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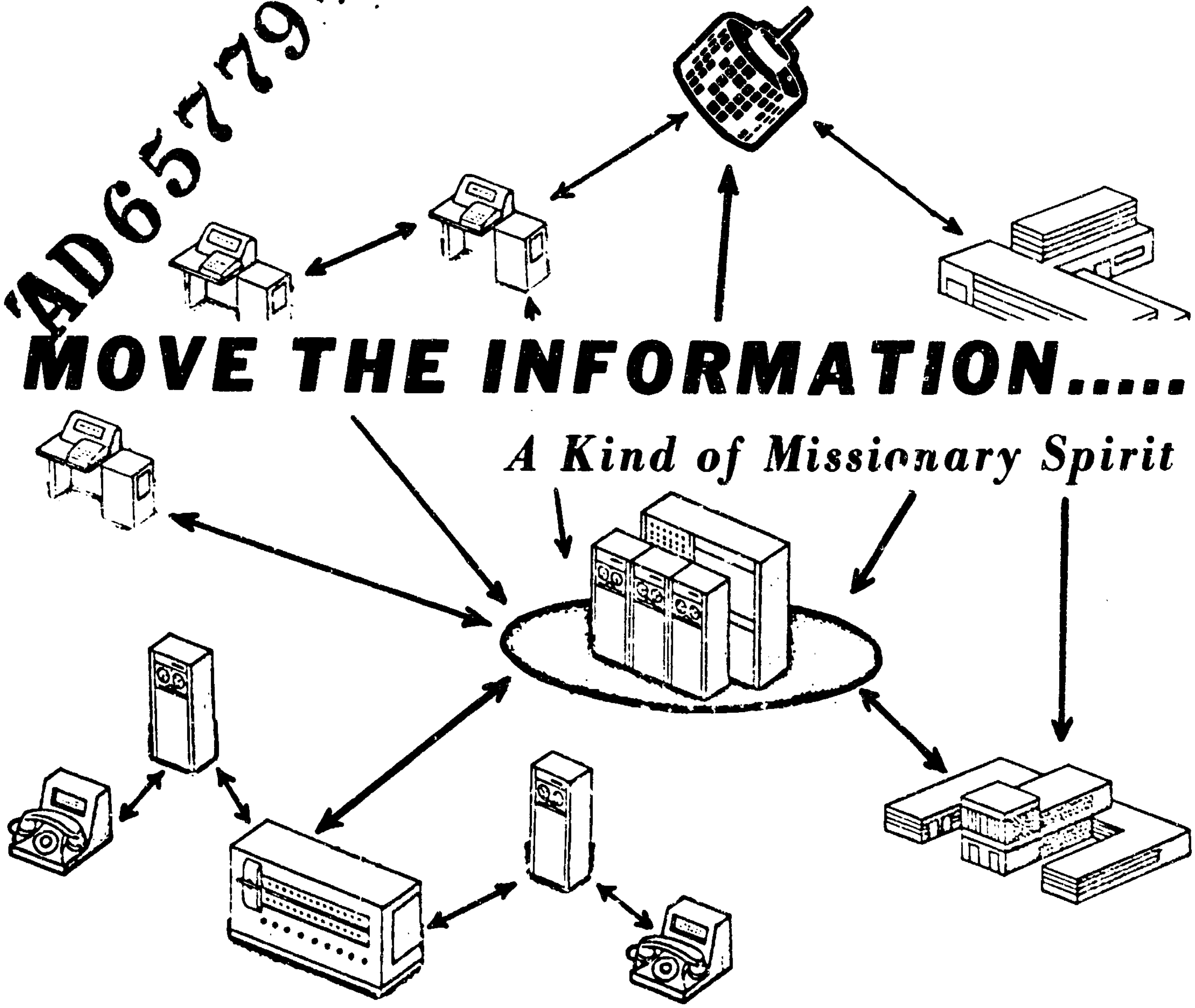

MOVE THE INFORMATION.....

A Kind of Missionary Spirit

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MOVE THE INFORMATION.....

A Kind of Missionary Spirit[1]

Rowena W. Swanson
Directorate of Information Sciences

Paper prepared for presentation at the 75th Annual Meeting, American Society for Engineering Education, Michigan State University, East Lansing, June 19-22, 1967

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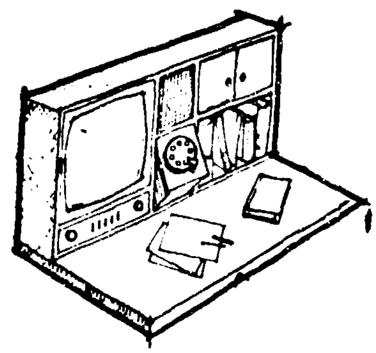
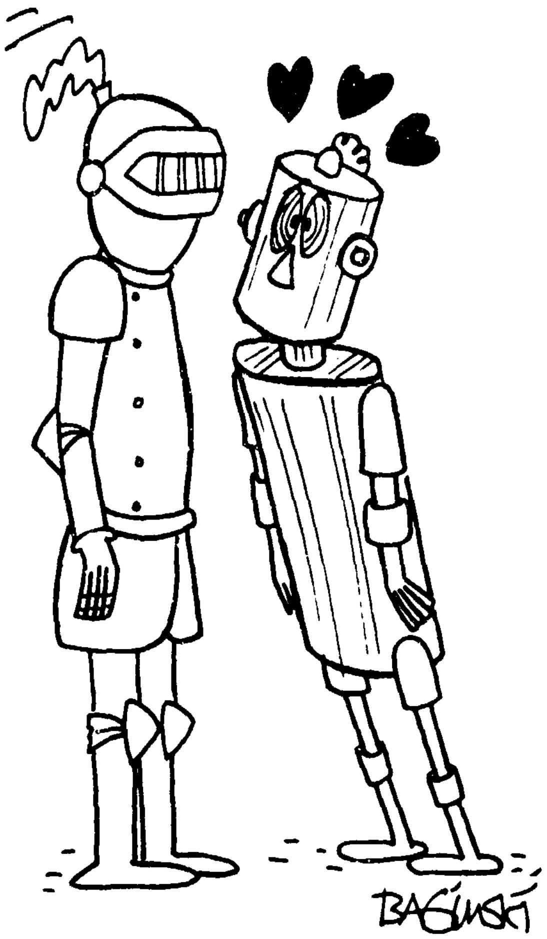


1. I owe the subtitle of this paper to Mildred P. Frary who used the phrase in commenting on Los Angeles in a panel discussion on "How School Library Supervisors of Three Cities Are Contributing to Solutions of Educational Problems." In Mary Helen Mehar, ed. School Library Supervision in Large Cities. Proceedings of a Conference, Sept. 23-25, 1964. Washington, D.C.: U.S. Office of Education, 1966. OE-15055; Circular No. 775. At p. 11. (Available from GPO, 50¢)* I detected in many papers cited in mine "a kind of missionary spirit." Perhaps one must have this human element to do really good work in any service-oriented profession.

* Items that are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402, will be so marked in the footnotes and Bibliography.

Move the Information .....



Industrial Research, June 1966

2. B. D. Thomas. "Our New Age of Civilization: An Age of Research." Battelle Technical Review, vol. 15, no. 2 (Feb. 1966) 7-12.

What has been is what will be,
and what has been done is what will be done;
and there is nothing new under the sun.
<u>Ecclesiastes</u> 1:9

Science appears to be the priming cap
that has set off a social explosion.
B. D. Thomas[2]

A. C. McClurg & Co. adverstisement

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PREFACE

I was asked to give a paper at a session of the 75th Annual Meeting of the American Society for Engineering Education (ASEE) organized by the Engineering School Libraries Committee. The session is entitled: "National Trends in Information Systems." The topic was left optional.

The invitation coincided with two other events. One of these was a part-time detail I had begun several months previously for the U.S. Office of Education's (OE) Library and Information Science Research Program. My own work for the Directorate of Information Sciences, Air Force Office of Scientific Research (AFOSR), concerns basic research. A portion of the OE program is more directly related to library operations and the implementation of library systems than AFOSR's. The second was designation by the Advanced Research Projects Agency of AFOSR as agent for a manpower survey in the information processing field. Thinking co-jointly about these three programs began to raise questions at the operational end of the spectrum. What should people who are recommending and installing systems be charged with knowing about what has been done and what can be done now? What are the manpower problems being faced in system design and implementation?

ASEE's invitation was fortuitous. I did not need to write this paper, but I did need to know what I report here. Although I do not relish writing, it seemed important to share the time-consuming reading and reference work.

Move the Information . . . . .

3. Summary of Activities Toward Interagency Coordination. Report of the Committee on Government Operations, United States Senate, Made by its Subcommittee on Reorganization and International Organizations. U.S. Senate, 89th Cong., 1st Sess., 24 June 1965. Senate Rept. No. 369. At p. 16.

4. Anon. "The Era of 'Total' Information." Dun's Review and Modern Industry, vol. 87 (Sept. 1965) 132-135, at 132.

5. Anon. "The Information Revolution." Dun's Review and Modern Industry, (Sept. 1966) 130-131, 199-200, at 131.

6. Inventory of Automatic Data Processing Equipment in the Federal Government. Washington, D.C.: Bureau of the Budget, July 1966. (Available from GPO, $1.75) At p. 10.

INTRODUCTION

In some circles, information is coming to be regarded, like steel and wheat, as a commodity. The Senate Committee on Government Operations has stated:

> Information is an agency resource, a Federal, National, and international resource.[3]

Dun's Review calls information "industry's single most important commodity."[4] L.W. Lynett, president of the Administrative Management Society, links company survival to its effective management of information.

> Quite aside from the quality of its products or services, a company's competitive survival may well hinge on the way in which it manages information -- the sureness with which it maintains control over costs and the speed and resiliency with which it reacts to shifts in demands, actions of competitors, emergency needs of customers or developments in its own technology.[5]

Investment in this commodity is great. The Senate Committee Report puts a dollar expenditure exceeding $200 million on information storage and retrieval systems in science and technology during Fiscal Year 1965. This amount is additional to a billion dollars for the purchase, lease, and use of implementing hardware. The Bureau of the Budget estimated total automated data processing costs for federal systems (salaries, contractual services, rental, purchase, maintenance, and site preparation) at $1182 millions and $1292 millions for Fiscal Years 1966 and 1967, respectively.[6]

The growth in popular emphasis on information has paralleled the evolution of machines for processing it. Extent of the impact of computers is reflected in President Johnson's directive last June to the heads of the federal departments and agencies:

> I want the head of every Federal agency to explore and apply all possible means to use the electronic computer to do a better job.[7]

Public fear of the computer as a major source of unemployment was the principal motivating force for the establishment of the National Commission on Technology, Automation, and Economic Progress.[8] A major public education program may be necessary to convey an understanding of the national employment picture as is reported by Martin Gainsbrugh in the December 1966 issue of Datamation.[9]

Spectacular computational and accounting feats have been performed by computers. Yet an AFIPS brochure on "The Quiet Revolution" states:

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7. Lyndon B. Johnson. "Memorandum for Heads of Departments and Agencies." Washington, D.C.: The White House, 28 June 1966. In Fisher Howe, The Computer and Foreign Affairs, Some First Thoughts. Washington, D.C.: Dept. of State, 1966. Occasional Papers, No. 1.

8. Harold R. Bowen, et al. Technology and the American Economy. Washington, D.C.: National Commission on Technology, Automation, and Economic Progress, Feb. 1966. Volume I. (Available from GPO, 75¢)

9. Martin R. Gainsbrugh. "Automation's Role in Employment." Datamation, vol. 12, no. 12 (Dec. 1966) 28-32.

10. Anon. The Quiet Revolution: Computers Come of Age. New York: American Federation of Information Processing Societies, (1966). At p. 11.

11. E. E. Morison. Men, Machines and Modern Times. Cambridge: MIT Press, 1966. (I owe this citation to Gerd Korman's Letter to the Editor, Science, vol. 156, no. 3771 (7 April 1967) 11-12)

12. Gilbert Burck and the Editors of Fortune. The Computer Age and Its Potential For Management. New York: Harper and Rowe, 1965, at p. 2-3.

> The full potential of the computer is just now being grasped. .....
> Our attempts to use this new tool to improve our world are limited only by our own imagination - and by the shortage of people who understand the computer.[10]

There may be more people who understand how to write instructions for a computer than who understand how to organize the information it is to process.

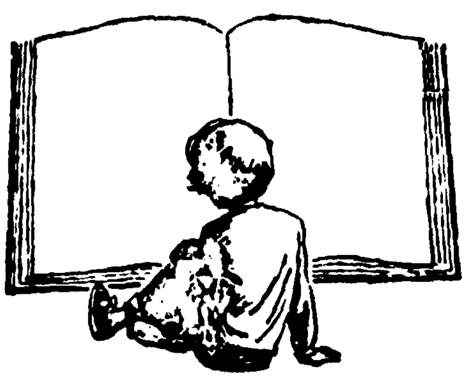
> I think we may have more difficulty in exploring the full limits of the computer than we have had with earlier gadgets. I think there may be more danger in the period of trial and error than there has been with earlier devices. These earlier devices - looms, engines, generators - resisted at critical points human ignorance and stupidity. Overloaded, abused, they stopped work, stalled, broke down, blew up, and there was the end of it. Thus they set clear limits to man's ineptitudes. For the computer the limits, I believe, are not so obvious. Used in ignorance or stupidity, asked a foolish question, it does not collapse; it goes on to answer a fool according to his folly. And the questioner being a fool will go on to act on the reply.[11]

The computer affords the opportunity to "enlarge brainpower," but it is also "a kind of Universal Disciplinarian:"

> One characteristic of the computer that makes it unique among technical achievements is that it has forced men to think about what they are doing with clarity and precision. A man cannot instruct the computer to perform usefully until he has arduously thought through what he is up to in the first place, and where he wants to go from there. Even scientists, once they have wrestled with a computer's demands on knowledge and logic, are astonished to discover how much of their mental activity travels in ruts. The rethinking process gets more difficult as the computer gets better.[12]

Recognition of the significance of and need for information is having salutary social effects. It is introducing small- and large-scale cooperative projects, among libraries and among government, industry, and university groups. It is introducing inquiry into better use of technological and human resources at a national level that crosses organizational boundaries. It is creating unprecedented analysis of the aims of education, and it is beginning to produce programs for student and adult education that should enable our people to progress individually and collectively.

This paper records activities in the development and improvement of information systems and in the education and training of people who will man them and bring them to higher levels of sophistication and value.



Lippincott
advertisement

13. Anon. "Over 1000 Areas of Application of Computers." Computers and Automation, vol. 15, no. 6 (June 1966) 88-92.

Trends in processing information

a paradox

Information processing is kin to breathing for the human being. He does some of it involuntarily. He adds to the involuntary store in his repertoire as he learns and gains experience.

The computer, within very recent history, has come to be looked on as "the information-processing machine," probably by people who work with it and know what it processes as well as by the general public. The "me too" phenomenon of ever expanding application of computers to information processing needs has been inescapable, and rightly so. (Computers and Automation lists over 1000 categories of current application).[13]

Growth in sophisticated use of the machines has been uneven. Systems of great complexity and computation power have been and are being developed for military, industrial, and scientific purposes. Scientist-users, from John von Neumann and his colleagues to today's Cullers, Estrins, and Slotnicks, have been principal contributors to advancements stemming from their own needs. Industrial applications have motivated some machine modifications. Military laboratories are experimenting with complex hardware configurations. Paradoxically, information-processing achievements by "information scientists" in "information centers" have been few.

Since I am a member of the information sciences group, I venture an explanation for the paradox. This group has been concerned primarily with the technical report literature that began to accumulate during the Office of Scientific Research and Development (OSRD) days of World War II. Vannevar Bush, OSRD director and a developer of the differential analyzer, was a strong proponent of broad dissemination of the information that would be declassified and an advocate, as well, of continued basic research and a "National Research Foundation" having a responsibility for directing announcement and distribution of the literature.[14] Information centers and a National Science Foundation became realities. However, many personnel, at least in the centers, were initially untrained for their jobs. Bush's challenge, in a 1945 Atlantic Monthly paper,[15] to consider mechanization of information-processing activities was accepted, but not by information center people. Nor by librarians who, with their liberal arts backgrounds and 15 credit-hours of library instruction, tended to retreat from the perturbations. First manufacturers, then software groups, plied their wares to information centers. Success was slow in coming because, as we are learning, mechanization requires team work and mutual understanding of what each member is to contribute and why. Much of the discussion of information systems in this report concerns aspects of the "information problem." We know enough to know, now, that solutions for some of them are still not obvious.

The paradox, with respect to competence, is slowly disappearing. Multi-disciplinary in-house groups are active in academic libraries and information centers. Public libraries, spurred by state and regional commissions and federal funds, are acquiring staff or at least knowledge to interact with mechanization planners. Some indus-

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14. Vannevar Bush. Science, The Endless Frontier. A Report to the President on a Program for Postwar Scientific Research. Washington, D.C.: National Science Foundation, July 1960, a Reprint of the July 1945 report with an Introduction by Alan T. Waterman, Director, NSF.

15. Vannevar Bush. "As We May Think." Atlantic Monthly, vol. 176, no. 1 (July 1945) 101-108.

trial libraries are beginning to take advantage of the sometimes extensive computer capabilities of their firms. The paradox, however, does continue. There is too little inquiry into possible innovation. Too much mechanization effort is directed solely to mundane operations. Machine processing of subject content is either being ignored or done with little imagination. Too little is being done on re-education and curriculum renovation. Too little interaction exists among librarians, information scientists, and computer scientists, both academically and professionally. There is too little worthwhile cooperative research on basic information-processing problems.

trends from statistics

During the summer of 1966, the Special Libraries Association (SLA) and the Library Technology Program (LTP) of the American Library Association (ALA) cooperated in the distribution of over 15,000 questionnaires to a variety of institutions and professional societies in an attempt to quantify the extent of library mechanization in the United States and Canada. Of 6150 responses, almost 1 in 5 indicated either active or planned mechanization activities. A printout of data from this survey has been published.[16] Eugene Jackson evaluated these data in two reports, one published and one to be published in the 1967 Proceedings of the University of Illinois Clinic on Library Applications of Data Processing.[17,18] Fig. 1 is a composite of Jackson's unpublished Tables A and B on users and planners and Table F giving numerics on

16. Anon. The Use of Data Processing Equipment by Libraries and Information Centers. New York: Creative Research Services, Inc., Oct. 1966. (Prepared for the Documentation Division, Special Libraries Association, and the Library Technology Program, American Library Association)

libraries and their professional staffs. Fig. 2 is Jackson's published Fig. 6 listing the functions that are being mechanized in their order of frequency.

Users & Planners		Users	Planners	Full-Time Prof. Staffs
415	Coll & Univ	31.1%	39.9%	5-10
310	Industrial	33.4%	25.5%	2
122	Public	12.2%	9.9%	11-20
143	Government	13.8%	11.7%	5-10
131	All Other	10.3%	11.7%	2
1130	Total	638	942	4 (median)

Figure 1

More EAM equipment (Electrical Accounting Machines, i.e., tabulators, card sorters, but not computers) is being used for serials control than for any other library function; such use is almost non-existent in public libraries. Universities and industrials, however, also use more sophisticated equipment (ADP hardware, i.e., Automated Data Processing) for serials control (97 users of EAM, 109 users of ADP). All users (37 academic, 27 industrials, 8 government) in Jackson's mode category use EAM for circulation control. This function heads the "planned" list (36, 17, and 12 libraries, respectively), some perhaps with plans for ADP equipment. Small computers appear neces-

17. Eugene B. Jackson. The Special Libraries Association-American Libraries Association/Library Technology Program Survey on Library Automation Activities; A Summary Review. Armonk: International Business Machines Corp., May 1967.

18. Eugene B. Jackson. "The Use of Data Processing Equipment by Libraries and Information Centers - The Significant Results of the SLA-LTP Survey." Special Libraries, vol. 58, no. 5 (May-June 1967) 317-327.

