (NODC) of the National Oceanic and Atmospheric Administration; Environmental Analysis Branch of the Army Corps of Engineers; and Fire and Aviation Management within the U.S. Forest Service. Two agncies provided extensive documentation on ways of accessing a variety of data files—Earth Sciences Data Directory and the NODC Users Guide. One agency sent an explanation of why it prefers to process data requests within its office (Duck Breeding Ground Survey), and one sent documentation for a single file (National Forest Fire Occurrence Data Library). The office of the Army Corps of Engineers, listed in Zarozny (1987), called to say that it was not aware of having any computer data.

This small sample is representative of the difficulties encountered in locating computer files within government agencies. A similar "form" request to USDA agencies resulted in the same range of responses. Agencies often do not understand a general library request for data, and in many cases the agency has no set mechanism for public access to their electronically stored information. This confusion is the outcome of a lack of policy in the federal government. The Office of

Technology Assessment recently released a report addressing the issue. The thrust of the report is illustrated by the following quote:

> OTA has concluded that congressional action is urgently needed to resolve Federal information dissemination issues and to set the direction of Federal activities for years to come. The government is at a crucial point where opportunities presented by the information technologies, such as productivity and cost-effective improvements, are substantial. However, the stakes, including preservation and/or enhancement of public access to government information plus maintenance of the fiscal and administrative responsibilities of the agencies, are high and need to be carefully balanced by Congress. (U.S. Congress, OTA, 1988)

A coherent policy is crucial. Presently, agencies disseminate data for the cost of a blank tape or they charge from $150 to $6,000 for a tape. In all cases the tapes contain raw data. The decision of who should provide what level of access to federal information has profound implications for continued equitable access to that information. Many questions need answers. Who should have government information? Who should get it free and who should have to pay? How should it be distributed? Who should be allowed to make a profit from it?

The same principles which lay behind the creation of the Federal Depository Library program should drive the policies covering electronic information. Taxes pay for the generation of the information and taxpayers should not have to pay again to use it. In addition, the information must be freely available to the citizens of this nation if a democracy is to be sustained. The premise is that libraries should disseminate electronic information as they do print.

In the absence of a federal policy on how the federal government's electronic data will be made accessible, private enterprises are stepping in and creating value-added data products. They purchase federal data, add ease-of-use features, statistical or graphics software, or additional information, and sell the enhanced product. In some cases they merge data from several sources to create a product to appeal to a specific audience.

An example of such value-added products is the Agribusiness database produced by Pioneer Hi-Bred. This database, accessible through the Dialog system, contains selected full-text federal and state information as well as bibliographic citations to the literature from several hundred journals.

AgriData, based in Milwaukee, Wisconsin, offers access to USDA information through its own dial-up system. Agribusiness also uses the same data. Both of these companies have created value-added databases. They have added related files from state and private sources to complement the federal files. Furthermore, in the case of Agribusiness, the data are mastered onto a compact disc every three months.

This multiplicity creates a dilemma which is well illustrated by *Vegetable Situation and Outlook Annual Yearbook* (USDA, 1988). The yearbook is produced by the Economic Research Service and contains time series on production for various vegetable crops and a narrative summary of the statistics. In 1988 the annual data were issued by the USDA on November 1 and transmitted to their EDI system that same day. Dialcom loaded the narrative portion of the report. Martin Marietta loaded the full tables. The USDA received the paper copy from the printer on November 18th. Presumably this paper copy was mailed to subscribers within the next few weeks. The data were loaded onto the Agribusiness file on DIALOG on November 29th and they appeared on the compact disc dated 1985-November 1988 distributed by Agribusiness in January 1989. If a depository library were only receiving the microform it could be 1990 before receipt depending on the status and efficiency of the company with the microfiche contract. To provide access to any other formats would require the depository library to pay additional costs.

Private Data. Data ownership can create barriers to data sharing. Researchers are hesitant to share their raw data, both because it represents their "capital" and lest it be subject to misuse. There is, however, a trend toward increased sharing.

Professors are creating local databases to be accessed by the members of their laboratories or for their students to use. Researchers in similar fields are trading data. At the national level there is also some sharing of data files. GenBank is an example of such a file. In 1982 the GenBank Genetic Sequence Data Bank was created by the National Institutes of Health (NIH). The database is housed on the computers at the Los Alamos National Laboratory and access is provided by IntelliGenetics, Inc. of Mountain View, California. The database aims to be a complete record of reported nucleic acid sequences and is cataloged and annotated for sites of biological significance. Researchers are encouraged to submit sequences to the databank. There is no cost for submission.