	Users	Planners	Total	% of 1,130 Inst.
Serials control	209	242	451	40
Circulation control	165	244	409	36
Accessions lists	170	220	390	34
Accounting	235	111	346	31
Acquisitions	102	226	328	29
Book catalog production	125	201	326	28
Retro searches—doc. retr.	131	156	287	25
Union lists	133	123	256	23
Catalog card production	101	139	240	21
KWIC indexes	135	98	233	20
Current awareness service	91	137	228	20
Retro searches—data retr.	66	105	171	15
Interlibrary communications	71	90	161	14
Other functions	99	44	143	12
Microform materials	48	81	129	11
Classified document control	57	52	109	9
	1,938	2,269	4,207	

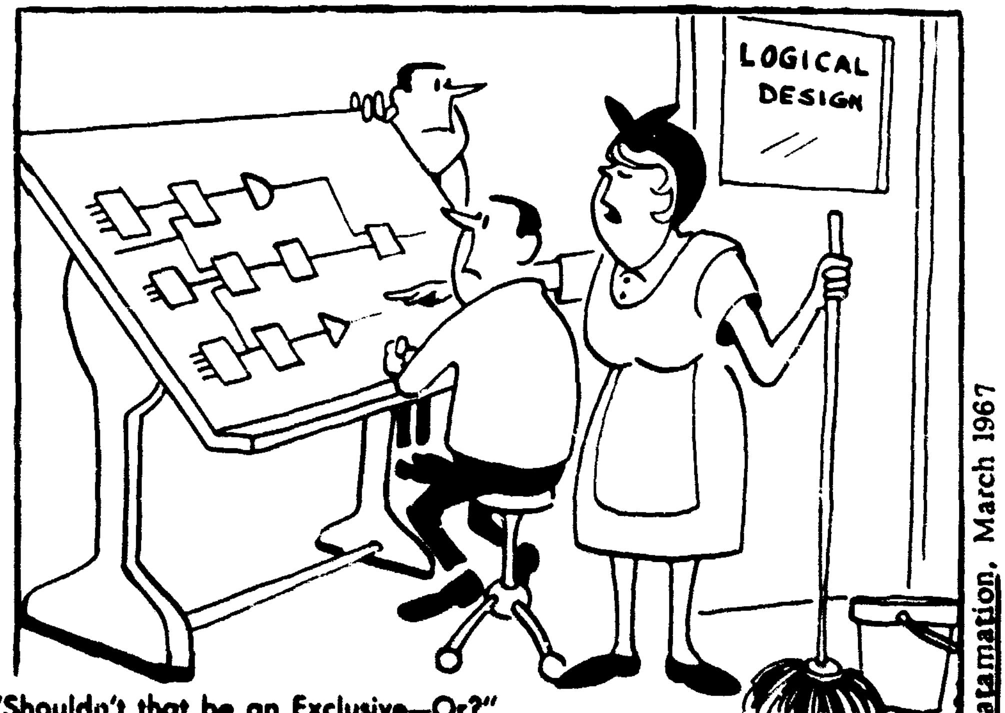
Figure 2 - **Functions Mechanized in Order of Frequency**

sary for efficient book catalog production (22 academics, 22 industrials, 9 government) and for Key Word-in-Context (KWIC) indexes (11 academics, 48 industrials, 7 government). Government practice diverges in equipment use for accession lists (small computers in 24 and 27 academic and industrial libraries, respectively, EAM in 9 government libraries).

In comparison with the 680 academic, public, and government libraries that provided input to the SLA/ALA survey, the Bowker Annual gives the following summary data on libraries from a 1964 survey:

Public Libraries	6141
Univ. & College	1442
Junior College	721
Special Libraries	3948
Law Libraries	456
Medical Libraries	973
Academics in Canada	235 [19]

The federal library group was among those excluded from the 1964 inventory. Automation of its mailing list enabled the Federal Library Committee to make a compilation that it estimates is 50-60% complete.[20] This shows a total of 1329 federal libraries: 3 legislative, 19 judicial, and 1307 executive.



"Shouldn't that be an Exclusive—Or?"

19. Anon. "Statistics on Libraries from American Library Directory." Phyllis B. Steckler and Wyllis E. Wright, eds. The Bowker Annual of Library and Book Trade Information. New York: R. R. Bowker Co., 1966. At p. 3.

20. Anon. "Distribution of Federal Libraries." FLC Newsletter, No. 5 (Sept. 1966) 4. (I am indebted to AFOSR's Technical Librarian, Catherine Hetrick, for this reference. Our 3-"man" library (Anthony G. Bialecki and Edith M. Stocker) provides unparalleled support to about a 100-man professional (military and civilian) staff.)

21. Ralph R. Shaw. "Machine Application at the University of Hawaii." College and Research Libraries, vol. 26, no. 5 (Sept. 1965) 381-382, 398.

22. Donald H. Kraft. A Total Systems Approach to Library Automation with Data Processing Equipment. Chicago: International Business Machines Corp., March 1966.

planning information processing

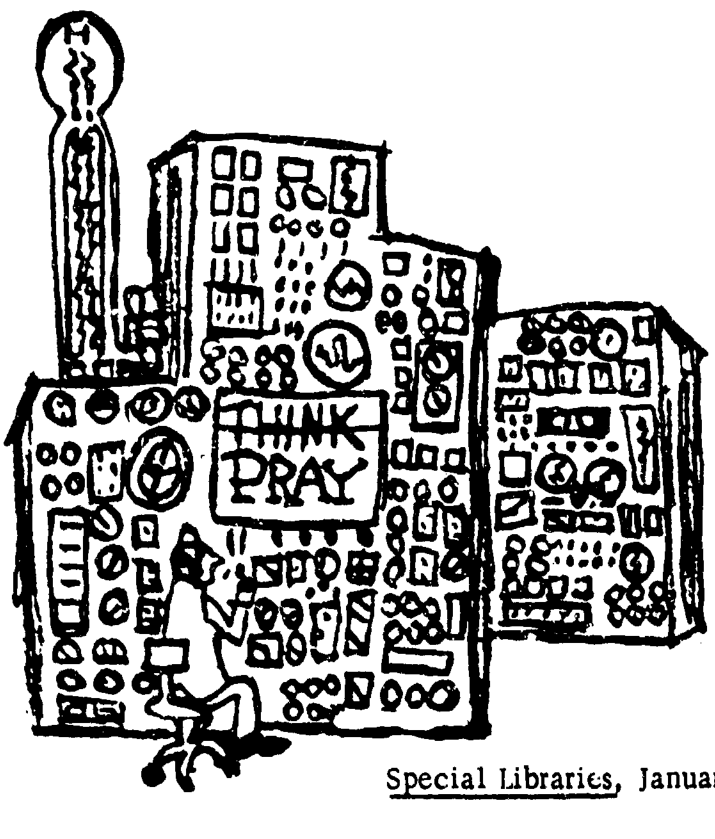
From the above data, personal discussion and observation, and a few papers,[21] I strongly suspect that a disturbingly large number of people aren't thinking of ways of improving their operations, not so much because of costs, but because of their own sense of unpreparedness. I discuss curriculum development in the second half of this report. Education, as a process of acquiring facts, is useful, but thinking is the glue that puts facts together into a pattern.

Donald Kraft wrote a report for librarians who neither have knowledge of data processing terminology or techniques.[22] He discusses the performance of various types of machines and how they can be used for various types f library operations. Samples of library products prepared by various machines, as well as two cost summaries, are appended. It is a good primer.

Among those who could contribute to mechanization efforts are system designers without background in library operations and librarians without a systems view. People who analyze information-processing operations in terms of flow diagrams without experience in a library or information center tend to oversimplify the flow patterns. In turn, they receive little help from even willing librarians who fail to appreciate the rote behavior of machines and the complexities of programming them. A skilled human almost automatically adapts to many idiosyncracies. Adaptation becomes second nature to a librarian; explication for mechanization can be a difficult task.

Planning is an elusive activity. Guides can be written for planners, but even if they are good, they may not be applicable at least in part for particular people and for particular situations. For particular people, because creative and insightful people do not necessarily solve problems according to rule books. For particular situations, because a given environment can introduce significant variables in an implementation of even a routine procedure. I tend to doubt that there is a single "best" system for processing information, even when the system is restricted to a small set of producers and receivers of a small number of categories of information. How often, for example, does transmission between husband and wife fall short of 100% transfer of the "you know what I mean" variety? Therefore, the steps below are suggestions of approach, not *a* procedure.

● a. Clear the mental registers. Establishing a plan is an opportunity for imaginativeness and creativity. Even if the plan is for modification of an existing operation that is a small part of a large system, and real limitations impose great restrictions on what can be vs. what could be, first thoughts should be directed to the latter. A new look sometimes discloses possibilities that might not otherwise have been anticipated and *can* even show that suspected limitations are unreal.



• b. Investigate inputs and outputs from a boite noire viewpoint. Experience teaches that operating systems are like tulip beds. Both continue to bear for years without attention, but when the digging time comes, the yield is often low. Neither the content nor format of inputs or outputs is necessarily fixed or rigid. Information may have to be obtained from many sources, producers and receivers, to discover what the inputs and outputs could or should be.

• c. Open the black box. Find out what it does, procedurally, to convert inputs to outputs, and whether it could perform if given desired inputs and instructions for desired outputs. Even if it could, acquire information to answer the question: What is the best procedure within allowable constraints of time, cost, information need, and available equipment and manpower?

• d. Study the environment of the system. Should the system continue to be treated as a self-contained entity, or could other entities in the environment merge with it so as to enrich all with an effective reduction of effort for each? How would mergers affect constraints on the systems individually and on the total configuration? Could mergers be fit into a realistic schedule over time?

• e. Interact with everyone concerned with the system. Everyone includes people who must pay for the changes, people who must be convinced that the changes are worthwhile, people who must put the changes into effect, and people on the producing and receiving ends. This is called communication -- upward, downward, and lateral. Its value is too often underrated. Yet one weak link could negate or delay an otherwise well-conceived and executed effort.

• f. Test, evaluate, test, evaluate. Not even a

23. Anon. "Sources of Management Systems Education." Systems, vol. 8, no. 4 (April 1967) 17, 18, 21.

24. Science, vol. 156, no. 3776 (12 May 1967). Articles include those of J. H. Shera on "Librarians Against Machines," H. Brown on "International Cooperation: The New ICSU Program on Critical Data," E. L. Brady and M. B. Wallenstein on "The National Standard Reference Data System," and A. Kantrowitz on a "Proposal for an Institution for Scientific Judgment."

25. Peter Calingaert. "System Performance Evaluation: Survey and Appraisal." Communications of the ACM, vol. 10, no. 1 (Jan. 1967) 12-18.

26. Carlos A. Cuadra, ed. Annual Review of Information Science and Technology. Vol. I. New York: John Wiley and Sons, Inc., 1966.

27. Franz L. Alt and Morris Rubinoff, eds. Advances in Computers. Vol. 7. New York: Academic Press, Inc., 1966.

28. Proceedings of the IEEE, vol. 54, no. 12 (Dec. 1966). Papers include the following: S. I. Allen, et al., on "Use of a Time-Shared General-Purpose File-Handing System in Hospital Research;" Gerard Salton on "Information Dissemination and Automatic Information Systems;" Melvin A. Breuer on "General Survey of Design Automation of Digital Computers;" R. M. Brown, et al., on "The SLAC High-Energy Spectrometer Data Acquisition and Analysis System;" E. P. Stabler and C. J. Creveling on "Spacecraft Computers for Scientific Information Systems;" Theodore J. Williams on "The Development of Computer Control in the Continuous Process Industries;" Ascher Opler on "New Directions in Software 1960-1966;" B. W. Lampson et al., on "A User Machine in a Time-Sharing System;" A. B. Lindquist et. al. on "A Time-Sharing System Using an Associative Memory;" Noah S. Prywes on "Man-Computer Problem Solving with Multilist;" A. P. Sage and S. L. Smith on "Real-Time Digital Simulation for Systems Control;" R. J. Gountanis and N. L. Viss on "A Method of Processor Selection for Interrupt Handling in a Multiprocessor System;" N. Nisenoff on "Hardware for Information Processing Systems: Today and in the Future;" T. H. Bonn on "Mass Storage: A Broad Review;" L. C. Hobbs on "Display Applications and Technology;" Bruce Wald on "Utilization of a Multiprocessor in Command and Control;" M. Lehman on "A Survey of Problems and Preliminary Results Concerning

telephone necessarily functions as designed when initially plugged in. Neither my present home nor office phones did. The constraints enumerated above impose practical limits on testing, but two cycles with a small population and a realistically structured one are advisable safeguards. Paradoxes and uncertainties, we are told by Russell, Heisenberg, and Gödel, occur all too often in our physical and man-man worlds. It is prudent to eliminate difficulties we can identify.

• g. GO.

Tools to help planners, designers, and testers are plentiful. They appear in the form of books, reports, papers in professional and trade journals, and courses of instruction, as well as in bibliographic compilations to these and to accounts of work that has been done. I attempt no exhaustive survey. A few starting points are:

1. The April 1967 issue of Systems, devoted to education for electronic data processing (EDP), lists companies, societies, and academic institutions that give courses or seminars on various aspects of systems.[23]

2. Journals such as Communications of the ACM, Datamation, Systems, Data Processing Digest, Computers and Automation, Wilson Library Bulletin, College and Research Libraries, Library Resources and Technical Services, and Special Libraries publish reports, announce courses, and contain various information features such as news notes, book reviews, and equipment reviews. Even Science specializes occasionally![24]

3. State-of-the-art surveys such as Peter Calingaert's on system performance;[25] the American Documentation Institute's Annual Review of Information Science and Technology;[26] Academic Press' Advances in Computers series;[27] the monumental December 1966 computers issue of the Proceedings

Parallel Processing and Parallel Processors;" Michael J. Flynn on "Very High-Speed Computing Systems."

29. Scientific American, vol. 215, no. 3 (Sept. 1966). Papers include: John McCarthy on "Information;" David C. Evans on "Computer Logic and Memory;" Ivan E. Sutherland on "Computer Inputs and Outputs;" Christopher Strachey on "System Analysis and Programming;" R. M. Fano and F. J. Corbato on "Time Sharing on Computers;" John R. Pierce on "The Transmission of Computer Data;" Anthony E. Oettinger on "The Uses of Computers in Science;" Steven Anson Coons on "The Uses of Computers in Technology;" Martin Greenberger on "The Uses of Computers in Organizations;" Patrick Suppes on "The Uses of Computers in Education;" Ben-Ami Lipetz on "Information Storage and Retrieval;" and Marvin L. Minsky on "Artificial Intelligence."

30. Lawrence Berul. Information Storage and Retrieval: A State-of-the-Art Report. Philadelphia: Auerbach Corp., Sept. 1964. Rept. PR 7500-145. AD-630,089.

31. Clinics on Library Applications of Data Processing. Urbana: University of Illinois. Proceedings of the 1963, 1964, 1965, and 1966 Clinics are available; the 1967 Proceedings are in preparation.

32. Rowena Swanson. "Information System Networks - Let's Profit from What We Know." In George Schecter, ed., Information Retrieval: A Critical Review. Washington, D.C.: Thompson Book Co., 1967, 1-52. AFOSR 66-0873. AD-637,488.

33. Goodman, Edith Harwith, ed. Computer Yearbook and Directory. Detroit: American Data Processing Inc., 1966. lst ed. This comprehensive volume contains separate bibliographic listings of books in the data processing field published in 1962-1964 and in 1965, respectively. Some of these books are also reviewed. Not listed in the bibliographies, but worthy of citation are:
Shera, J. H. Libraries and the Organization of Knowledge. Hamden, Conn.: Archon Books, 1965.
Schutze, Gertrude. Documentation Source Book. New York: Scarecrow Press, Inc., 1965. This is also an annotated bibliography.
Loose-leaf services include American Data Processing's Data Processing Systems Encyclopedia and Computer Applications Service and Auerbach Data Communications Reports published by Auerbach Info, Inc., Philadelphia.

<u>of the IEEE</u>;[28] the thought-provoking September 1966 information issue of <u>Scientific American</u>;[29] Lawrence Berul's report on information storage and retrieval systems;[30] the University of Illinois' proceedings series of <u>Clinics on Library Applications of Data Processing</u>;[31] and my own summary on information systems networks.[32]

4. Texts from which substantive information can be obtained at many levels of specificity with respect to software, hardware, and even to the refinement of one's thought processes.[33]

5. Factual and evaluative summaries that are regular features in various publications. These include <u>Dun's Review</u>'s Annual Office Report;[34] <u>Library Resources and Technical Services</u>' annual reports;[35] "Auerbach on Equipment" in <u>Data Processing Magazine</u>.[36] Short reviews also appear irregularly that assemble or up-date knowledge on particular topics. Citations to several of these are given in the footnotes.[37-46]

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34. "Thirteenth Annual Office Report." <u>Dun's Review</u>, vol. 88, no. 3 (Sept. 1966). Software and hardware developments are summarized under such section headings as: The Information Revolution, General Office Machines; Electronic Data Processing; Data Acquisition and Display; Information Storage and Retrieval; Telecommunication; Communication Aids; and Public Utility Data Services.

35. Tauber, Maurice F., and Irlene Roemer Stephens. "Technical Services in 1965." <u>Library Resources and Technical Services</u>, vol. 10, no. 2 (Spring 1966) 211-221.

36. For example, F. H. Reagan, Jr. on "Viewing the CRT Display Terminals" in <u>Data Processing Magazine</u>, vol. 9, no. 2 (Feb. 1967) 32-37.

37. Anon. "Information Transmission: Communication Carrier Services, Communication Equipment, Facsimile Systems." <u>Systems</u>, vol. 8, no. 2 (Feb. 1967) 14, 18, 21.

38. Edward A. Chapman and Paul L. St. Pierre. Systems Analysis and Design as Related to Library Operations. Troy: Rensselaer Polytechnic Institute, 1966. (Out of print; intended for publication by John Wiley and Sons, Inc., in 1967)

39. Kiersky, Loretta J., comp. "Bibliography on Reproduction of Documentary Information, 1966." Special Libraries, vol. 58, no. 5 (May-June 1967) 335-347.

40. Markus, John. "State of the Art of Computers in Commercial Publishing." American Documentation, vol. 17, no. 2 (Apr. 1966) 76-88.

41. Menkhaus, Edward J. "The Ways and Means of Moving Data." Business Automation, vol. 14, no. 3 (Mar. 1967) 30-37.

42. Morehouse, H. G. Telefacsimile Services Between Libraries with the Xerox Magnavox Telecopier. Reno: University of Nevada Library, Dec. 1966.

43a. Nelson, E. A. Research into the Management of Computer Programming: Some Characteristics of Programming Cost Data from Government and Industry. Santa Monica: System Development Corp., 1965. Rept. TM-2704/000/00. AD-642, 304.

43b. E. A. Nelson. Management Handbook for the Estimation of Computer Programming Costs. Santa Monica: System Development Corp., Oct. 1966. Rept. ESD-TR-67-66.

44. M. S. Piligian and J. L. Pokorney. Air Force Concepts for the Technical Control and Design Verification of Computer Programs. Bedford: Air Force Systems Command, Electronic Systems Div., Apr. 1967. Rept. ESD-TR-67-67.

45. Pokorney, Joseph L., and Wallace E. Mitchell. A Systems Approach to Computer Programs. Bedford: Air Force Systems Command, Electronic Systems Div., Feb. 1967. Rept. ESD-TR-67-205.