As the number of files grows, and the awareness of the value of computer files spreads, the pressure to share data will increase. This trend can be accelerated if libraries and other information providers create databases which list computer files. For example, BIOSIS plans to create a list of data sets of use to biologists and put the list on their online system.

The print industry has developed a reasonably efficient and effective method of distributing monographs and serials. Through vendors, jobbers, established catalogs of in-print materials, and direct mail lists, publishers are able to inform libraries about their publications. By comparison, computer files can and are "published" by almost anyone with access to the hardware which generates the information. Most electronic information producers do not yet realize that libraries might be interested in computer files; they tend to focus marketing on the end-user. Because of these differences, locating computer files is a more complicated and extensive process than locating print materials. At the federal level, the National Technical Information Service (NTIS) markets some data sets but has no monopoloy or mandate to serve as a clearinghouse.

Fragile Data. Data collected by agencies or companies for their own purposes can be of interest to researchers. Often, outsiders are granted access to the data or the agency ships the data to another machine designed for public access. At other times the agency generates a print report. Sometimes the next block of data is loaded into the agency's system and the earlier data are discarded. For example, the Chicago Board of Trade collects daily data on trading activity. These data are cumulated into monthly summaries and published as print tables. The computer files of the data remain on the computers until the space is needed to generate another summary, generally about two months. The earlier files are then deleted. The original data of the individual trader activity is archived in case the Board of Trade needs to re-examine it, but those data are confidential and cannot be released. A researcher wanting to chart patterns in trading has to rekey the monthly summary data from the print tables.

If agencies are unwilling or unable to archive and distribute historical data for public use, libraries should establish arrangements to be the depository for datasets in a particular subject area along the pattern of the RLIN conspectus. Alternate solutions would be the creation of an official archive or, in the case of federal information, the designation of an existing federal agency as an archive.

The routine reviewing structure that exists for print materials has not been established for computer files. Until this exists, gaining access to electronic information will be an extremely time-consuming process.

In summary, the trend toward a crisis in publishing is characterized by:

—the expenditure of increasing amounts of money to buy less of the scholarly publishing due to poor foreign exchange rates on the American dollar and price increases of publications far beyond the inflation rates in the costs of publishing;
—increase in publishing driven by twigging, the development of new areas of knowledge, and the publish or perish syndrome;
—the production of information in electronic form in both the public and private sectors driving the need for "add-on" acquisitions dollars;
—lack of structure to allow systematic review and acquisition of electronic information;
—failure of the federal government to provide a cohesive policy for the dissemination of electronic information; and
—erosion of equitable access to federal information in electronic formats.

Deterioration of the Records of Agricultural Science Scholarship

The Library of Congress, the National Library of Medicine, and the National Agricultural Library hold approximately 5 million volumes in the fields of science and technology. Of these, about 1 million are threatened by serious deterioration. In the major research libraries across the United States, the number is closer to 25 percent of each collection which is in jeopardy.

Within this body of materials there can be none of greater importance to this country and to the world than the records of knowledge in the agricultural sciences. They do not simply provide solutions to farmers' problems but are the basis for helping the world to feed itself. The agricultural libraries of this nation are responsible for preserving this heritage and passing it on to scholars and citizens of tomorrow. Today the body of literature in the agricultural sciences is immense and growing fiercely. In the 1940s, the *Bibliography of Agriculture* provided fewer than 10,000 citations to the primary and specialized literature. In recent years, there have been 200,000 citations per year to journal articles, reports, and monographs in the agricultural sciences. There are 12,000 journals alone in the agricultural sciences and approximately 100,000 scientific and technical journals published in the world.

Before preservation of the agricultural science literature can proceed systematically, this vast amount of publishing must be sorted through to identify a heritage collection. A heritage collection can be defined as that material which provides optimal value to researchers, teachers, and policy makers in the agricultural sciences.

Such a comprehensive work has never been undertaken, but broadly it would involve the identification, from the inception of publishing in a given discipline to the present, of the most significant primary monographs, primary serials, reference collection titles, and specialized literature idiosyncratic to that discipline—e.g., *Working Papers* in Agricultural Economics. The heritage collection would be selected to provide a rounded selection of literature in the disciplines to serve research, instruction, and policy making. This differs, for example, from the "most important" literature identified by the Institute for Scientific Information through its analysis of journal citations. That analysis is almost exclusively of research literature. It is also important that the heritage collection be selected not just on a quantitative basis, which is the case with citation counting, but on the basis of quality. This does not exclude citation analysis, but does require other mechanisms to introduce the quality factor, such as review by librarians, many scholars, and national and international associations.

In 1986, the Commission on Preservation and Access was established as a result of recommendations by a committee sponsored by the Council on Library Resources. The primary goal of the commission is to "foster, develop and support systematic and purposeful collaboration among all libraries...to ensure the preservation of the human record"

(Council on Library Resources Reports [CLR], 1988). The modus operandi is to support a range of research and demonstration projects, consultants, technical advice, and scholarly expertise necessary for the development of a massive preservation effort.

The establishment of the commission gives weight to the significance and magnitude of the preservation problem in the United States. The actual preservation decisions and tasks, however, still have to be carried out and funded at the local level, probably within a consortium arrangement. For agricultural libraries this means a grassroots level preservation program stimulated and carried out by a collaboration of land-grant libraries and the National Agricultural Library. A blueprint needs to be developed for preserving the heritage collection of agricultural science literature to be passed on to the United States of tomorrow.

One way of approaching preservation would be discipline by discipline. The process would involve:

1. identification of the heritage list;
2. review of the titles on the list for severely embrittled volumes, and decisions made to replace those with commercially available microform or reprint, or to microfilm—preserving or not preserving original plates, or to photocopy, again with or without preserving original plates; and
3. review of the titles on the list for conservation in their original condition, and decisions made to restore bindings, recase, reback, repair, or resew.

Table 9 contains cost estimates for various preservation and conservation activities. Figures not attributed to other sources are based on studies at Mann Library; these are consistent with comparable figures at other institutions.

Although microfilm currently represents the best and most cost-effective method, there are other means of preservation storage. These include magnetic storage of images on videotape, encoded information on computer tape and discs, and laser-based digital/optical systems. These vary in ease of use, performance, cost of originals and copies, equipment requirements, methods of reproduction, and storage capacity. There are special technical factors to be considered in developing electronic storage systems for preservation, and it has been suggested that this is an important area in which the Commission on Preservation and Access could become involved (CLR Reports, 1988). Optical media are particularly suited to preservation needs in science and technology.

It is important that the national scholarly associations be made aware of the need for preservation of the literature of their disciplines. Their support and efforts will be very helpful as libraries pursue funding for these programs.

Toward a New Literacy

Literacy can be defined as having the skills one needs to find, use,

TABLE 9
COST FIGURES FOR PRESERVATION AND CONSERVATION ACTIVITIES

Activity	*Average Cost/Volume ($)*
*Microfilming	61.64
Photocopy	80.00
Preservation of original plates (est. = 17/volume)	51.00
Recasing	25.00
Reback	28.00
Restore binding	60.00
Repair, resew, rebind	200.00
Rudimentary repair	65.00

*Microfilming costs are based on: (1) data from recent participation in the RLG Cooperative Preservation Microfilming Program (CPMP), (2) Patti McClung's cost analysis of the CPMP participant's operations, and (3) completion of McClung's "Worksheet for estimating project costs" (pp. 169-170 in *Preservation Microfilming-A guide for librarians and archivists.* Chicago, IL: ALA, 1987).

and communicate the information necessary to survive in society. The basic skills of literacy as we know it today are the abilities to read and write (Webster's, 1976). As Benjamin Compaine (1984) of the Center for Information Policy Research at Harvard University points out, this has not always been the case, however (p. 6). Before the written record came into widespread use in eleventh-century England, the oral tradition dominated. To be literate meant the ability to compose and recite orally. The spoken word was the legally valid record.

The emergence of the quill pen and the production of written texts on paper were the beginning of the technologies which have brought us to the current concept of literacy; in addition, the steam driven rotary press, the spread of railroads, and innovation in the manufacturing of paper have also played a significant role in stimulating development of literacy skills which enable individuals to find, use, and communicate the information needed to function in society. The current notion of literacy has evolved from the technology of the quill pen, paper, movable type, and the mechanically powered rotary press. The group of skills called *literacy* has evolved with technology and use of information in the print tradition.