46. Comments and a tabulation in D. H. Brandon's Letter to the Editor in Datamation, vol. 12, no. 12 (Dec. 1966) 13-14 seem appropriate to conclude this series of footnotes. Brandon says: "I have never seen an effective installation made in less than 18 months; I have never seen an effective on-line installation implemented in less than 36 months." He provides the following task allocation:

opportunities for academic libraries

The academic library offers unique challenges because of its environment. Its potential clientele is semi-captive, literate, has at least some familiarity with library resources, and has frequent need for subject information in depth. Academic institutions are acquiring increasingly sophisticated computer centers.[47] Members of staffs from many departments either have active interest in cooperating with their libraries or can be prevailed on for advice. Moreover, library personnel shortages are giving students a view from inside. A recent ALA tabulation of library statistics shows that student assistance in academic libraries has been increasing at a rate of about 1,000,000 hours a year per year since 1959-60.[48]

Eugene Jackson concluded, from the SLA/ALA survey, that the typical "mechanized library

47. Anon. "Roster of School, College, and University Computer Centers." Computers and Automation, vol. 15, no. 6 (June 1966) 96-102. Equipment and courses given in conjunction with each center are listed for over 350 institutions.

48. Library Administration Div., American Library Assn., comp. Library Statistics of Colleges and Universities, 1965-66, Institutional Data. Chicago: American Library Assn., 1967. At p. 6, 7.

Task	Min. Time (mos.) On-Line	Min. Time (mos.) Batch
Analysis of Feasibility	6	3
Vendor selection	6	3
Basic Planning	2	1
Training of Personnel (& Retraining)	3	2
Basic Design Parameters	3	1
Systems Design	6	3
Programming	6	4
Installation/Systems Test/Conversion	4	3
Totals	36	20

1. Is a university or special library.
2. Has more than 50,000 books.
3. Has more than 1000 periodical titles.
4. Has a small technical reports collection.
5. Has a minimum staff of 10 and a maximum staff of 20, evenly divided between professional and non-professional members.
6. Has its Serials Control function running on EAM (unit record) equipment.
7. Has its Accounting function running on ADP (computer) equipment.
8. Is utilizing its host organization's machine equipment rather than having its own.
9. Does not use a service bureau.
10. Has plans for extending mechanization to Circulation Control and Accessions Lists functions in the next one to two years.
11. Is located in California or New York.[49]

Since tables in Jackson's report suggest comparatively greater emphasis by academic libraries on accounting-type functions and by industrials on products for users (KWIC indexes, methods of selective dissemination of information), the former are considered here and the latter in a following section.

The cooperative project Bruce Stewart describes among Texas universities, for example, has analogies in public-library and some industrial library networks as well.[50] In late 1964, the libraries of Texas A & M, Rice University, and the University of Houston began to collaborate on mechanization, each examining the function that

49. Ref. 17, p. 1.

50. Bruce W. Stewart, "Data Processing in an Academic Library." Wilson Library Bulletin, vol. 41, no. 4 (Dec. 1966) 388-395.

troubled it most. The result was attacks on serials control, circulation, and acquisitions, respectively. A & M converted records for 200,000 volumes in 5 months with in-house keypunching. (This is the circulating collection in its main library; 200,000 additional bound volumes that do not circulate and branch library materials are not included). The system is not yet operational, but is designed to produce the following working tools: monthly lists of subscriptions; bound holdings; current and unbound items; and a want list; an annual list of domestic serials for contract bidding; punched card output for inventory control; and a punched card file for bindery assignments. A "union" list of serials is planned.[51] Stewart raises two points that are well not to overlook. The first is the condition of the record to be converted. Stewart calls A & M's "unreliable." The older a library's records, the more variants are likely to be found. (Some that I have seen are marginally legible). The second concerns perspective in the evaluation of a system. A & M's check-in procedure will not save time. It will permit automatic up-dating and file maintenance. Elsewhere in this paper I comment on the need for new methods of assessing the value of a system. This is one illustration. Rice's system, installed in 1965, makes circulation and return cards automatically from book cards and the borrower's badge and generates circulation printouts and overdue notices periodically.[52] A & M used Rice's experience for its circulation system. Houston now plans to profit from both. Stewart notes the "hours of daily conferences among library staff members" that guided planning, and says:

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51. An impressive number of serial activities is reported in William H. Huff. "Some Aspects of Serials Work in 1965." Library Resources and Technical Services, vol. 10, no. 2 (Spring 1966) 176-196.

52. Frederick Ruecking, Jr. Circulation Control at Rice University Using the IBM 357 Data Collection System. White Plains: International Business Machines Corp., (1966).

> ... - data processing is not a spectator sport. It is necessary to make arbitrary decisions, and a great deal of time and emotion must be devoted to changing the old to the new; the increased service, however, can usually be guaranteed to justify the effort.[53]

Ritvars Bregzis' paper on ONULP (Ontario New Universities Library Project) continues as my best reference on the wealth of possibilities available to libraries from bibliographic data records.[54] The ONULP pattern -- the establishment of new universities within a single or affiliated university network -- has ample counterparts in the United States. The Province of Ontario requested the University of Ontario library to compile 35,000-volume basic collections for five new universities and colleges. Toronto's experience with multiple catalog maintenance indicated that customary card catalogs were less economic than book-form catalogs. Taking a long-range view, ONULP developed a bibliographic control system that has, to date, produced shelflists in catalog form and book catalogs, but is designed for other

53. Ref. 50, p. 395.

54. Ritvars Bregzis. "The Ontario New Universities Library Project - an Automated Bibliographic Data Control System." College and Research Libraries, vol. 26, no. 6 (Nov. 1965) 495-508.

information-processing services as well. These include:

> ... specialized lists of books and reading lists by subject, language, etc.; periodic information to teaching staff regarding recent acquisitions in their respective fields of interest; records for automated circulation control; provision for tying in special subsystems, e.g., serials control; bibliographic data transmission to and from other institutions; financial and acquisition records; up-to-date working tools, e.g., subject lists; and statistical data regarding contents, patterns of use, and growth and size of the library collection.[55]

Each bibliographic unit is individually addressable. The set of codes enable automatic production of selective secondary records in abbreviated form, a forerunner of automated editing of bibliographic data received from extraneous sources (i.e. for exchange with other libraries). The data format intentially corresponds as closely as possible with conventional formats. This facilitated transition from manual to automated methods, with respect both to the records and the staff. A special print chain, the result of collaboration with Florida Atlantic University, Yale University, and IBM, provides upper and lower case and all diacritical marks for the Roman alphabets of all major languages. Availability of the record for selective sorts emphasizes the inadequacy of conventional bibliographic data for subject retrieval, but the processing capability may now make possible research on theoretical bases of bibliography.[56]

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55. Ibid. p. 496.

56. On book catalog projects in several public-library systems, see Catherine S. Chadwick. "The Book Catalog - New Hope for Cooperative Programs." Library Resources and Technical Services, vol. 10, no. 2 (Spring 1966) 160-163; Kelley L. Cartwright and Ralph M. Shoffner. Catalogs in Book Form: A Research Study of Their Implications for the California State Library and the California Union Catalog, with a Design for Their Implementation. Los Angeles: University of California, Jan. 1967.

Filing rules pose one of the biggest problems in mechanization. Bregzis calls ONULP's file modifications "modest" but notes that instructions "are impressively costly in terms of programing and operational factors." William Nugent describes a procedure that would do "minimum violence to existing Library of Congress conventions." However, Jean Perreault observes:

> I do not say that filing rules adaptable to a computer are better because they are so adaptable, but conversely: the rules that would provide better service are those that can be adapted to the computer just because they are simpler, clearer, and less ambiguous.
>
> I maintain that the goal of filing rules has been sadly obscured by consideration for a system that need not persist, since it is no real servant of the library's global goal: intelligible order.
>
> .....
>
> Users can reason, but they cannot remember endlessly complicated exceptional particularities; principles as bases for such reasoning should thus be re-established to replace the 'rules' traditionally employed.[57]

The computer-produced book catalog is expected by proponents to

> revolutionize subject access to books in unversity libraries, not only by providing indexes which never existed before but by providing them in a much more usable form. For,

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57. Jean M. Perreault. "The Computer and Catalog Filing Rules." Library Resources and Technical Services, vol. 9, no. 3 (Summer 1965) 325-331, at 325, 330.

58. Maurice B. Line. "University Libraries and the Information Needs of the Researcher. I: A Provider's View." Aslib Proceedings, vol. 18, no. 7 (July 1966) 178-184, at 180.

59. Anon. "Regional Library Computer Center Under Study." Higher Education in New England, vol. 10, no. 3 (Autumn 1966) 1, 7.

60. Carl F. J. Overhage and R. Joyce Harman, eds. INTREX, Report of a Planning Conference on Information Transfer Experiments, Sept. 3, 1965. Cambridge: The M. I. T. Press, 1965.

> let us be honest about this, the card cabinets which adorn our catalogue halls, so far from being keys to the library's contents, are to most users more like a formidable portcullis which they prefer to circumvent by swimming the moat and gaining direct access to the castle. For a sum which is rarely less than £10,000 a year we produce and maintain a vast repository of mysterious lore that is all but useless to the researcher with an information problem. Before we devote too much time to explaining the catalogue to readers we should explore ways in which we could make it more self-explanatory.[58]

Six New England state universities are examining possibilities for a regional computer processing center. While each would retain autonomy over selection, the center would order, catalog, prepare book labels, maintain author and subject files, compile reference lists, and process circulation records.[59] Each library would have a telecommunication link to the center. A pilot-scale study is in progress. The Intrex plan of the Massachusetts Institute of Technology is a large-scale coordinated program of information-transfer experiments "to provide a design for evolution of a large university library into a new information transfer system that could become operational in the decade beginning in 1970."[60] Current research concerns the adaptability of on-line software and console design to information storage and retrieval applications.

Many aspects of the value of academic (and other) libraries to users are only peripherally related to mechanization, at least at the present state of the art. Use and acceptability of library services is, and probably will continue to be, partly functions of human behavior, preferences, and idiosyncracies.

A major policy issue in large universities concerns the separation of collections. Should there be a single library, or should there be a central library and departmental or special-subject libraries? If the latter, what should the extent of duplication of collections be? Who should select the materials? What kinds of persons should be staff members? Should cataloging practices differ? Should hours of service differ? Should service products differ? A reasonably narrow-minded view is expressed in a paper entitled "Death of the Departmental Library." 61 The paper suggests that departmental libraries cannot support the quality or quantity of staff desirable for good service. It states that the "interdisciplinary characteristics of modern thought" have produced "horizontal as well as vertical kinship which make it increasingly difficult to separate clearly the literatures of different subjects." The writer fears that users of a departmental library might "not see it as a subject section of the larger university collection," and might "either remain ignorant or fail to exploit the resources of the library system as a whole." Additionally, the writer believes that a collection built by faculty tends to be "haphazard," "neither broad nor impartial," since faculty do not have time to do a systematic job of selection and are not in a position "to achieve an equitable balance of materials for the teaching programs." Apropos of centralization may be findings such as

61. Jean Legg. "The Death of the Departmental Library." Library Resources and Technical Services, vol. 9, no. 3 (Summer 1965) 351-355.

62. Ref. 58.

63. Gorham Lane. "Assessing the Undergraduates' Use of the University Library." College and Research Libraries, vol. 27, no. 4 (July 1966) 277-282.

64. A. K. Jain. "Sampling and Short-Period Usage in the Purdue Library." College and Research Libraries, vol. 27, no. 3 (May 1966) 211-218.

those of Britain's National Lending Library that, of about 8000 requests received, about 50% were for materials marginal to or outside the requester's subject specialty.[62]

The issue raises several others. Who uses the library collections? How frequently? Should a library cater to graduate students, faculty, and research staff or to the numerically larger undergraduates? Gorham Lane conducted four studies at the University of Delaware on undergraduate use of the general library and two special libraries. He found that less than 30% of the students from any school used general library facilities.[63] More than half the freshmen used the library as a place to study from their own books. Seniors were the heaviest users of library resources (in order of priority - reserve books, reference books, and, least, microfilm and recordings) and returned to the library most frequently. Periodicals were used most heavily in the specialized libraries. Percentages of students who withdrew books in a two-year longitudinal study did not exceed 52%; this figure is for seniors. Correlations between library use and grade-point-average "failed to reach statistical significance." Lane's general-library-user random sample did not include many students from scientific fields. A limited study of withdrawals by Purdue University library users during the summer of 1964 showed graduate student borrowing outnumbering that of undergraduates and faculty by 3:1 and 4:1, respectively.[64] Percentages of library occupant use of their own and library materials at Purdue were 60 and 54%, respectively. Patrons who used library materials averaged 2.2 hours and 3 titles per visit.

Lane commented that few students used the library for recreational reading. Should academic librarians give "bread-and-butter service," the "combination of public relations, library instruction, and general reference" that Donald Hunt fears is rapidly disappearing?[65] What role should the librarian have as an educator? Patricia Knapp's Monteith College experiment explored joint participation of librarians and teaching faculty in course planning.[66] The project began during Monteith's first year of existence (1960). A pilot group found that

> the student's "need" to use the library derives from the value placed upon such work by his instructor. The instructor is, generally, less concerned with the student's experience in locating materials in the library than he is with what the student makes of such materials when he has located them.
>
> .....
>
> Our own diagnosis of the problem at this point is that our concept of "sophisticated understanding of the library and increasing competence in its use" as a goal of general education is not accepted, perhaps not understood, by most of the faculty... We conceive of the library as a highly complicated system, or better, a network of interrelated systems, which organizes and controls all kinds of communication. A few instructors understand the conception, but we believe that more conceive of sophisticated library understanding and competence as "command of the literature of a field of study."[67]

Miss Knapp's report does not present a tidy set of statistically significant results. Social structures in the College, as well as library competence and subject field, strongly influenced

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65. Donald R. Hunt. "Where Is the General Reference Librarian and Bread-and-Butter Service?" College and Research Libraries, vol. 26, no. 4 (July 1965) 307-310, 326.

66. Patricia B. Knapp. The Monteith College Library Experiment. New York: The Scarecrow Press, Inc., 1966.

67. Ibid, p. 39, 40.

68. Ibid, p. 139.

69. Ibid, p. 143.

library staff involvement. "Every innovation must make its way against patterns of relationship and behavior which are firmly established and very powerful," even in a new college. The report is a log on the testing of various approaches, both with student and faculty.

> There are so many variables involved in the use of library tools and resources that it would seem wise for investigators to make the most of methods which provide an opportunity for studies in depth of a small number of cases. Through such studies it should be possible to develop hypotheses worthy of testing with a larger number of respondents.[68]

A model program is suggested that extends through a four-year curriculum based on Monteith's concept of the library "as a complex, but unified system of 'ways' or paths to library resources," particularly "the machinery through which the results of scholarly and scientific work are reported, organized and communicated." A subsidiary study of bibliographic assistance to 24 faculty members found that,

> whether the tasks were assigned for teaching or for research, they were much more likely to be bibliographical than informational. And of the bibliographical tasks, most called for selective and scouting activities. We concluded, therefore, that training for bibliographic service to academicians should minimize retrieval of specific information and should stress, instead, bibliographies and indexes, particularly selective bibliographic tools, scouting techniques, and the apparatus of reporting and communication in the academic disciplines.[69]

One approach to specialized service from a central collection proceeds through staffing. At Indiana University, for example, Cecil Byrd reports that the library recently established ten subject-specialist positions as "a compensatory action on the part of the library toward those academic departments not served by branch libraries and whose needs could no longer be satisfactorily met within the traditional library organization."[70] The library "sought individuals with both subject and library training, but has not insisted on the latter if a person with language and subject skills has been available." (Eight of Indiana's ten do have library degrees). One of the specialists' main jobs is selecting current and retrospective materials for purchase. They work closely with faculty and graduate students whose independent purchase requests are routed preliminarily to the subject specialists. The individuals are taking active support roles in research and education programs. The African and Latin American Studies librarians consult several hours weekly with graduate students and faculty on bibliographic, biographic, and statistical information. Two subject specialists prepared manuals that are used as guides to the literature. The librarians also lecture on library resources and bibliographic compilation, some in regularly scheduled courses and seminars. One librarian teaches introductory courses in Persian. Dr. Byrd finds

> Their daily contacts with faculty members have done much to create a positive image of the library. In many minds the library has changed from a highly institutionalized, impersonal service unit to one that is essentially sensitive to the needs of graduate student and faculty in the learning and research process.[71]

In Indiana's new library, offices of the subject librarians and student reading areas will be adjacent to the stacks for the specialty.

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70. Cecil K. Byrd. "Subject Specialists in a University Library." College and Research Libraries, vol. 27, no. 3 (May 1966) 191-193.

71. Ibid. p. 193.

72. Committee of Standards, Assn. of College and Research Libraries. "Guidelines for Library Services to Extension Students." ALA Bulletin, vol. 61, no. 1 (Jan. 1967) 50-53.

73. Ibid. p. 51.

Another serious issue for academic libraries concerns services for extension students. In a statement of guidelines, the Committee of Standards of the Association of College and Research Libraries notes that 272,000 students were enrolled in extension courses leading to bachelor's and higher degrees in 1963.[72] Many of the courses are taught in outlying communities. Library resources are often transported by the instructor. The Committee's guidelines, that it emphasizes are not intended as "standards," suggest that

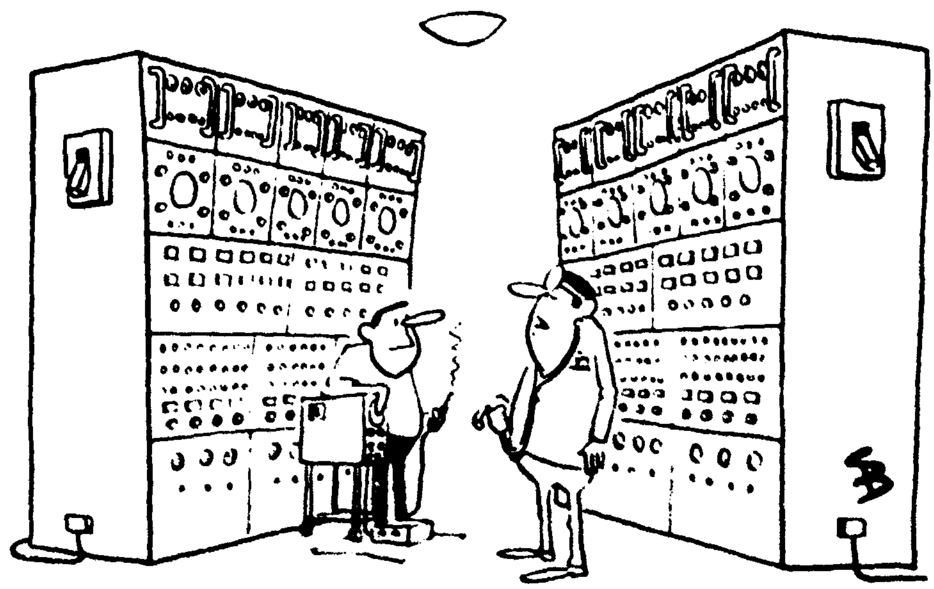
> 1. Library services for extension purposes should be financed on a regular basis.
>
> 2. A professional librarian should be given the specific responsibility for handling library materials and services for extension classes.
>
> 3. Before approving the teaching of a course off campus, the appropriate officer in the extension division, the instructor, and the librarian in charge of library materials and services for extension should consider jointly what the library needs are for the course and the extent to which these can be supplied locally or through the university library.
>
> 4. Special attention should be given to the availability of library resources taught at the graduate level.
>
> 5. The use of the university library should be encouraged, and, where feasible, required.
>
> 6. Essential journal materials and indexes should be provided despite the understandable problems involved in making them available.[73]

The Committee bases the guidelines on the following postulates:

> The library experience in higher education, at both the undergraduate and graduate levels, is an important aspect of a person's total education. This library is an extension of the classroom and, as such, has a recognized teaching function. The student may study research methods in the classroom, but it is in the library and laboratory where they begin to have real meaning. The librarian, with his professional competence and breadth of subject background,

introduces the student firsthand to the tools needed in his research. Through him the student learns to use indexes to journals and other types of materials and discovers that the library is truly a storehouse of knowledge available to him when he has mastered the bibliographic tools necessary for access to it.