Today, information is produced by computer. It is stored in electronic form, retrieved in complex ways, and distributed via telecommunications. As we move toward the twenty-first century, this technology increasingly will be the means of generating and storing information. To be in a position to exploit information—i.e., to create, locate, use, and distribute information—society will have to shift its perceptions and abilities related to information formats. Individuals will have to acquire a new bundle of information skills necessary to function in society; in practice they will have to expand the traditional skills of literacy. This new literacy is not simply about programming computers or working a computer; it is not about computer literacy—that is too narrow. This new level of literacy has to do with understanding the role and power of information in society, its use, and misuse; being able to handle the varieties of information formats; understanding the systems used in organizing information; and being able to generate and manipulate information using electronic processes.

The foundation of this new literacy is the social and cultural change being driven by the increasing use of computer technology. It is clear that there is already precedent in history for the influence of technology on literacy. History shows that literacy is dynamic and not static. Today computer technology is being placed in the hands of the people. Millions will be faced with a new way of dealing with substance. Computer technology and telecommunications is forcing a fundamental innovation in the means for using and communicating information. In short, it is forcing an expansion of traditional literacy skills.

In the literature of education today one can find extensive acknowledgment of the reality of the computer technology and information era. One can also find extensive examination of what constitutes an excellent undergraduate education for the 1980s with particular concern expressed for the state of student literacy. Interestingly, however, it is impossible to find any discussion of the implication of information technology for traditional literacy and the responsibility of undergraduate education to respond to this. For example, *A Nation at Risk* (U.S. Department of Education, 1983) states that effective participation in our "learning society" requires each person to be able to manage complex information in electronic and digital form and therefore places great importance on computer literacy. This is not enough; it is too narrow. The forward-looking discussion paper by Benjamin Compaine (1984) does actually address a concept of "new literacy." He asserts that computer literacy is not enough and then strongly presents the possibility that a new literacy might indeed evolve as the result of the information age. This is not enough either. The development of a level of literacy essential to functioning in society cannot be left simply to evolution. It has to be cognitively developed.

Among those who should be most concerned about the implications of information technology on literacy in society are educators, particularly in terms of curriculum design. Questions need to be raised concerning what schools and higher education should be teaching. If the education community is slow to understand and respond to changes, the loss will be in the long term effects on society and its inability to compete with others who are more responsive as educators.

Bernice MacDonald (1966), in *Literacy Activities in Public Libraries,* identified the question: "Is it the library's job to teach?" and concluded that the debate was probably won by those who said: "It is the library's job to see that the teaching gets done" (p. 24).

Libraries have a long history of involvement in literacy programs. Democratization of society and its concern with every citizen's need to know have put a premium on the individual's ability to read (Monroe, 1986). Public libraries have held the philosophy that:

> the public library has a responsibility to maintain the climate for use of the library's resources; a literate society is essential to its continued use. As Ranganathan has made clear, libraries have a responsibility to their resources to see that they are used by people who need them. (MacDonald, 1966, p. 35)

Helen Lyman (1977), in *Literacy and the Nation's Libraries,* perceived literacy as providing the power to the literate to deal with the tasks of daily living.

In the land-grant university environment, the same question and answer are pertinent. In fact, traditionally libraries have done some teaching. The purpose has been to instruct in the use of specific bibliographic tools. As some of these tools have become computerized, a number of libraries have taught users how to work with the electronic versions.

This does not acknowledge the basic principle at issue. The technology of the computer is forcing a fundamental innovation in the way all information will be conceptualized, retrieved, analyzed, and synthesized. As the transition occurs from resources in print to electronic form, the traditional skills of reading and writing are no longer sufficient. To these must be added new skills of retrieving information from a variety of electronic systems and formats and of organizing and manipulating information using electronic processes. The basic principle at issue is to produce students who will be electronically literate. Libraries need to teach, or see that teaching occurs, to provide students with the computer skills required to find, use, and communicate information as it moves from the print tradition to the electronic.

In practical terms it could be said that information literate graduates will:

—understand standard systems for the organization of information;
—have the ability to retrieve information from a variety of systems and in various formats; and
—have the ability to organize, manage, and access information for various purposes.