But perhaps just as important as learning the mechanics of using an academic library is the informal experience of browsing among the books and journals and delighting in the discovery of authors and ideas often quite unrelated to any particular course one is taking but still an integral part of his higher education. One cannot measure the full significance of this form of education in terms of credit hours and courses completed, but this makes it nonetheless real.[74]



. . . NOTHING ORGANICALLY WRONG, THEY'RE JUST INCOMPATIBLE.

Faith, Hope and Parity
Thompson Book Co., 1966

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74. Ibid., p. 51

75. Emma Ruth Christine. "School Library Extension Service, Real or Imagined?" ALA Bulletin, vol. 60, no. 6 (June 1966) 623-626.

How does this image jibe with the reticence of many librarians toward "extended uses" of libraries? Emma Christine reports the results of an admittedly limited survey of "selected California schools" (high schools).[75] (Though libraries in these schools are not strictly "academic libraries," the librarians influence attitudes and habits of adults-to-be. Therefore, their opinions are important). Librarians, Miss Christine says, "were decidedly opposed to keeping the library open at night," many fearing "discipline problems" with teenage students. But she records the sad fact that "many of our students come from homes where a place to study is impossible to find." On library sharing of book collections and magazine subscriptions, "major objections voiced concerned inadequate collections, no proper staffing to accommodate additional work involved, lack of sufficient funds to provide more materials, ... and that the student body might need whatever was gone!" On permitting adults to use collections and the library for classes and other meetings, opinions were split, some objections going to already heavy use of resources by the student body. (A possibility was raised of use if collections were augmented from adult education budgets). A frequent refrain to any extended use was reference to availability of the public library. Comments reflected how much more fiction that fact is the presumed interaction between school and public libraries. Miss Christine surmises that "a strengthening and extension of both types of libraries can only result in dual progress" and suggests

> There is room here to make this interaction come true, with some city-school cooperation in the manner of an interchangeable library card or some other reciprocal arrangement. Schools and city administrations have worked out such with municipal swimming pools or other community facilities, sharing personnel as well as buildings. Although many of the librarians and some administrators said "there is plenty of public library service and

> facilities" available to handle such matters as citizen use, adult education demands, and night crowds of students, we have had very clear indications from many public libraries that they are heavily overburdened with demands directly connected to school needs. If the school people most instrumental in doing something about the condition will not even admit it exists, how may it be combated?[76]

On support of ALA standards that could aid librarians in improving services, librarians' opinions were about equally divided, some calling these "ridiculous" and unrealistic. But Miss Christine observes:

> I would suggest that the chasm is between the Standards and practicing librarians who should be using them to assist in gaining improvements. Some of these replies refused any consideration of the expanded teaching opportunities afforded by additional staff, more time for teacher-librarian conference and planning sessions, more time for curriculum development work, to say nothing of time to begin or strengthen an up-dated program of instruction, materials, and services.[77]

A Public Library Facility

76. Ibid., p. 626.

77. Ibid., p. 626.

78. Henry T. Drennan. "Statistics of Public Libraries: Public Libraries Midway Through the 1960's." The Bowker Annual of Library and Book Trade Information, New York: R. R. Bowker Co., 1966, 13-16.

79. Ibid., p. 14.

80. Charles A. Bunge. "Statewide Library Surveys and Plans, Development of the Concept and Some Recent Patterns." The Library Quarterly, vol. 36, no. 1 (Jan. 1966) 25-37.

opportunities for public libraries

Classified as public libraries are the mighty New York Public and the 4388 institutions in service areas whose populations are below 10,000 persons.[78] In 1962, public librarians serving communities of 35,000 and above earned an average annual salary of $5748, 4% below the $6000 national average. Yet the public library is an "urban institution" and it is said that

> The contribution to the quality of urban life that public libraries can provide, cannot be separated from the social problems of the 1960's.[79]

I consider growing cooperative arrangements among libraries, and expansions in scope and quality of service, the most significant of the current trends in the public-library sector. In many instances, these activities co-join academic libraries, but the principal impetus emanates from the public-library group.

Charles Bunge comprehensively summarizes the historical framework for these efforts.[80] Ill-fated plans followed World War I, but from studies conducted in the 1930's, regional and network concepts evolved. Revised ALA standards for public library service and the Library Services Act both appeared in 1956. Bunge notes major early contributions by New York, California, Vermont, the Southwest, the Southeast, and, antedating all other regions, the Pacific Northwest whose Library Association was formed in 1909. The Library Services Act enabled more comprehensive analyses of regional and state deficiencies, often by research teams recruited from a local university. (Many of the surveys, however, reached only small audiences and lack information on research methods and sources of data).

Five state plans are described in the January

1965 issue of Library Trends that reflect the major patterns of cooperation.[81] New Hampshire, that boasts Peterborough, the first tax-supported library in the United States, has a single state library system that serves all but 5000 of its citizens through 229 libraries, the ten largest located in cities with populations under 100,000.[82] The State Library has four branch offices that operate a bookmobile service. Service Center libraries are being established to provide resources and services to augment those of affiliated member libraries. The anticipated 25 Service Centers, expected to become the largest libraries in the state, are to be located within 25 miles of satellite communities. Purchasing and cataloging will be centralized, and a single borrower's card will be honored in all member libraries.

Tennessee operates a multi-county system.[83] The median family income in this state's wealthiest county is less that the national median. Four metropolitan counties contain 42% of the population. Of the remaining 91, 74 have no town whose population exceeds 10,000. Tennessee's 11 regional library centeres are state agencies that contract with the State Library. The centers are

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81. Hannis S. Smith, ed. "Regional Public Library Systems." Library Trends, vol. 13, no. 3 (Jan. 1965). Several other library systems have been described in the December 1966 issue of ALA Bulletin. Library Journal has begun an occasional report-from-the-states series.

82. Mildred P. McKay. "New Hampshire's Single State Library System." Library Trends, vol. 13, no. 3 (Jan. 1965) 279-286.

83. Mary Nelson Bates. "The State-Supported Regional Library Center in Tennessee." Library Trends, vol. 13, no. 3 (Jan. 1965) 296-303.

84. Ibid, p. 298.

85. Alma S. Jacobs. "Montana Chooses Federations of Libraries." Library Trends, vol. 13, no. 3 (Jan. 1965) 304-310.

developing procedures for centralized ordering and processing, and for in-service training of local librarians, many of whom have no professional library training. Some cities and counties transfer funds to the regional board for selection and purchase. The centers provide bookmobile service to local libraries and small rural communities. In Tennessee as in similar areas, deposit stations are set up in stores, banks, and other accessible locations where bookmobiles leave small stocks of books that are changed frequently. As Mary Bates observes,

> The stations are important because they place attractive books within the reach of rural residents in their own communities and make available to them the entire resources of the region. A reader in a small community can meet the bookmobile and select the books he wants. He can also make requests on printed cards supplied for the purpose, and the books he wants will be mailed to him; thus, those who are unable to meet the bookmobile still have books available to them. One value of the book station is that it brings books to the attention of people who might never go to the county library, but many people use the station in their community and also use the county library.[84]

The integration that members of center staffs have achieved has created a feeling at the local level that these state representatives are not outsiders. State officials, on the other hand, support these state agencies but would be less inclined to help local libraries!

Montana's initial starts collided with localism. The state now has three "federations" of libraries, each built around a strong central library.[85] (The Northwest Federation differs slightly, having 4 relatively strong, independent libraries). Composition of the federations is based on homogeneity of population, ease of transportation and communication, contiguity, professional leadership at the federation center, and sufficient tax-able valuation to ensure adequate funds. Ordering, purchasing (of books, supplies, and equipment), processing, and cataloging are centralized. Monthly or bimonthly meetings of library representatives provide in-service training and opportunities for shared counsel. A characteristic of this, as well as cooperative enterprises elsewhere, is an intensive, area-wide public relations program.

In Washington, 13 of 39 counties have regional systems that serve more than half the incorporated towns. Ten other counties have rural library districts.[86] Service extends to 94% of the population, some of it being accomplished by mail to the isolated and physically handicapped, some by boat, and some by forest-service parachute. An integral part of the organization is interlibrary loan, proceedings from the system's resources to the State Library, to the Pacific Northwest Bibliographic Center through which the major library resources of the region are accessible to all libraries in the area.

S. G. Prentiss summed a "typical" library system in New York State as follows:

> If there were such a thing as a "typical" library system in New York State, it might look something like this: It would be an organization created under Education Law by vote of the trustees of about thirty community libraries, who would have elected at the same time a board of trustees of the system. It would later have received a charter from the Board of Regents as an autonomous library agency, and its plan of service would have been appro-

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86. John S. Richards. "Regional Library Organization and Development in Washington State." Library Trends, vol. 13, no. 3 (Jan. 1965) 311-317.

87. S. Gilbert Prentiss. "The Public Library System Program in New York State." Library Trends, vol. 13, no. 3 (Jan. 1965) 287-295, at 287.

ved by the Commissioner of Education in order for it to receive state aid averaging about 62.5¢ per capita. Its member libraries would still derive their main support from local sources, and they would retain their own boards of trustees, staffs, buildings, and endowment funds, and their complete autonomy in all other respects. The member libraries would receive no grants directly from the state, and whatever cash they might receive from the system would be quite small in comparison to the cost of services and materials which the system would make available to them. The number of persons served by the system and its member libraries would be about 300,000, and in area it would cover the best part of three counties.

There would be a system staff consisting of a director (who might also be director of the major library in the area), five professional librarians, and other supporting staff, totaling about fifteen in all. The system staff would probably operate bookmobile service in areas where library service did not previously exist and where it would not be feasible to establish community libraries; otherwise, its efforts and resources would be directed towards cooperative services to the member libraries, such as centralized ordering and processing of books, a wide variety of consultant services, pick-up and delivery service, rotating collections, interlibrary loan and reference assistance, and other services. The system would be financed almost exclusively from state funds, supplemented by modest county support for some specific purpose such as bookmobile service. Finally, there would be a central library collection, based on the largest library in the system, whose adult non-fiction acquisitions would be matched, four volumes to one volume, from state funds until the collection reached 100,000 volumes.[87]

New York has 15 cooperative systems with this type of structure, though they vary in size, support, services offered, and other characteristics. New York also has 4 federated systems that are similar, but their trustees are appointed by a county board of supervisors. The remaining systems are of the consolidated type - the New York, Brooklyn, and Queens Borough Public Libraries in New York City - in which a board of trustees operates and controls the program for the entire system, the units being branches rather than autonomous libraries. The 3 consolidated systems serve nearly half of the state's population. The 22 systems, operating directly and through 638 member libraries, reach 97% of the people and received about $13 million from the state in 1966.[88] Prentiss believes that advantages of size can be exploited provided that local interest, local initiative, and, "to a considerable extent local support" are preserved. Several other factors for New York's success are:

1. assignment of decision-making authority to trustees of participating libraries rather than to county boards of supervisors

2. flexibility of organization that encourages ingenuity and diversity to accommodate particular types of clientele

3. acceptance of the principle of gradualism in achieving member participation and in meeting minimum standards

4. state aid not pegged to matching funds during start-up

5. a strong central library in each system (even if it has to be created)

6. a flexible legal base for contracting within and among systems

Prentiss also cautions that inequities can arise.

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88. E. B. Nyquist. "The Three R's in New York." ALA Bulletin, vol. 60, no. 1 (Dec. 1966) 1134-1138.

89. Ref. 87, p. 293. Helen S. Gilbert's "Planning New Service Outlets" in the same issue of Library Trends, p. 364-375, is a superb statement for planners of all types of cooperative systems. The entire paper is worthy of being quoted and requoted.

90. Ref. 88.

91. Jean O. Godfrey. "Public Libraries in the New York Metropolitan Area." Library Trends, vol. 14, no. 1 (July 1965) 95-101.

Some local communities tend to let the systems do more for them than they are willing to do for themselves. Populations in some areas whose libraries aren't adequate overburden adjacent stronger libraries that are thus penalized for their progressiveness. Time is needed for education of trustees, staff, and the community and for discernible progress to become evident. The sharp rise in demands on state "backstopping" agencies and on central processing facilities sometimes exceeds expectations. He also notes that success in itself stimulates use and validates increased support. Prentiss envisions the following directions for libraries:

> (A) growing interrelatedness of all types of libraries. The increasingly complex informational needs of the academic, research, business, and professional communities and the sheer volume of informational materials require that all types of libraries - public, school, college, university, and special - define their separate roles and at the same time combine their strengths in formal and systematic relationships, so that each can concentrate on its specialty knowing that it can turn to the full resources of other libraries in the state when it is necessary to go beyond that specialty.[89]

New York, in 1966, also appropriated $700,000 to study automation and to organize an Academic and Research Library Bureau.[90] Six systems were chartered (7 are planned) as bases for improved reference and research library service. Through voluntary associations of public and private research and academic libraries, the use of major subject collections could be expanded to accommodate academic and industry needs. New York Public's Reference Department was forced to discourage use of its facilities to undergraduates (the City has 33 public and private academic institutions).[91] The Library plans a novel branch adjacent to the Department with 500,000 volumes selected particularly for undergraduate needs. This may presage another trend, since librarians in some of the larger libraries are beginning to find that "large public libraries ... cannot continue to be all things to all people."[92] Margaret Brown and Philip Ennis suggest that libraries re-examine their multi-purpose situation and more clearly define their objectives.

Papers on metropolitan public library problems in Detroit, Los Angeles, and New York in the July 1965 issue of Library Trends focus on serious situations that exist in our cities arising from urbanization and large changes in population from

92. Margaret C. Brown. "A Look at the Future Through Bifocals." Library Resources and Technical Services. vol. 9, no. 3 (Summer 1965) 261-265.

93. H. C. Campbell, ed. "Metropolitan Public Library Problems Around the World." Library Trends, vol. 14, no. 1 (July 1965).

94. Ralph A. Ulveling. "Metropolitan Areas Growing Under Stress: The Situation of the Detroit Public Library." Library Trends, vol. 14, no. 1 (July 1965) 76-82.

95. Harold L. Hamill. "Metropolitan Library Problems of the Los Angeles Area." Library Trends, vol. 14, no. 1 (July 1965) 83-94.

the middle-class literate to the functionally illiterate.[93] Detroit has been the center, first for French empire and then of English rule. It now is the headquarters for 6 international trade unions and 3 of the nation's 12 largest corporations (based on value of sales).[94] It traces interest in public libraries to a plea to the legislature for support that is dated 18 Oct. 1808. The Detroit Public Library is considered one of the three major research resources (the others are Wayne State University and the University of Michigan) in a three-county complex of 138 cities and townships. The Library is not part of the city government; it was established by law as a "local government." Organizationally, it is two separate but coordinated systems; a Home Reading Services unit and a Reference Services unit, the latter consisting of 10 specialized departments. Detroit continues to service the urban resident and business populations, so much so that it issues "company" cards, operates a special book-charging arrangement for pick-up by corporation messengers, and has special parking facilities for company trucks. It is in the midst of finding a procedure whereby its extensive and expensive collection can continue to grow and be exploited as a common, in-depth library center for the entire metropolitan district.

Though Harold Hamill writes that the "geographic absurdity" of the Los Angeles area offers special problems for "a rational and economic pattern of public library service," he notes that most of the 31 libraries in the county are well supported and well run.[95] Even smaller libraries "do a really distinguished job." The city is enriched by the libraries of the University of Southern California and the University of California, Los Angeles, the latter with a 3,000,000-volume goal by 1970. The city also has, however, a 7.6% population of Negroes and a 9.[illegible]% population of Mexican-Americans, many of whom are functionally illiterate (4.7% of LA's population over 25 years of age, i.e., 168,000 are in this category). In New York, 900,000 people left the city between 1950 and 1960, and 800,000 people replaced them, mostly Negroes and Puerto Ricans, many unable to speak English, in poor health, poorly housed, and unemployed. These disadvantaged, and the handicapped, offer a scope of opportunity to librarians and other service-oriented people that defies parallel. Evelyn Levy describes what I consider tremendous achievements of an Enoch Pratt Free Library group in a predominantly Negro area in Baltimore.[96] In her words,

> With some hardware, wood, and ingenuity, he converted the Volkswagen into a mobile unit with paperback racks, hung on the outside. During the summer and fall months, before cold weather set in and while people were sitting on their front steps or just standing around, we took this improvised bookmobile up and down streets in the Target Area, one person driving and another ringing a bell. Pap Paperbacks were loaned without the formality of charging out, and we talked to people about the centers beginning to open up and the collections of paperbacks available there.
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> .....
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> In November 1965, we added a more stable library service as we opened our first library room in a center.
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> .....
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> Neighborhood meetings uncovered problems as basic as sanitation, but they also revealed a desire for relaxation, humor, and escape.
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> .....
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> We have sometimes discovered a genuine need to keep a book - the borrower is a slow reader, or is using the book to learn a new skill. In one home, the child was testing the joys of re-reading the familiar.
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> .....
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> We added educational games such as geography, animal and ABC lotto and puzzles, arithmetic and word flash cards, and picture alphabet cards for the children to "play" with in the library rooms and for Vista Volunteers to use

96. Evelyn Levy. "Library Service in the Inner City." Wilson Library Bulletin, vol. 41, no. 5 (Jan. 1967) 471-477.

97. Ibid, p. 474, 475, 476, 477.

in their tutoring programs. We bought sets of blocks for preschoolers but soon found the older children using them, too, as a new experience in color and form.

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We had outdoor story hours, reading aloud to groups of children, and outdoor movies.

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Efforts have been made to involve parents in the preschool story hour, but they have, so far, been unsuccessful. Indeed, in order to ensure that the children come, staff call for children at their homes. Sometimes they even dress them, because parents are working, or are indifferent.

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As might be expected, it has been easier to reach the children, both in the library rooms and in special activities, than the young adults and adults. Expectations and the natural friendliness of most children have not yet been killed or dulled. Neighborhoods may be crowded and in disrepair, but the children are still open to new experiences. One begins to sense the beginning of a difference in the ten-year-old.

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And then there's Chicory. "I gotta write book someday. I got some idea that won't wait," says Turk in the first issue of Chicory, a new venture in the program. Started in October, it is a magazine of the writings of people in the Action Area who have something to say. Little editing is done, the writings are in whatever form the writer chooses.

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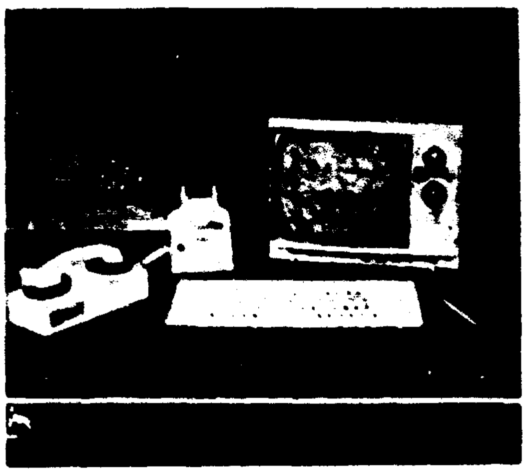
But the first efforts to draw the adult nonreader toward books and libraries have been effective only as it becomes clearly evident that books and reading are relevant to his or her immediate concerns. It is a long and often slow process, and requires patience and cooperation from all of us - social worker, educator, and librarian.[97]

The Pratt Library group initially consisted of 3 professionals, a supervisor, a children's specialist, and a young adult specialist. By Oct. 1966, there were 8 service centers manned by clerical aids with high school educations whose exposure to books and the professional staff altered their own attitudes. Books were classified only by broad reader-interest categories, and were not shelflisted or cataloged, enabling rapid processing. Over $4000 was spent for paperbacks; most were not returned. Considerable reader interest was stimulated in books on Negro culture and books directly related to job training. During the second summer, increasing sophistication was noted in both children's and adults' interests. Many other tangible results are summarized in the paper. The May 1966 issue of Wilson Library Bulletin, on "Service For Everyone," discusses bringing the wealth of libraries to the partially sighted, the orthopedically handicapped, the mentally disturbed, the mentally restored, and the elderly, most of whom are not institutionalized.[98] Edward Noakes, in the same issue, recommends modifications in building design for structures, including libraries, functional for people - the convalescent, the tall, the obese, as well as the infirm.[99]



Remote Terminal Display and Entry Station

98. Kathleen Molz, ed. "Service for Everyone." Wilson Library Bulletin, vol. 40, no. 9 (May 1966) 817-857.

See also papers in Reference 1 on library services and materials for culturally disadvantaged students, for the gifted, and for urban communities.