Examples of skills that students will have include:

—use of telecommunications software and systems;
—use of command languages and Boolean logic to search computerized databases and files on mainframes;
—use of network connections to download information and store it on a floppy disc;
—use of microcomputer software such as word processors, hypertext, database management packages; and
—use of the online catalog to locate library holdings records.

The case has been made earlier in this article that if the United States is to remain internationally competitive in an age when information has become a strategic commodity, libraries, and land-grant libraries particularly, must take responsibility for applying modern computer technologies to the storage, retrieval, and management of information. The followup case is now being made that libraries must also concern themselves with developing in the user, expanded literacy skills appropriate to being able to make use of this information. In the land-grant spirit, the libraries must help people help themselves.

TRENDS IN LAND-GRANT UNIVERSITIES

This article began by reviewing the land-grant mission—one of the great and enduring ideas in American education. Senator Morrill's fundamental idea in the mid-nineteenth century was to link the knowledge generated within the university to solving the everyday problems of the people.

Morrill applied the idea to agriculture since that was the principal occupation of a large number of the population.

> The draftsmen of the Morrill Act were wise enough to foresee that this might not always be so. They carefully included in their stated objective the promotion of "the liberal and practical education of the industrial classes in the several pursuits and professions in life." (Fleming, 1987, p. 11)

This article will conclude by reviewing briefly the perspective of the 1980s on the conduct of that historic mission.

At this point in the history of the land-grant "contract," the colleges of agriculture in the land-grant universities are being challenged to reassess seriously their interpretation and implementation of the land-grant "contract." The substance of the challenge is expressed in an article by McDowell (1988):

> The conclusion is clear. Without change, the land-grant colleges of agriculture will find themselves caught in a downward spiral of ever declining political and budgetary support. Faculty will increasingly set their own agenda in response to the highest grant or contract bidder. The land-grant universities will become as bad as Harvard and Yale, producing knowledge fundamentally oriented to special interests rather than broadly based public interest.
>
> The alternative calls for leadership, especially from the traditional agricultural groups. They must act to reverse the spiral by insisting that the colleges of agriculture address issues important to non-farming audiences. (pp. 18-21)

In another article Schuh (1986) states:

> The land-grant universities have lost their way. Faculties have become introverted in their disciplines...land-grant universities have found it difficult to relate to new and changed social conditions.
>
> For these institutions to be relevant to the problems of society, they need major changes in their programs. But for a variety of reasons many land-grant universities find themselves paralyzed. Somewhat surprisingly each university considers its particular problems unique. This is not the case. The important problems are systemic.

> The basic challenge of today's land-grant university is to bridge the gap between society's current problems and the frontiers of knowledge.
>
> To meet this challenge presidents, deans and faculty must reinstill a mission orientation into our land-grant universities. They must revitalize the tripartite mission of teaching, research and extension...to devise solutions for the pressing problems of our society.

Connor (1989) observes:

> Undergraduate enrollment in the agricultural sciences at land-grant universities declined by 38 percent in the nine years from 1978 to 1987 according to a 1988 report to the National Association of State Universities and Land-Grant Colleges. All disciplines experienced a decline except for food science/human nutrition and related biological/physical sciences...agricultural colleges have a definite enrollment problem.

The agricultural libraries of the United States are inextricably bound to the land-grant mission and its implementation. These libraries have the responsibility to understand the perspective of the 1980s on the mission and its implementation, and to ally themselves with courses of action identified for the 1990s. The following are emerging priorities established by at least one college of agriculture and life sciences in the United States; most of these are similar to priorities recently recommended within the USDA (USDA, Joint Council), 1989:

—food safety and nutrition;
—environmental issues;
—profitability and competitiveness of food and agricultural businesses;
—community and rural development;
—biotechnology and biological research;
—improving educational opportunities for underrepresented minority undergraduate and graduate students;
—the changing mix of undergraduate students and the cost of higher education; and
—global agriculture and food systems.

If these challenges are not addressed successfully, what will be the cost?

> There will still be universities where the land-grants are now and they may even retain the land-grant designation as a historical curiosity. Their faculty will likely think of them as great centers for higher learning. But like Harvard, Yale and MIT, they will be sold piecemeal to the highest bidders. They will serve and produce society's new elites, but they will no longer serve those who cannot qualify to sit in their classrooms. (Connor, 1989)

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