99. Edward H. Noakes. "Making Libraries Useable." Wilson Library Bulletin, vol. 40, no. 9 (May 1966) 851-853.

opportunities for industry-oriented libraries

An explanation is in order for the heading of this section. The written record known as the "scientific and technical report" is a most unlovely document, at least with regard to procedures that must be devised for cataloging it descriptively and by subject. It is also elusive. It is usually and irregular publication. It is thus difficult to determine whether a particular report exists and difficult to look for an item one can't describe. The report is nonuniform as to physical condition, content, and sometimes source. It could be a creation of the printer's art; too frequently it is minimally legible. It can be terse and contain only essential information summarizing a long period of effort. It can ramble and say little with high redundancy (e.g., many "status" reports). Or, it could be a comprehensive record of research or development, all or parts of which could be valuable to many people in many places in connection with their own work. This latter type of report could be a state-of-the-art survey, conceivably with a life expectancy of six or seven years. Alternatively, as a report of progress, its current value might be high with a rapid decay rate. The technical report doesn't find its way to journals or books, except by summary or reference, primarily because it is a medium for rapid dissemination of information, with minimum editing for literary style and with minimum external review.

The concern, referred to above, that arose toward the end of World War II, for documentary control, not only of OSRD reports, but of captured German and Japanese reports, had a purpose. Vannevar Bush and others knew that some reports contained information that was needed as a basis for futher research and development. The scientist, like the medical researcher, may repeat an experiment, but with the intention of verifying results. There is little merit in redoing ab initio unless one is a student and trying to learn and understand. Moreover, Bush and others recommended increasing federal support of scientific research, and indeed the government's investment has gone from $1.6 billion in 1950 to about $15 billion in 1965, with a comparable rise from $1.2 billion to $5.5 billion in industrial support.[100] Thus the to-be-large federal library was born to acquire, process, and store these materials and to provide means of announcing acquisitions and furnishing reference access to the store. To a smaller extent, libraries for subsets of these materials began to proliferate within industrial establishments.

"Heat as well as light," as the saying goes, was generated in criticisms of the report libraries. A PSAC report, the so-called "Weinberg report," on Science, Government, and Information, is a manifesto dated 10 Jan. 1963, aimed at improving the network of libraries that had developed and aimed at a refinement of their objectives for a more efficient and effective total effort.[101] A few words are warranted to critics by way of a view from inside. Though cataloging, per se, was not new in 1944, the technical report and other materials that are now beginning to be processed (film, tapes, etc.) raise genuine and difficult cataloging problems. These problems pertain both to how to describe the item (how to document the corporate author, author, sponsoring agency, etc.) as well as how to describe the content. Conven-

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100. Paul J. Grogan, dir. Office of State Technical Services, First Annual Report, Fiscal Year 1966. Washington, D. C.: U.S. Dept. of Commerce, Jan. 1967, at p. 3.

101. Alvin M. Weinberg, et al. Science, Government, and Information, The Responsibilities of the Technical Community and the Government in the Transfer of Information. A Report of the President's Science Advisory Committee. Washington, D. C.: The White House, Jan. 1963. (Available from GPO, 25¢)

tional subject classifications (Library of Congress, Universal Decimal, etc.) do not permit the specificity needed to retrieve the one or small number of reports that a particular user wants from a rapidly growing file. Vocabularies differ among scientific specialties; meanings of a given word differ from specialty to specialty; new terminology is continually introduced and old terminology (that may only be a few years old) changes or disappears. The larger the scope of coverage in a library for these materials, the higher its position on an exponential curve of complexity in all aspects of operation and service. Neither internal organization of staff and functions nor external services nor efficient networking of libraries is immediately achievable or even achievable over a short time span. It is probable that better networking should exist than presently does. Valid reasons could be given as to why it doesn't. It is meaningful to look to the past, but only to learn from experience rather than to flay dead horses.

This section, then, will describe some current activities toward making this literature available to users. "Industry-oriented" is the descriptor in the heading because, irrespective of who or where the user is, he is usually "application-oriented" in the sense that he seeks information to apply it. It is immaterial, from a service standpoint, whether the application is for on-going research or product development. The term "industry" is intended to convey my view that the raison d'etre for this library is the customer. Niceties of collection for collection's sake or scholarship, except as it pertains to improved services, take second place, if time, staff, and funds permit.

Two major types of libraries have evolved for handling large collections of materials for large groups of users. These are designated the "information center" (or "documentation center") and the "data analysis center." The information center is a depository, usually for materials in a number of subject areas. It acquires, catalogs, and stores; distributes announcements of accessions; and provides reference service (furnishes copies of reports, compiles bibliographies, etc.). The analysis center usually concentrates on a particular subject area. It "reviews, evaluates, and synthesizes data from published and unpublished sources, and it furnishes information directly in a format pertinent to the individual request."[102] A recent compilation, from which the latter definition is quoted, lists 22 analysis centers established by the Department of Defense (DOD) and 14 centers sponsored by the Atomic Energy Commission (AEC). It also has a bibliography of directories that have attempted to keep track of the international, national, regional, and local information centers that have mushroomed. Growth in the scope of activities (i.e., networking) of data centers and in the range of coverage is competently reported in the NSRDS News of the National Bureau of Standards' (NBS) National Standard Reference Data System (NSRDS).[103]

The Annual Historical Summary of the Defense Documentation Center (DDC) gives insight into the operations of a major information center.[104] Numbers, of course, are impressive. DDC has a collection of 850,000 reports that span the spectrum of science and technology. It had an assigned staff

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102. Donna F. Spiegler and Richard E. Bowman, comp. "AEC and DoD Information Analysis Centers." Special Libraries, vol. 57, no. 1 (Jan. 1966) 21-34.

103. NSRDS News reprints relevant news items from the NBS Technical News Bulletin. NSRDS News is available from the NBS Office of Standard Reference Data, Gaithersburg, Md. 20760. The Bulletin is a monthly, available from GPO, $1.50/yr. domestic, $2.25 foreign.

104. Robert H. Rea. Annual Historical Summary, 1 July 1965 to 30 June 1966. Alexandria, Va.: Defense Documentation Center, Oct. 1966. Rept. RCS DD-DSA (A) 216 (L), AD-645, 500.

of 472, 28 in planning and management, 86 in accessions and analysis, 101 in "data systems," and 205 in user services, as well as 6 and 8 in offices of technical liaison and lexicography, respectively, as of 30 June 1966. DDC's Title Announcement Bulletin (TAB) published titles and abstracts for 48,667 documents in Fiscal Year 1966 (47,891 new titles, of which 37% were unclassified, 39% were unclassified/limited, and 24% were classified). The average delay time from receipt to publication was 25 work days. TAB added a report number index in Jan. 1966 to the previous corporate author/military agency, personal author, subject, and contract number indexes. (The report-number index was the index improvement most frequently requested by users). DDC received 1,506; 996 requests for documents and filled 1,342,268, of which 1,228,950 were hard copies and 11,318 were microform (50% were unclassified/unlimited). (Users specify the form in which they desire copies). Under arrangement with the Clearinghouse for Federal Scientific and Technical Information (CFSTI), that services non-DOD-sponsored requesters, DDC and CFSTI shared the request load (677, 000 from DDC, 665,268 from CFSTI). Hard copies from DDC's shelf stock were shipped in an average of 2.1 work days, and from reproduction in 6.1 work days. DDC received 17,496 requests for bibliographies, completed 17,403 (of which 99% were machine processed), each bibliography listing an average of 137 citations. Bibliography requests were satisfied in an average of 3.3 work days.

DDC has, over the past few years, also been adding both to its range of services and to in-house research for improved services. The RDT&E (Research, Development, Test and Evaluation) Work Unit Data Bank System exemplifies combined contributions yielding user-oriented products. DD Form 1498 is DOD's mechanism for summary reporting of on-going research projects, primarily for management. Between Oct. 1965 and June 1966, DDC received 18,584 Form 1498's. DDC analyzes, catalogs, and indexes these records by procedures similar to those for its documents. A number of iterations were required to determine DOD managers' anticipated demands on this file (types of reports, formats, and frequencies). DDC delivered its first management report in Dec. 1965. In the last quarter of FY 66, it gave top priority to the

Datamation, March 1967

"I've just been looking up old J. B.—boy, oh boy!"

105. Frank Y. Speight and Norman E. Cottrell. The EJC Engineering Information Program - 1966-67. A Progress Report on the Role of Engineers Joint Council in Improving Dissemination of Engineering Information and Data. New York: Engineers Joint Council, Feb. 1967.

106. Stanley Klein. "Meeting Information Needs." Engineer, vol. 8, no. 1 (Jan-Feb. 1967) 12, 14.

system, deploying 40-50% of its systems and programming personnel, with the addition of 11 contract personnel, to mechanize final requirements. By the close of FY 66, it had received 992 requests and satisfied 924, 285 of which required special computer printouts and tabulations. Another DDC-manned effort is vocabulary control. Its Thesaurus revision of June 1966 contains 7146 terms in three major sections: (1) a COSATI subject category distribution, (2) an alphabetic listing, and (3) a hierarchic listing. Machine subject search capabilities were extended to permit descriptor truncation for search on morphological stems and for search of all subsumed terms by specification of the generic term in a hierarchy. DDC detailed one person full time to Project LEX, a DOD-sponsored effort to develop a DOD-wide thesaurus. DDC sent tapes containing its AD-600,000 series from TAB 66-8 to NASA and the Army Electronics Command, Ft. Monmouth, in April 1966, toward developing a standard tape exchange system with other agencies. It is exploiting its resources, to a limited degree, for education and training. Two interns worked on 6-week projects in FY 66; one joined the staff. Employment of a blind programmer trainee included DDC's sending him to a special school for 5 months.

Two large-scale efforts still in the beginning stages, are those of the Engineers Joint Council (EJC) and member engineering societies, and the Office of Education's (OE) Educational Research Information Center (ERIC) network. EJC, representing over a half million engineers, recently published recommendations for a United Engineering Information System that emanate from a program begun in 1962.[105] The engineering societies place great emphasis on disseminating information. In 1966, 18 of them spent about $14 million, or about half their budgets, on literature programs.[106] To encourage the incorporation of indexes and abstracts in the journal literature, EJC also recently distributed a Guide for Source Indexing and Abstracting of the Engineering Literature.[107] The hope of some planners is

> the development of a network of specialized information centers with on-line, instantaneous retrieval capability, utilizing remote consoles that perhaps will be placed on the desks of every project engineer.[108]

Although the ERIC system is strictly outside the scientific and technical information purview, common areas of interest exist as well as common characteristics in the nature of the body of literature ERIC is processing. The ERIC system reflects heavy reliance on experience gained in DOD systems. It may add innovations of its own that could be adapted to the DOD and other environments. Twelve of ERIC's Clearinghouses derive from a Request for Proposals (RFP) dated Feb. 1966. Ten were established in universities. Each has a defined area of specialization. An RFP dated Jan. 1967 outlined 8 additional areas of OE interest.[109] The ERIC system contemplates

> a nationwide information service ... to help put the results of new educational research into the hands of those who need it - teachers, administrators, researchers - and to do so on an up-to-date basis at nominal cost to the user.[110]

The ERIC organization, operations, and goals are amplified as follows:

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107. Frank Y. Speight, ed. Guide for Source Indexing and Abstracting of the Engineering Literature. New York: Engineers Joint Council, Feb. 1967.

108. Ref. 106, p. 14.

109. Letter, 9 Jan. 1967, Subject: Request for Proposals (RFP) for the Establishment and Operation of Educational Research Information Center (ERIC) Clearinghouses. Request for Proposal No. 67-2. With Attachments, "Request for Proposal: ERIC Clearinghouses."

110. Lee G. Burchinal. "ERIC .. and the Need to Know." Washington, D.C.: U.S. Office of Education, (1966).

At the present time ERIC consists of a headquarters office (Central ERIC) in Washington and a network of 13 clearinghouses in universities and other institutions throughout the country. Each clearinghouse is responsible for information in a given area of education. Its staff of specialists acquires, selects, abstracts, and indexes all relevant documents. Central ERIC coordinates the clearinghouses, stores the full texts of documents on microfilm, announces all new acquisitions, and makes the documents available to the educational community at nominal cost in pamphlet or microfiche form.

In addition to Central ERIC and the clearinghouses, the network includes an ERIC Document Reproduction Service (EDRS) operated under an Office of Education contract with Bell and Howell Company in Cleveland, Ohio.

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Obviously, the success of the ERIC system depends on its being widely used by the educational community it is designed to serve. But to an even greater extent, its success depends on the acquisition of current, significant reports on educational R & D projects. Without these, the system cannot exist. Here, the clearinghouses must turn to the educational community for help.

We therefore are requesting that individual educators make a practice of sending to the appropriate clearinghouse two copies of any document they think meets ERIC's criteria.... In addition, we ask that educators add the appropriate ERIC clearinghouses to their standard distribution lists to automatically receive copies of future reports.

The clearinghouses seek not only typical research reports with their hypotheses, test methods, and findings, but also published and unpublished conference papers, newsletters, speeches, curriculum guides or studies preliminary project reports, and other works that educators think will have value for teachers, administrators, educational specialists, researchers, or the public.

We are especially interested in documents that may have had limited distribution but are worthy of broader announcement and distribution.

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Another related information system, Phi Delta Kappa's School Research Information Service (SRIS), is interested

> in receiving copies of all research and other innovative educational materials developed recently by local school systems and school study councils. Arrangements are being developed to ensure that any materials received by SRIS that are within the subject areas of the ERIC clearinghouses will be forwarded to them.[111]

In Nov. 1966, the OE ERIC staff began publishing a new monthly announcement bulletin, Research in Education.[112] In four sections, it provides report resumes (abstracts, ordered by accession number), report indexes (author, institution, subject, and program), project resumes (abstracts, ordered by accession number), and project indexes (investigator, institution, subject, program, and contract and grant number). All reports cited in the bulletin are available from EDRS. The RFP also calls for the development of "an educational thesaurus" and "means to test and evaluate the effectiveness of the clearinghouse's operations." The individual clearinghouses are charged with responding to reference inquiries and producing local reference services. The RFP anticipates repetitious inquiries enabling the "packaging" of responses. Clearinghouses are encouraged to develop their own publicity brochures, periodic newsletters, and interpretive reports and reviews.

The scientific and technical information needs of industry and efforts of various types of libraries to meet these needs are extensively sur-

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111. Ibid, p. 2, 7.

112. Research in Education, a monthly. Washington, D.C.: U.S. Dept. of Health, Education, and Welfare, Office of Education. (Available from GPO, $11.00 domestic, $13.75 foreign, annually)

113. Katharine G. Harris and Eugene B. Jackson, eds. "Library Service to Industry." Library Trends, vol. 14, no. 3 (Jan. 1966)

114. Eugene B. Jackson. "The General Motors Research Laboratories Library: A Case Study." Library Trends, vol. 14, no. 3 (Jan. 1966) 353-361, at 353-54.

veyed in the January 1966 issue of Library Trends. 113 Eugene Jackson notes, for the General Motors Research Laboratory Library, that

> It borrows about 1,100 items on interlibrary loan a year (equivalent to one-sixth of the total interlibrary loans supplied to all industry in a year by the Massachusetts Institute of Technology libraries), has deposit accounts in several of the libraries mentioned by Ralph Phelps, William Budington, Dwight Gray and J. Brulin Johnson (i.e., professional and trade association libraries, independent research libraries, and federal government libraries -RWS) and still cannot answer all the demands placed upon it by its three "publics."
>
> These are, first, the Research Laboratories staff of 500 professional scientists and engineers; second, the several hundred engineers and scientists in other staffs and groups at the Technical Center site (some of whom have their own professional library support); and, third, the thirty-three Divisions of the Corporation located all over the world.
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> .....
>
> It seems inevitable that there is a triangle associated with the availability of information to an industrial firm. At the apex is a small area representing material physically located at a given location; below this, there is an area larger in size representing material elsewhere in the Company; and finally the far larger area in the remainder of the triangle represents the material available on the outside. Interlibrary loan is the catalyst that permits a decentralized industrial library system to work under these circumstances. 114

Pfoutz and Cohen report that public library service to industry is frequently less adequate than the resources maintained by industry itself.[115] Natalie Nicholson's survey of industry use of 30 academic libraries in 1962 and repeated for 12 in 1965 show the following trends:

115. Daniel R. Pfoutz and Jackson B. Cohen. "Service to Industry by Public Libraries." Library Trends, vol. 14, no. 3 (Jan. 1966) 236-261.

First, there is increased use of university libraries by industry; second, photocopying has greatly diminished the need for interlibrary loan and room use; third, the opinion is growing that there should be full reimbursement by industry for the costs of library service; and fourth, in consequence, more formal plans for service to industry are being made.

. . . . .

The growth of photocopying in lieu of loan is the most interesting aspect of increased use. Better quality copying machines, accompanied by more efficient and speedier service, has had its effect. Comments from a few industrial librarians queried also in the spring of 1965 indicate great satisfaction with photocopying services, although one pleaded for the availability of deposit accounts as standard practice.[116]

116. Natalie N. Nicholson. "Service to Industry and Research Parks by College and University Libraries." Library Trends, vol. 14, no. 3 (Jan. 1966) 262-272, at 264.

117. Ralph H. Phelps. "Service to Industry by Professional and Trade Association Libraries." Library Trends, vol. 14, no. 3 (Jan. 1966) 273-287.

118. William S. Budington. "Service to Industry by Independent Research Libraries." Library Trends, vol. 14, no. 3 (Jan. 1966) 288-294.

119. Bill M. Woods. "Regional and National Co-Ordinating and Planning for Library Service to Industry." Library Trends, vol. 14, no. 3. (Jan. 1966) 295-305, at 297.

Miss Nicholson also comments that erosion of service to the academic clientele caused by industry demand can also be subtle but nonetheless real. Ralph Phelps summarizes results of a survey of professional and trade association libraries.[117] Of 26 questionnaires sent, 15 were returned, only 8 of which reported service "more or less generally available to industry." He concludes that, except for the EJC program discussed above, "membership and consequently income of professional societies is not increasing at a rate sufficient to continue services under the same conditions as in the past." Of the independent research libraries, the John Crerar Library (Chicago) and the Linda Hall Libraries (Kansas City) are notable for their service to science and technology. Demand has shifted from the local to the national user. Crerar and Linda Hall mail about 24,000 and 30,000 packages (loans and photocopies) per year, respectively.[118] These libraries depend for income on endowment and charges for service. Bill Woods, in discussing cooperative planning among libraries for broadened service, comments:

> Although some librarians in each generation since Winsor have questioned the merits of cooperation, it has flourished and taken several forms - storage centers, interlibrary loans, directories, cooperative cataloging, duplicate exchanges, union lists of several sorts, shared resources, and cooperative acquisitions. Industrial libraries have participated to some extent in all.[119]

His paper reviews cooperative efforts and concludes:

> Critics will contend that there is little rhyme or reason to the paucity of planning in some areas and a multiplicity of plans in other areas. Some would place great faith in plans for development of a national science information system or network of systems, as is presently being studied by the Federal Council for Science and Technology's Committee on Scientific and Technical Information (COSATI). Others would place hope in the voluntary programs which develop invariably to meet existing needs.[120]

About 30,000 computers are in use in the United States, almost 2600 of them in the federal government.[121] U.S. industry uses about $6 billion of computer power of the $13 billion worth estimated to be installed around the world.[122] Some hardware, such as DDC's Univac 1107 and related equipment, was obtained specifically for information processing requirements. Most hardware in industry is obtained for manufacturing and management purposes. Alert members of computer staffs, or library and information center personnel, have capitalized on the existence of hardware at an installation to do some mechanized information processing. Principal among the products generated thus far for dissemination to users have been accession lists, KWIC indexes (and variants), and bibliographies. Marguerite Fischer's fine review of the KWIC index concept traces it, sans computers, to practices of old European libraries, notably to the schlagwort ("catchword" or "keyword") procedures in German libraries over a century ago.[123] She also cites Crestadero's Art of Making Catalogues of Libraries, 1856, that introduced permutation indexing. Nevertheless, the KWIC index, a permutation index based on titles and produced by machine, has become a generally

120. Ibid, p. 303.

121. Government Electronic Data Processing Systems. Hearings Before the Subcommittee on Census and Statistics of the Committee on Post Office and Civil Service. House of Representatives, 89th Cong., 2d Sess., 14, 15, 28, 29 June 1966.

122. Anon. "Top 100 EDP Users Comprise One-Sixth of Worldwide Installations." Communications of the ACM, vol. 10, no. 4 (April 1967) 250.

123. Marguerite Fischer. "The KWIC Index Concept: A Retrospective View." American Documentation, vol. 17, no. 2 (Apr. 1966) 57-70.

124. Ibid., p. 67.

accepted format for the rapid announcement of content of a large number of documents since Hans Peter Luhn's 1959 paper discussed its computer implementation. Miss Fischer notes that Luhn anticipated its use mainly as a current awareness tool:

> (1) The principal merit of the method is timeliness. The KWIC system lends itself to index production in the shortest possible time with a minimum of effort.
>
> (2) The proper objective of KWIC indexes is to increase among their readers an awareness of current research.
>
> (3) The usefulness of these indexes is of a temporary nature. Ideally, they should be superseded ... by "an instrument prepared with care in due course, incorporating all those features which will enhance its usefulness as a permanent tool of reference."[124]

To make it serve for retrospective search, departures in format, human editing of titles, and vocabulary supplements have been introduced.

Mechanization of the SDI concept (Selective Dissemination of Information) also traces to "Pete" Luhn.[125] His "business intelligence system" of 1958 envisioned "auto-abstracted" and "auto-encoded" documents and "action-point profiles" for users.

> One of the basic requirements of the system is the ability to recognize by mechanical means the sphere of interest and the type of activities that characterize each of the action points the system is to serve. This is accomplished by means of an information pattern similar to that of the documents.
>
> .....
>
> As soon as a new document has been entered into the system and its pattern developed, this pattern is set up in a comparison device which has access to all of the

125. H. P. Luhn. Selective Dissemination of New Scientific Information with the Aid of Electronic Processing Equipment. Yorktown Heights: International Business Machines Corp., Nov. 1959. Rept. 17.010.

> action-point profiles. The comparisons are carried out on the basis of degree of similarity, expressed in terms of a fraction, for each of the profile patterns. This fraction is subject to change as time goes on, depending upon conditions to be explained later.
>
> Whenever a profile agrees to a given extent with a given document pattern, the serial number, title, and author of the affected document, together with the action-point profile designation, are transferred and stored in a monitoring device.
>
> .....
>
> Of the various ways in which such an announcement may be transmitted to the affected action points, the most effective one is by means of a printing device at each action-point location. An objective of the system is to command attention of the recipient. The use of individual printing devices is more effective than are centrally located devices serving several action points.[126]

User feedback to the system would up-date the record on user need and the system could monitor user response. One detailed report of experience with SDI is that of C. R. Sage at Iowa State University's Institute for Atomic Research.[127] Profile terms in this system can be weighted (given a "significance" value). Users need not employ a fixed vocabulary. Descriptors for some of the 83 profiles now in the system are foreign language terms and journal and author names. Profiles are frequently up-dated and expanded. Iowa's document record is composed of citations obtained from the magnetic tapes used in index production. Iowa's program, for example, can accept the tape formats used for Science Citation Index, Chemical Titles, Sandia Corporation Publications Accession Lists, Nuclear Science Abstracts, IBM KWIC Index, and the Ames Laboratory Publication Master File.

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126. H. P. Luhn. "A Business Intelligence System." IBM Journal of Research and Development, vol. 2, no. 4 (Oct. 1958) 314-319, at 316.

127. C. R. Sage. "Comprehensive Dissemination of Current Literature." American Documentation, vol. 14, no. 4 (Oct. 1966) 155-177.

Sage ran tests with 13 semi-monthly issues of Nuclear Science Abstracts (NSA) (25,378 entries) and 13 weekly issues of Science Citation Index (SCI) (69,348 entries). NSA tapes contain authors, titles, sources, and keywords. SCI tapes contain authors, titles, and sources. The two overlap in journal coverage. NSA includes AEC research and development reports. SCI includes patents. Twenty-one users reported that notifications disseminated over a six-month period contained 40.39 and 41.10% "positive" references for them from NSA and SCI, respectively. In another test, responses were grouped in 7 area-of-interest categories. Notifications were least satisfactory to 12 metallurgists. Thirty chemists, the largest group with the most comprehensive profiles, were the most satisfied. In early runs, a group of experimental physicists found need to modify their profiles. Authors' names constituted 53.8% of their adjusted profile terms, and 89.2% of their negative terms were journals. Their notifications contained the highest numbers of references per user. This group was the most interested in currency, and had little use for citations older than 6 months. Limited profiles for 5 engineers were not adequate for matching against title-author-source entries. Sage suggests that 10 to 15 users is minimum for testing adequacy of an SDI service for a group. Iowa's input averages 6500 to 7500 entries weekly. An unanticipated "subtle noise" in the system was caused by variants in authors' names. This may be reflected in the large number of "neutral" (i.e., neither "positive" nor "negative") references in the notifications. "Participation enthusiasm," Sage writes, depends on the system's ability "to offer a very comprehensive coverage to a prospective user." Tests on abstracts and indexes are planned.

Mary Stevens' extensive state-of-the-art coverage of automatic indexing makes additional comment superfluous.[128] Donald Black subsequently examined the implications of automatic indexing for the library functions of classification and indexing.[129] He asks: "what is it that we are attempting to produce when we classify or index?" He questions whether tests of machine-produced indexes have been judged fairly. He notes that work of Montgomery and Swanson, for example, was directed to measuring the extent that human indexing operations in an existing system could be simulated by machines. Should machines be judged against standards of infallibility in the abstract? Black's data show adequacy of indexes developed from titles alone, with stated provisos, and inadequacies of humans in formulating search questions for machines. He observes:

> Enough research has been performed to indicate that any system of subject headings, coordinate index terms, machine retrieval, whatever, which continually makes its specifications narrower, in order to eliminate irrelevant material, will be subject to the error of over-specification. This error will cause relevant material, to a greater or lesser extent, to be missed. The problem, then, is not to find a solution which will be theoretically perfect and which will prevent all irrelevant material as

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128. Mary Elizabeth Stevens. Automatic Indexing: A State-of-the-Art Report. Washington, D.C.: National Bureau of Standards, March 1965. Monograph No. 91. (Available from GPO, $1.50)

129. Donald V. Black. "Automatic Classification and Indexing, for Libraries?" Library Resources and Technical Services, vol. 9, no. 1 (Winter 1965) 35-52.

130. Ibid, p. 48, 50.

131. G. A. Kershaw, et al. Study of Mechanization in DOD Libraries and Information Centers. Bethesda: Booz, Allen Applied Research Inc., Sept. 1966. BAARINC Rept. 914-1-1; AD-640,100. (Contract DSA-7-15489)

132. Citations and abstracts of 30 of the reports are contained in Ref. 131 and also appear in DDC's TAB, Issue No. 66-22, 15 Nov. 1966, p. 10-15. The reports bear AD numbers 640,101 through 640,130.

well as produce all relevant materials in any given collection. For such a solution exists only as a rather fantastic dream. Rather, our goals should be to produce a system which will minimize irrelevant retrieval and maximize relevant retrieval to the greatest extent practical. The emphasis should be on the word practical in all cases.

.....

Subject heading authority guides, the knowledge of many individuals, cross references, etc., can all be placed in a machine memory, and the system tested again and again, each time perfecting it a little more, so that ultimately a practical system is obtained.

To conclude, I should like to summarize a system which I believe can be used to provide automatic classification and indexing. It depends on more than titles alone. What I would add as machine readable input is as follows: table of contents; an index contained in the book itself (if any); introductory paragraphs which describe the contents of the book; a short indicative abstract (where available) would also be useful. Such material could be put into machine readable form (where it is not now available) by clerical personnel, following a consistent set of rules as to the elements of the materials to be used and in what order they are to be followed.

This system works by means of a machine thesaurus which contains a vocabulary of words weighted for retrieval importance. The computer looks up in the thesaurus every word and contiguous word pair of each sentence of input. ... The computer keeps track of the location of each word, and thus proximity and pairing factors can be calculated. ... Weights and pairing factors are put into the thesaurus by knowledgeable human beings.[130]

A readable, informative report is the result of a survey begun in July 1965 of 76 DOD libraries and information centers.[131] Of these, 33 had "significant" mechanized systems in development or operation. Details on the system designs, programs, equipment, operations, costs, and future plans of the mechanized systems and 2 manual systems are separately documented.[132] Of the 33, only 6 were judged to have "relatively sophisticated" systems, and none had "novel" programs (automatic abstracting and indexing) nor was the need or desire for them expressed. No system used time-sharing techniques. Four facilities, all information centers, could retrieve data; the remainder furnish only references to documents. Four facilities had SDI systems. Four produced or were planning permuted indexes for users. Two centers (a University of Michigan complex and the Electrical and Electronic Properties Information Center) are planning or developing generalized information retrieval programs that can be shared by several facilities. This approach "can make the difference between being able to justify and afford a mechanized search process, and having none at all." Cost accounting was poor:

> Cost information on system development was either not available, of questionable reliability, or not comprehensive. In addition, there was an almost universal lack of concern about development costs on the part of the librarians when these costs were not associated with manpower billets or hardware purchases. Information center operators, conversely, were generally very concerned about costs and maintained detailed records of current operating costs, although even in these cases the historical development costs were usually not available.[133]

The report attributes many system development problems to inadequate communication between librarians and programmers. Conversely, less difficulty occurred in information centers:

> The centers' staffs were usually more technically oriented and had a meaningful understanding of computer technology. They were able, therefore, to communicate with the programmer on his terms. (We encountered no programmers who could communicate with the librarian on his terms).
>
> Some centers (e.g., TPRC and MIDC) maintained a staff member who had the ability to program.[134]

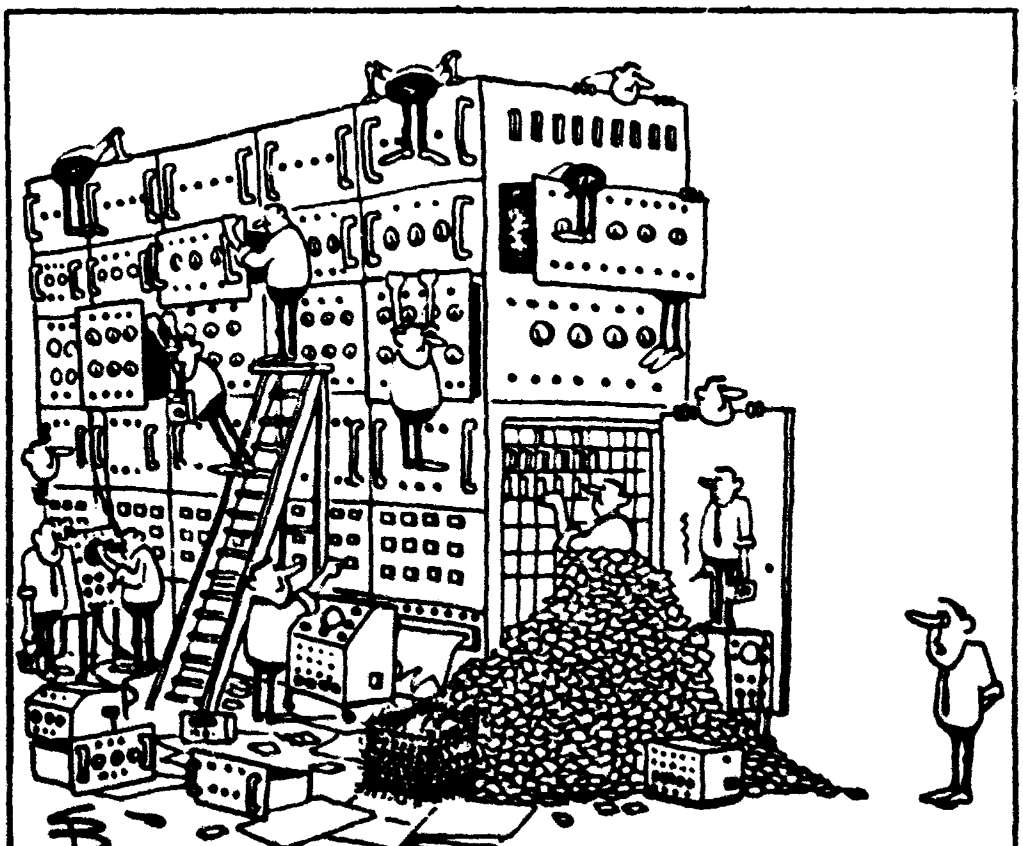
133. Ref. 131, p. 1-9, 10.

134. Ibid. p. 1-9.

Lack of understanding may also be partially the culprit for several systems that "seemed remarkably able to operate and to expand in the vacuum of a nearly complete absence of considerations of user needs." SDI systems encounter difficulties when interest profiles are not properly developed. "There is no substitute for patient, painstaking work on the part of both the profile developer and the participant." Effectiveness of the systems could not be determined because "factors of effectiveness for information systems have not been generally agreed on" and "facilities which have mechanized processes that formerly were manual have generally not attempted to compare the two except in superficial ways." The Thermophysical Properties Research Center and 4 information centers at Battelle Memorial Institute retain manual files that they believe give faster, more detailed subject and fact retrieval than present mechanization could.

I am excluding extensive discussion of the "system of the future," known to the user only by a console in his office or his home. An indication of the state of this art is given in the section on education in this report. Software, not hardware, is lacking. Software is the classifications and indexes, the authority records, the internal and external operating procedures, schemes for cooperation among libraries and resource centers, etc. -- the totality other than hardware needed for viable systems. Machines don't know what they do, but they do it very rapidly and expensively. The largest publishers in New Jersey, New York, and Connecticut, it is said, are 137 computers that produce a million pages a month.[135] The machines force us to look more closely at the soundness of what we tell them to do, and at the soundness of what we do ourselves. The status of mechanization and information retrieval suggest to me the pointlessness of "blue skying" at this time.

Toward systems of the future, significant questions are being asked about how people acquire information and what use they make of the libraries, centers, and services thate are established for them. The DOD sponsored a two-phase study to determine patterns of use of information by scientists and engineers in government (Phase I) and in the defense industry (Phase II). Phase II queried 1500 people in 83 organizations. Some of its findings and comparisons with Phase I data follow: [136]



"Trouble?"

Datamation, July 1966

135. Anon. "Microfilm Seminar Examines State of the Art." Systems, vol. 7, no. 11 (Nov. 1966) 20-26, at 26.

136. Arnold F. Goodman, et al. Final Report, DOD User-Needs Study, Phase II, Flow of Scientific and Technical Information within the Defense Industry. Vol. I, Overview. Anaheim, Calif.: North American Aviation, Inc., Nov. 1966. Findings from p. 35-41, 50-53, 60.

- In search and acquisition, industry users wanted and received specific answers more often than government users.

- Industry users were less dependent on their local work environment for task information, but they went beyond this environment only 20% of the time.

- Industry users tended to use a first source of information more often than government users because it was available or the only one known; company technical information centers are used by almost all individuals; DDC is used by about 50% of them, but is unknown to 1 out of 3.

- Over 40% of the industry sample used DOD special information centers; these were unknown to 1 out of 3.

- NASA's services were used by 20% of the industry sample; 2 out of 3 didn't know about them.

- Tasks in industry were less self-generated and required more formal and written reporting over longer time periods.

- About 25% of industry users are asked to perform tasks outside their normal area of activity (greatest for mathematicians).

- Industry users were less subject to time constraints, and used acquired information more directly in task accomplishments.

- As work proceeds away from research and toward an end product, need for in-depth information decreases.

- Title listings or abstracts could have been useful to locate 40% of information needs.

- Industry users found post-task information more often than government users (for 20% of the tasks); they were more often unaware of DDC, TAB., etc., and encountered more difficulty in acquiring information.

• Two out of three industry users were in development work; over 50% possess the bachelor's degree and almost 1 of 3 an advanced degree; 3 of 4 are in salary levels corresponding to government's GS-11 to GS-14 levels.

• Industry users were younger, had more post-graduate degrees, had been in their present work longer, were more involved in administration and technical management, and had higher salaries.

• Industry users with advanced degrees reported more problems in acquiring information.

	NSA	STAR	TAB	USGRDR	Totals
Industrial	588 46.6%	1688 62.1%	1346 71.9%	1666 79.4%	5288 (66.5%)
Educational	617 48.9%	970 35.7%	510 27.3%	322 15.3%	2419 (30.4%)
Private	24 1.9%	52 1.9%	11 0.6%	96 4.6%	183 (2.3%)
State/Local	33 2.6%	8 0.3%	4 0.2%	14 0.7%	59 (0.7%)
Total	1262 15.9%	2718 34.2%	1871 23.5%	2098 26.4%	7949 100%

Figure 3 — NON-FEDERAL U.S. RECIPIENTS

137. Irving M. Klempner. Diffusion of Abstracting and Indexing Service Media for Government-Sponsored Research. New York: Columbia University, June 1967. Rept. AFOSR-

A Columbia University thesis of Irving Klempner, to be published shortly, examined use and nonuse patterns for 4 federal index-and-abstract services: AEC's Nuclear Science Abstracts (NSA); NASA's Scientific and Technical Aerospace Reports (STAR); DDC's TAB, and the Dept. of Commerce's U.S. Government Research and Development Reports (USGRDR).[137] His culling of mailing lists of subscribers to these services disclosed 7949 non-federal U.S. recipients of one or more copies of the services. Fig. 3 , Klempner's Table 6, gives the recipient distributions. Fig. 4 is Klempner's Table 9 for the distribution among industries grouped according to the Standard Industry Classification. Fig. 5 is Klempner's Table 10 showing the combinations of services received at a total of 4179 sites (3004 discrete organizations). Almost 50% of the recipients are located in 5 states: California, New York, Massachusetts, Pennsylvania, and New Jersey. Of 1139 questionnaires (12 pages, 50 questions) mailed to a stratified random sample, 823 were returned (776 usable). Analysis of the data disclosed:

• 82% of the host organizations engaged in federal R & D work, about 50% employing 300 or more scientists and engineers; 96% maintained a library or information center, but about 50% employed one or less professional librarian

• among the respondents, 47% were acting as librarians, 22% were engaged in R & D, and 20% were managers or administrators

• almost all respondents held a bachelor's degree; 25% held Ph.D.'s; about 40% are estimated in the 30-40 age group

• 42% had task assignments at least once annually outside their field of specialization

• 91% used an index-and-abstract service over a specified 6-month period; regular use was indicated by 60% to acquire specific information directly related to an on-going project (57.1%), for current awareness in a primary field of interest (42.2%), and for current awareness in a secondary field of interest (45.3%)

• 63.9% preferred present coverage to a more specialized subject service, 47.1% being satisfied with the present format

• about 30% of the libraries do not permit circulation of the services; the collections of 40% ex-

Aircraft and missiles	132
Chemicals and allied products	196
Industrial chemicals	86
Drugs and medicines	33
Other chemicals	76
Electrical equipment and comm'n	392
Comm'n equip. & components	261
Other electrical equipment	129
Fabricated metal products	81
Food and kindred products	29
Lumber, wood products	5
Machinery	195
Manufacturing industries, public utilities, wholesale & retail trade	586
Motor vehicles, transportation	38
Other manufacturing, tobacco, printing, leather products, misc.	97
Paper and allied products	23
Petroleum refining & extraction	45
Primary metals	87
Primary ferrous products	41
Nonferrous & other metal prod.	46
Professional & scientific instruments	164
Measuring instruments	104
Optical, surgical, photographic	59
Rubber products	33
Stone, clay, glass products	36
Textiles and apparel	15
TOTAL	2154

Fig. 4 – INDUSTRIAL RECIPIENTS BY MAJOR S.I.C. GROUP

ceed 15,000 report titles (15% exceed 100,000 titles)

- of recipient libraries, 80.2% of the industrials and 19.8% of the academics catalog technical reports (40% assigning 5 or more descriptors); 83.5% and 16.5% prepare abstracts, respectively; 83.5% and 16.5% issue acquisition bulletins, respectively; and 85.2% and 14.8% maintain an SDI service, respectively

- over 50% of the libraries retain copies of the services for 3 or more years

- 82.3% expressed no difficulty in acquiring announced publications

Klempner worked with the following data to isolate research-oriented non-recipients of the services: 3260 industrial firms listed by Industrial Research Laboratories of the United States (1965) (believed to represent more than 95% of the dollar volume of the U.S. industrial R & D effort); 1096

	No. Sites	%
USGRDR	1067	25.5%
STAR	853	20.4%
TAB	529	12.7%
TAB, STAR	362	8.7%
NSA	334	8.0%
NSA, STAR, TAB, USGRDR	239	5.7%
STAR, TAB, USGRDR	160	3.8%
NSA, USGRDR	125	3.0%
STAR, USGRDR	114	2.7%
NSA, STAR, TAB	113	2.7%
NSA, STAR, USGRDR	85	2.0%
TAB, USGRDR	77	1.8%
NSA, STAR	66	1.6%
TAB, NSA	29	0.7%
TAB, NSA, USGRDR	26	0.6%
Total	4179	

Figure 5 — COMBINATIONS OF SERVICES

institutions listed in the Roster of U.S. Government Research and Development Contracts in Aerospace and Defense (awarded 7500 contracts in FY 64); 2775 firms on the List of Small Business Concerns Interested in Performing Research and Development (1963); and 3188 organizations in the Research Centers Directory (1965) (3014 located in the U.S.). Checks against his recipient file disclosed that 68.6%, 34.1%, 86.4%, and 92% (of 3014), respectively, were non-recipients of any of the 4 services. He mailed non-recipient questionnaires to a random sample of 480 and received 235 replies. His analysis shows:

• respondents primarily in electronics and engineering (24.4%), chemistry and chemical engineering (16.2%), and other engineering (15.8%)

• 81.3% of the host organizations employ fewer than 20 scientists and engineers; 87% conduct in-house research (about 50% of this for private organizations and 18% for the federal government)

• 75% maintain libraries, 12% of these being staffed by professional librarians

• of the individuals who replied, 63% were in management, 27% were engaged in R & D, and 1.7% were

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138. An earlier survey attempted to canvass 100 librarians (42 replied) in government, industries, and universities on government information center services. Respondents criticized subject indexes, indexing consistency, microfiche quality, and overlap among announcement bulletins. The CFSTI was praised for its translation service, its FAST Announcement series, and the cooperativeness of its field offices. Many respondents called Nuclear Science Abstracts the "best of the government indexes." Ten respondents had never used specialized information and data centers. Thomas L. Minder, et al. "Users Look at Information Centers." Special Libraries, vol. 57, no. 1 (Jan. 1966) 45-50.

139. Richard F. Klinger. Annual Report of the Aerospace Materials Information Center. Dayton: Wright-Patterson Air Force Base, Air Force Materials Lab., Feb. 1967. Rept. AFML-TR-67-32. (Document subject to export controls).

librarians or information services personnel

• 48% of the respondents believed their information needs were being met "fairly well" and 13% "inadequately;" 63% needed information outside their field of specialization during a specified 12-month period

• 23% were Chemical Abstracts subscribers; less than 10% received any other well-recognized service; 86% had no knowledge of NSA or TAB; 77% and 71% did not know about STAR and USGRDR, respectively; and 60% wanted information about one or more of these services

• most respondents favored an index-and-abstract service, 26% within their specialty and 54% in a broader primary field; 53% most often needed specific data for assigned tasks, 30% also needing information about laboratory techniques and apparatus [138]

The Aerospace Materials Information Center (AMIC) is the information support arm for the Air Force Materials Laboratory (AFML) (320 professional staff). A 3.8-man-year staff manages specialized data analysis centers through contract and a "general" center (30,000 documents), primarily in fields not specially covered. It serves AFML personnel, government agencies, DOD contractors, and others. It uses its own and other information sources, as necessary, to satisfy requests for information. Several AMIC activities are summarized in a first annual report.[139] AMIC calls some of these "practical experiments." One is a service to in-house managers who review their programs annually. AMIC asks if they wish a current awareness search; managers asked for 15, 47, 180, and 90 searches in support of FY 64, 65, 66, and 67 programs, respectively. Of the 180 made for FY 66, 152 evaluations indicated that the searches provided 53% of the managers with new information and affected the course of work in 29% of the programs. AMIC plans to use DDC's 1498 file as a selective dissemination mechanism, although a first attempt resulted in "moderate acceptability to disappointment." (As a manager, I suspect this could grow to be a most useful information-transmission device). AMIC also canvassed opinions of users of its analysis centers. Of 6000 questionnaires distributed by the centers, approximately 2000 were returned. Some (100-200) users indicated willingness to pay about $100 annually for the services of each of 8 centers (AMIC estimates the total at $300,000), but a larger number (400-500 for most centers) said they would not subscribe. During 8 months in 1966, AMIC also included questionnaires with 400 replies to requests it serviced. An analysis of 107 returns is separately reported.[140] About 46% of the recipients judged the references as close to moderately related to their work; more significantly, 26% said the material was new and pertinent. Nine replies noted direct, beneficial value. AMIC estimates that each reply saved the inquirer $400 or 6.7 man-hours. This may be a low figure, since AMIC used its own file 32 times, DDC's report file 23 times, DDC's 1498 file 12 times, the Science Information Exchange 15 times, and 8 other sources 25 times. Users might not have done this as knowledgeably.

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140. Richard F. Klinger. Aerospace Materials Information Center (AMIC) User Evaluation. Wright-Patterson AFB: Air Force Materials Lab., Dec. 1966. Tech. Memo. MAA TM-66-26.

Return of questionnaires is, in itself, I believe, a measure on the user. Users may need education on the need of responses to gage service. No response, to some extent, indicates both lethargy and ignorance, as well as dissatisfaction with or indifference to service.

141. E. J. Feinler, et al. "Attitudes of Scientists Toward a Specialized Information Center." American Documentation, vol. 16, no. 4 (Oct. 1965) 329-333.

142. A. T. Drury. User Survey of Navy Technical Reports. (Washington, D.C.(?): East Coast Navy Interlaboratory Committee on Editing and Publishing, May 1966. ILCEP-East Monograph No. 3, AD-646,893.

Comments obtained in a 1965 user study bear repetition. Questionnaires and interviews gathered opinions from about one-third of the then 1100 scientists doing research in atomic and molecular physics.[141] About 2000 documents (one-third are published) are written annually. The scientists were concerned about promptness of announcement. They found fault with literature searches, particularly with machine searches, that listed references indiscriminately, i.e., nonapplicable references and organized poorly. They distrusted searches by "information specialists" who would not understand the field. Many questioned the value of an information center for their field because of "bureaucratic inefficiency" and duplication of effort. (An Atomic and Molecular Processes Information Center has since been established by AEC for data compilation).

Four members of the East Coast Navy Interlaboratory Committee on Editing and Publishing conducted a questionnaire study on the acceptability of technical reports.[142] Respondents were 129 scientists, engineers, and medical doctors, mostly in intermediate Civil Service grades. Several questions and answers follow:

- How do you find the reports you wish to consult?
  - (81) references or citations in other reports
  - (28) library catalog
  - (25) periodic listings (TAB, STAR)
  - (21) library acquisitions lists
  - (26) other (received in mail; referenced in conversation; etc.)

- Which do you find more useful, a table of contents or abstract?
  - (84) abstract (38) table of contents

- Do you find "quick and dirty" reports (to speed reporting) less understandable than those painstakingly prepared?
  - (17) yes (99) no

• On speed of reporting, 93 preferred carefully prepared reports as opposed to those without editing.

• How extensively do you use technical library reference services to locate reports?
(61) frequently (63) infrequently

• Would you want an abstract circulation service? (i.e., current awareness, SDI)
(90) yes (27) no

• Do government reports contain excessive jargon?
(29) yes (98) no

• Do you feel that research reports are trivial?
(25) yes, many (68) yes, a few

Several studies have examined communication patterns among scientists and engineers. Richard Rosenbloom and Francis Wolek selected a deliberately heterogeneous population of 2177 individuals in 5 industrial organizations.[143] They found oral communication most frequent (55%); books and professional journals were resorted to 25% of the time. In over 30% of reported instances, information was obtained by a person through voluntary transmission by another person. Scientists had more personal-professional communication with in-

143. Richard S. Rosenbloom and Francis W. Wolek. Studies of the Flow of Technical Information. Cambridge: Harvard University, Jan. 1966, interim rept.

144. T. J. Allen and S. I. Cohen. Information Flow in an R and D Laboratory. Cambridge: Massachusetts Institute of Technology, Nov. 1966. Rept. PB-173,524.

145. J. M. Lufkin. "The Reading Habits of Engineers - A Preliminary Survey." IEEE Transactions on Education, vol. E-9, no. 4 (Dec. 1966) 179-182.

146. Elizabeth M. Walkey. "User Reactions to Nonconventional Information Systems." Special Libraries, vol. 57, no. 10 (Dec. 1966) 716-717.

dividuals outside the corporation than engineers; they also used the literature more frequently. A type of individual characterized as a "technology gatekeeper" is described in an M.I.T. study of information flow in a research and development laboratory.[144] He is a person (a) whom others consult for technical advice, (b) who exposes himself to the literature and other information sources, and (c) who maintains informal contacts with members of the scientific and technical community. The MIT study also identifies "primary groups" which influence the attitudes of others in such matters as feasibility of a research approach.

In a recent reading-habits study, 2200 scientists and engineers in two industrial organizations were polled (1765 responses).[145] Patterns were similar in both organizations. The study attempted to relate reading to continuing education needs. About 75% of the respondents spent less than one hour per week reading contract reports, 40% spent 1 to 5 hours on professional society journals, 65% spent 1 to 5 hours on technical magazines (80% of the supervisors were in this group), and less than 50% read review journals. However, individuals who had received recognition by promotion, publication, or special commendation read more than the average, as did those with Ph.D.'s. About 20% relied on conversation for information. J. M. Lufkin and E. H. Miller also investigated the widely held belief that productive and creative engineers read little and don't have to. Of 18 engineers and 5 scientists, not supervisors, known to be in this category, only 2 read little, the others averaging over 9 hours weekly on the above-itemized literature.

A number of user reactions were reported at a specially held SLA symposium.[146] MEDLARS (Medical Literature Analysis and Retrieval System) users prefer SDI service to one-shot bibliographies. A sophisticated manual system at the Aerojet-General Corp. (15,000 document collection, 400 items acquired monthly) that provides custom searches and SDI-type selections is preferred to an automated system. A 30% increase in demand was made on the Autonetics Division of North American Aviation after it installed and publicized its computer-based information network that links 9 divisions in 4 states. Autonetics found that a sometimes negative attitude of users to microfiche could be overcome when users were informed that this medium reduced service delay time. The information center at Monsanto's new research center resorted, with success, to audio-visual education and publicity.[147] For example, only 25 copies of

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147. C. Warren Keller. "Monsanto Information Center's Audio-Visual Orientation Program." Special Libraries, vol. 57, no. 9 (Nov. 1966) 648-651.

148. Some success is reported at Mt. San Antonio college on the use of audio-visual equipment for instruction in library use, by Harriett Genung. "Can Machines Teach the Use of the Library?" College and Research Libraries, vol. 28, no. 1 (Jan. 1967) 25-30.

149. R. O. McManus. "Engineering Management Techniques to Prepare a User for a New Electronic Information Processing System." IEEE Transactions on Engineering Management, vol. EM-13, no. 4 (Dec. 1966) 196-200.

150. "Title 15 - Commerce and Foreign Trade. Chapter VII - Office of State Technical Services, Department of Commerce. Part 700 - General Regulations Governing Operation and Administration of State Technical Services Act of 1965." Federal Register, vol. 31, no. 75 (Apr. 19, 1966)

151. Anon. NASA's Technology Utilization Program. Washington, D.C.: National Aeronautics and Space Administration, 1966. Brochure.

152. Richard L. Lesher and George J. Howick. Assessing Technology Transfer. Washington, D.C.: National Aeronautics and Space Administration, 1966. Rept. NASA SP-5067. (Available from GPO, 50¢)

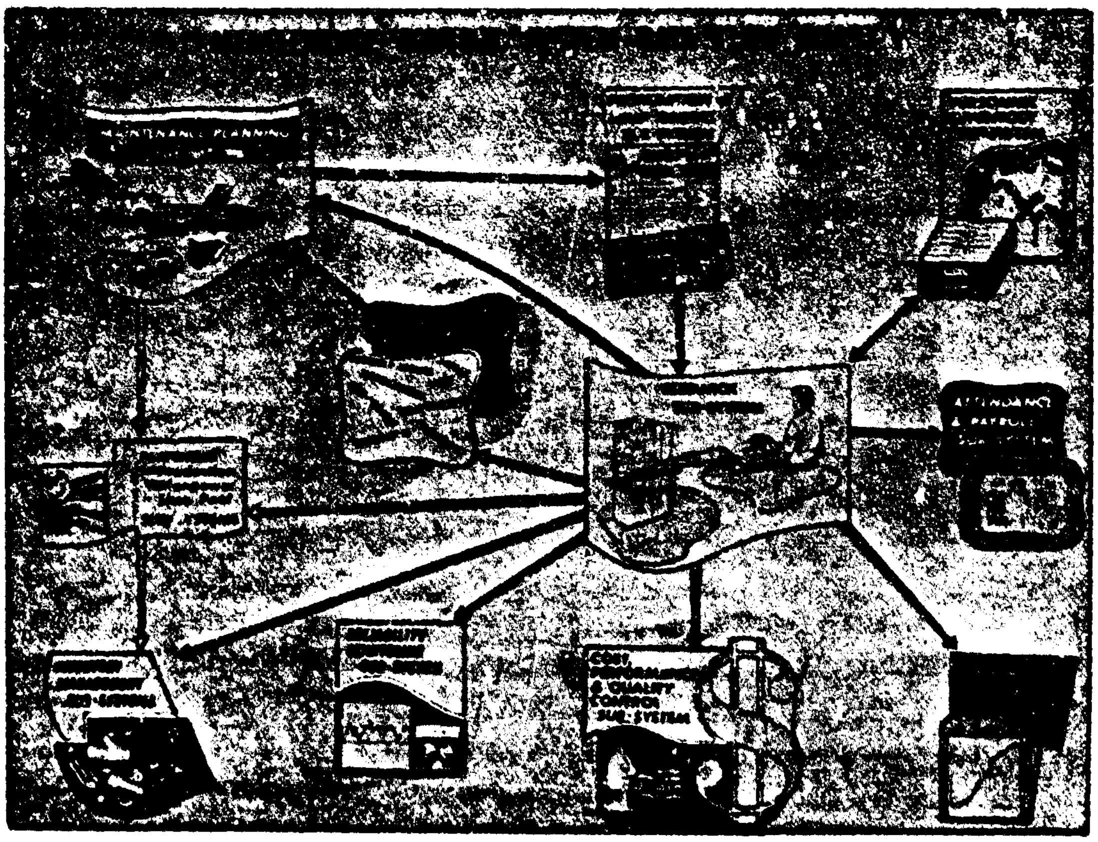
153. Ref. 100.

a new type of index were initially requested. After exhibiting a film on how to use the index, requests the following year rose to 200. Monsanto has prepared films, at a unit expense of $1500 to $2000, to orient and instruct personnel on the library's services and facilities.[148] Experience in a different type of system environment, that of the Air Force's Ballistic Missile Early Warning System, reinforces a general principle that close interaction with users paves a road to success for an information system.[149] R. O. McManus gives details on the sequence of interactive steps employed in installing BMEWS. Communication and joint activities enabled users to know system operations, possible faults, limitations on products, and the meaning and significance of the information furnished.

The State Technical Services Act of 1965, administered by the Department of Commerce, is a

> national program of incentives and support for the several States individually and in cooperation with each other in their establishing and maintaining State and interstate technical service programs in order that the benefits of federally-financed research, as well as other research, may be placed more effectively in the hands of American business, commerce and industrial establishments throughout the country. As stated n the Act, this program is essential to the growth of the economy, to higher levels of employment, and to the competitive position of U.S. products in world markets.[150]

NASA's Office of Techuology Utilization and other federal agencies have already made inroads into the use of information systems and media for the rapid transfer of research results to applications.[151,152] The first annual report of the Office of State Technical Services lists many projects that have begun for improved dissemination of information, new referral services, field services and liaison, instruction about information services, and the use of new media.[153] Many of the projects contemplate better exploitation of existing services. The burden will increase on knowledgeable people and on available resources as these projects get underway. It is probable that our resources are adequate if they are effectively used. This is a time for objective self-assessment, for cooperation, for careful planning with a long-range view, for an end to "this is mine and that is yours." The "information problem" is manageable, but it needs managers, and doers who know what they are doing and why. This is a time when machines can be used to make better men of men.



American Airlines,
Systems, June 1967

opportunities for managers

Robert Forest's editorial introduces the May 1967 issue of Datamation on management information systems (MIS) with the following balm for troubled spirits:

> There is no general agreement on a definition of MIS. As a matter of fact, nearly all of our interviews started with the interviewee asking us what we meant by MIS. We turned that one around in a hurry, and found that by and large, most of our friends do not equate MIS with on-line, and certainly not with real-time. One company which has pioneered in MIS doesn't even believe in random access; their system is tape-oriented. Just about everybody we talked to thinks that the idea of a CRT in the president's office is a fad, not likely to achieve reality for another umpteen years. One man described his planned systems as "almost real-time."
>
> In most cases, indeed, the MIS is a long-range plan with most of the people far enough along to have that gleam in their eye dimmed just a bit by a look at the problems between here and the magic manana when management will know All, and plan his company's long range future by diddling with a computerized model of the corporation, aided by data describing the external world as well. For the two who have working systems, one claimed that it required 40 man-years to develop, with another 20-30 going so far into extending its capabilities. The other says it took five programmers not very long to develop his company's MIS, but we suspect it's limited to sales information.
>
> The problems and hurdles mentioned as handicapping the development of MIS won't surprise you. Most frequently mentioned: the shortage of good, experienced systems people. Another: lack of manufacturer-provided software. Other obvious problems include safeguarding the security of data, controlling accuracy of input from many remote terminals, defining management's information requirements, lack of stature for the edp group.

Move the Information .....

There was general agreement on the need for the active support and involvement of management in the MIS development. While everybody would like to have the systems planning group report to a key top executive, there's no single title or organizational box which represents a must. One of the companies which has a working MIS has seen its group report to five different titles. Conclusion: it's the man, not the title, that counts.[154]

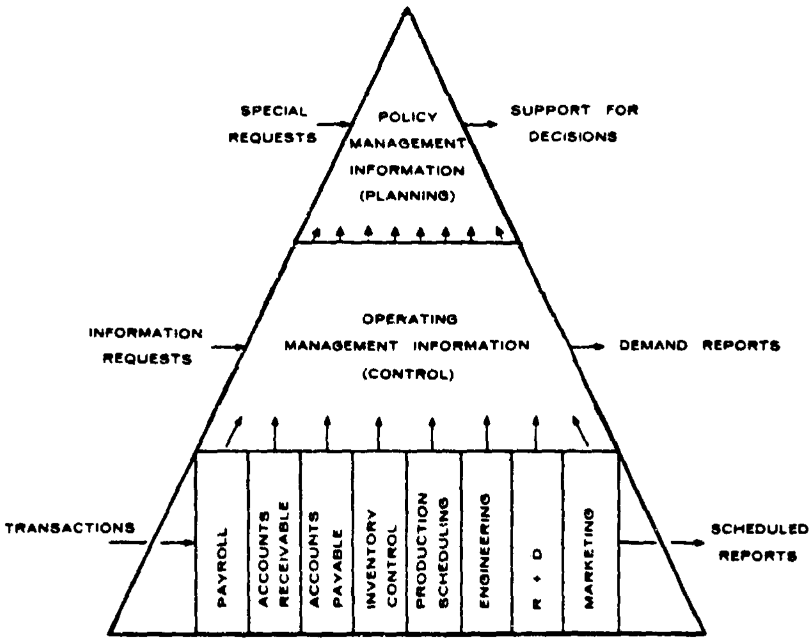


Figure 6
MANAGEMENT INFORMATION SYSTEM

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154. Robert B. Forest. "Not Quite All About MIS." Datamation, vol. 13, no. 5 (May 1967) 21.

155. Robert V. Head. "Management Information Systems: A Critical Appraisal." Datamation, vol. 13, no. 5 (May 1967) 22-27.

156. Report to the President on The Management of Automatic Data Processing in the Federal Government Prepared by the Bureau of the Budget. U. S. Senate, 89th Cong., 1st Sess., 4 March 1965. Senate Document No. 15.

157. Ref. 121.

Robert Head, in a general appraisal of management information systems, believes that experience with data processing should make MIS ready for innovative and imaginative applications.[155] Operations on the lowest level of his triangular representation of an MIS (Fig. 6) are within the state-of-the-art. Third-generation hardware (mass direct access storage, on-line terminal devices, remote processors) permit (perhaps demand) substantial rethinking of second-generation systems. Longer range planning and more careful system designs are required. The cost-reduction myth no longer pertains as a justification for mechanization. Since cost per item processed and hardware and software costs are higher in an absolute sense in the new systems, managers might be wise to develop a new method of accounting for the so-called "intangible" benefits of MIS. The transactions and middle-management areas of Head's triangle offer challenging opportunities to managers for innovation. These could include new file maintenance procedures, new types of management reporting, on-line systems employing user languages for information retrieval applications, and "conversations" with persons at remote stations.

Several Congressional reports are authoritative "texts" on management uses of computer-based systems. A Bureau of the Budget (BOB) report, authorized for printing by the Committee on Government Operations, U.S. Senate, surveys the impact of a decade of automatic data processing with perceptive suggestions on selection, financial arrangements, standardization, use, and research.[156] Hearings for the Committee on Post Office and Civil Service, House of Representatives, is a gem of a summary (516 pages) of the major management systems of federal military and civilian agencies and selected state and city systems, actual and planned.[157] Effects on personnel are also considered in testimony of representatives of the American Federation of Government Employees and the National Federation of

Federal Employees. A status report is included of activities of the American Standards Association, a federation of 138 trade association and professional societies with a sustaining membership of over 2000 companies. A report of the Committee on Government Operations, U.S. Senate, Vice-President Humphrey's last as chairman of the Subcommittee on Reorganization and International Organizations, reviews the status of coordination among federal agency systems achieved under Sub-

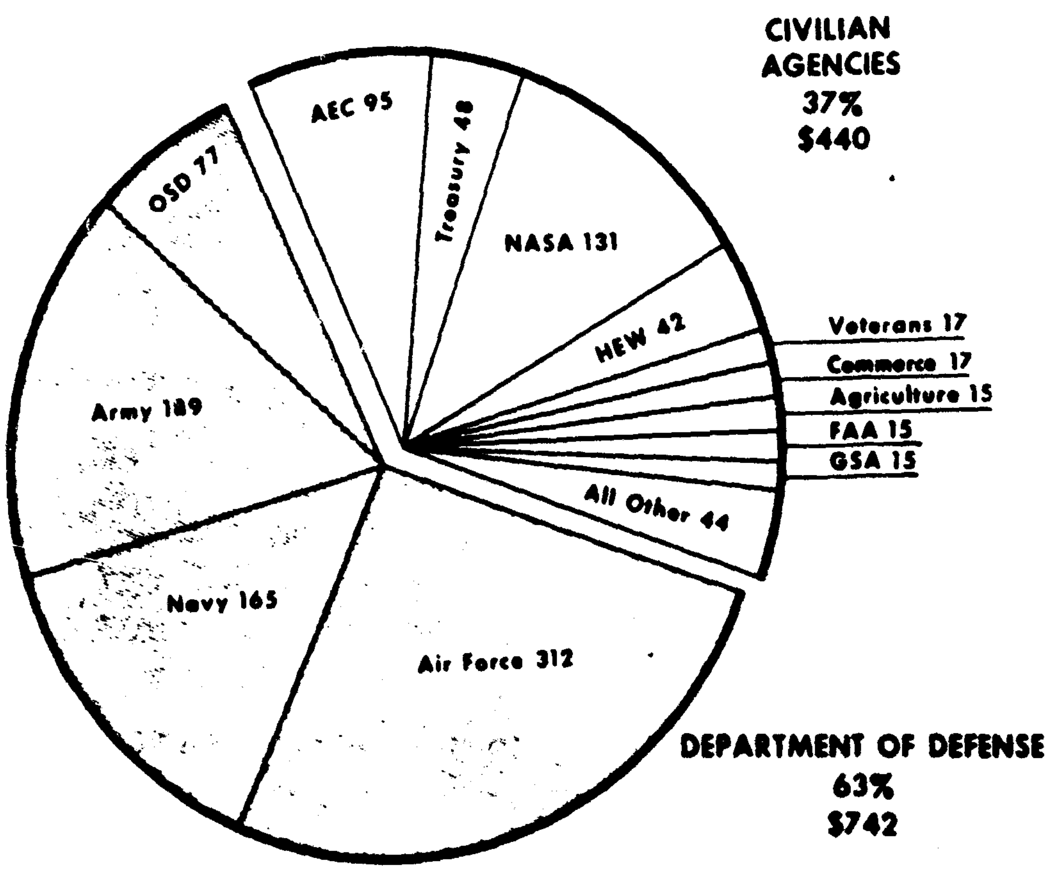

Figure 7

DISTRIBUTION OF TOTAL ADP COSTS BY AGENCY, FY66
($ millions)

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158. Ref. 3.

159. Ref. 6.

160. Press Release. Washington, D.C.: Bureau of the Budget, 23 Feb. 1967. Information Office, OD-196.

committee prodding since 1957.[158] The Report is both retrospective and anticipatory in content. It levies a management viewpoint on information problems and outlines needed areas for research and development. (See Appendix A that reproduces a section from the report entitled "Future Steps"). The BOB is also a source of information for managers. BOB's Inventory of Automatic Data Processing Equipment contains data and highlight charts showing the progressive mechanization of federal management systems (1959 to 1967).[159] Figures 7 and 8 are from the Inventory. A BOB press release dated 23 Feb. 1967 gives statistics on federal use of computers and describes applications implemented on them.[160] (This release, if made in the U.S.S.R., might well have found its way verbatim to the pages of Pravda. I saw no notice of it in U.S. publications but for short references in two professional journals that bore no citations). Applications of MIS interest in the release include:

- computer analysis of aircraft accident data leading to rapid corrective action and, thereby, improved air traffic safety
- an improved UHF TV channel assignment system
- a method of simplifying scheduling, validation, and scoring of employee applicant examinations
- a method of reporting fund expenditures in the poverty program to assist federal, state, and local officers in assigning priorities
- a system for collecting and disseminating critical weather data to air operational units
- a more detailed census of 3 million farms at a saving of $2 million and 700,000 man-hours over the prior census
- optical scanning of over 20 million earning items per quarter from employer tax reports, a change from punched card procedures

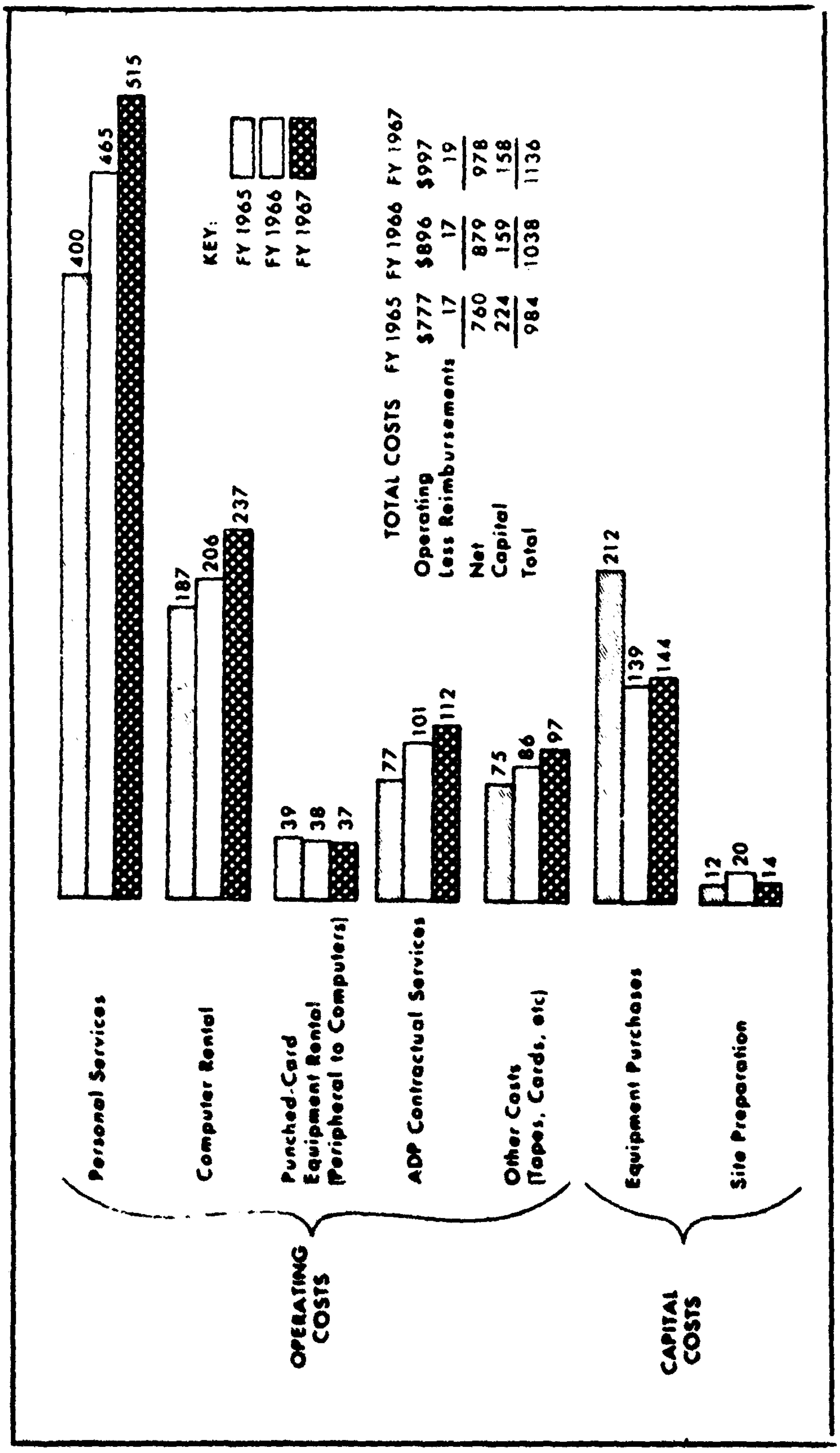

Figure 8 – MAJOR ELEMENTS OF TOTAL COSTS FOR ADP UNITS WITH COMPUTERS ($ millions)

Sharing computer facilities and services saved the government about $26 million in Fiscal Year 1966. The editors of Systems have rightly said:

> The government has long been a testing ground for new systems techniques. It has to be to keep up with an expanding population and economy. It also incorporates and is scrutinized by some of the best minds in the country.[161]

A section in the bibliography of this paper lists references to MIS systems that have been or are being implemented. Many are less complex and less critical than that of California's Department of Motor Vehicles (DMV). The DMV account of R.E. Montijo[162] is retold here because of its illustrative value -- as to management participation, personnel preparedness, the hardware state-of-the-art, the significance of appropriate software, etc.

The DMV has a large file - 10 million driver records and 11 million vehicle registrations in 1965. It has a heavy workload, 200,000 queries and input items daily, for a diverse clientele -- law enforcement agencies, courts, insurance companies, and the public, as well as its own staff of 5265. It projects an increased load of 3 million drivers and 6 million vehicles by 1975. Management decided, in late 1964, to explore automation, and hired a consultant. Two in-house teams assessed feasibility of the consultant's model. DMV then sent bids to 15 manufacturers. It reached the letter-of-intent stage by August 1965. RCA began phased implementation of a Spectra 70 system in 1965, with completion due in 1970. DMV altered its original specifications to include conversion of its driver records to machine-readable form. Its own team evaluated various techniques and se-

161. Anon. "Business Can Benefit from Government Systems." Systems, vol. 8, no. 1 (Jan. 1967) 2.

162. R. E. Montijo, Jr. "California DMV Goes On-Line." Datamation, vol. 13, no. 5 (May 1967) 31-36.

lected on-line keyboard video processing over keyboard-to-magnetic tape (50% fewer operators, lower document control costs, no floor space, no EAM card costs, thus offsetting higher equipment costs). RCA provided 500 man-weeks of instruction, including two month-long, six-hour-day classes for DMV programmers, supervisors, and the RCA on-site systems staff to insure knowledge and understanding of the general systems, programming languages, operating systems, and operations. RCA subsequently trained new supervisors on production communication programs and clerks on use of the video data units. RCA switched from COBOL to assembly language (a departure in its plans) since COBOL needed 4 to 7 times the mass storage capacity achievable with assembly language. COBOL and FORTRAN can be used for transaction logic programs. COBOL will be used for batch processing. RCA also innovated; video terminals are the primary input device. Each video controller stores up to 16 different formats on a magnetic disc. Different controllers can store different formats. Fragmentation of human operations on a record is thus reduced 16-fold. Response time of the video unit is 1 to 5 seconds. System specifications call for real-time processing of input data and inquiries received from remote locations intermixed with batched input entered locally (Sacramento), and real-time output to remote stations simultaneous with local, high-volume batched output. The data bank will have a 15-billion character capacity. The system will handle 16,000 transactions per peak hour, 225,000 transactions per day, and 1400 remote terminals. Hardware and software delivery schedules have been met. The system was placed under program control (i.e., PERTed) in late 1965. A weekly exception report lists all activities

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163. Ibid, p. 36.

164. George Berkwitt. "Middle Managers vs. the Computer." Dun's Review and Modern Industry, vol. 88, no. 5 (Nov. 1966) 40, 42, 107-109.

ahead of and behind schedule. Reports are reviewed at regular DMV steering committee meetings. Automation is expected to yield a net cumulative saving of $1.7 million; a recurring annual saving by 1974-75 of $5.3 million; recovery of all conversion costs; and ownership of $13.6 million of electronic data processing equipment; 2575 new positions are projected by 1975, 590 fewer than for the manual system. Montijo notes that "no dollar value has been placed on highly improved public service and other intangible but valuable benefits."

The most critical factor with respect to computer-based information systems for managers is neither the software nor the hardware, but the managers themselves. This statement applies equally to other groups of users in their own system contexts. One component of this factor is well-stated in Montijo's closing paragraph:

> Perhaps the most important characteristic of third-generation implementation is that it portends the end of hardware- or software-limited systems. The power of the hardware and the software which is available today is well beyond most of us to apply and use most effectively. Actually, we have entered a new era in edp ... an era characterized by its almost total dependency on an inadequate supply of experienced and competent systems analysts, systems programmers, and systems engineers, together with sophisticated edp-oriented management ... an era whose end is not in sight within this human generation.[163]

Middle managers are said to be apprehensive about mechanized systems. They fear the loss of responsibility, status, or job; they resent being jolted into new environments; they worry about their own shortcomings.[164] Presumably, however, management's prime mission is adapting to change, and sometimes causing it.

> The highest activity of management becomes a continuous process of decision about the nature of the business. Management's degree of excellence is still judged in part

> by its efficiency of operation, but much more by its ability to make decisions changing its product mix, its markets, its techniques of financing and selling. Initiative, flexibility, creativity, adaptability are the qualities now required - and these are far more "human" than the old mechanical desideratum, efficiency.[165]

Information needs for these purposes should make the availability of machines a boon rather than a bane. Managers <u>have</u> a basis for concern, though computers are but one manifestation of the cause.

Our age is described as a period of "conscious social change," advancements in technology being the prime mover.[166]

> The change we are witnessing includes the rapid growth of population, the massive flow of peoples from rural areas to the cities, the steady growth of national wealth and income, the rise of oppressed and submerged peoples, the spread of mass education, the extension of leisure, the venture into space, and the frightening increase in the destructiveness of military weapons.
>
> . . . . .
>
> As men have learned the power of applying thought and experiment to the attainment of human ends and have sys-

165. Max Ways. "Tomorrow's Management: A More Adventurous Life in a Free-Form Corporation." Fortune, vol. 74, no. 1 (July 1966) 84-87, 148, 150.

166. Ref. 8.

167. Ibid, p. xi.

168. Robert A. Charpie, et al. Technological Innovation: Its Environment and Management. Washington, D.C.: U.S. Dept. of Commerce, Jan. 1967. (Available from GPO, $1.25)

169. Ibid, p. 16.

170. Robert C. Albrook. "Participative Management: Time for a Second Look." Fortune, vol. 75, no. 5 (May 1967) 166-170, 197, 198, 200.

171. Ref. 165.

> tematically exploited the possibilities of pure science and technology, a steady flow of new methods, new designs, and new products has resulted.[167]

Paradoxically, however, there is an "abundance of ignorance about processes of invention, innovation and entrepreneurship."[168] Why have independent inventors and small, technologically based companies been the producers of over 50% of the important inventions and innovations of this century? An advisory committee to the Department of Commerce suggests that many industries are underspending on innovation, or they lack people with adequate managerial and technological skills.

> The major barrier is one of attitude and environment. It is primarily a problem of education - not of antitrust, taxation, or capital availability.[169]

Do large companies tend to ignore the man with the idea -- because of distance from the chief executive's office, the "not invented here" syndrome, conservatism in taking risks, inbred viewpoints, unfamiliarity with growth-business markets, etc.? Where might most businesses be ranked along the spectrum from authoritative to participative management? Rensis Likert leads businessmen who attend the University of Michigan's Institute for Social Research through a series of steps that frequently show them they do not practice what they say they believe. Their answers associate the successful company with a strong participative management system in the abstract, but their profiles of their own firms describe strongly authoritative organizations.[170] Glowing pictures paint the position of tomorrow's manager, armed with computer-processed information, in a "free-form corporation." He has but to learn to ask the right questions to achieve an influence in tomorrow's fluid society "greater than that of any past 'captain of industry.'"[171] To reach this point, however, he has homework to do, to fill in gaps in his knowledge both with respect to technology and with respect to social, political, and economic developments.

The Armed Forces cannot afford the luxuries of delay, procrastination, and self-pity. Speaking for the Air Force, for example, the Chief of Staff, Gen. McConnell, observed:

> The classical concepts of military strategy have been outdated by the fantastic compression of time and concentration of firepower brought about by modern aerospace power. In turn, aerospace power makes possible a "National Military Strategy of Conflict Management" which is broad and flexible enough to meet the uncertain needs and threats of the aerospace age.[172]

The Industrial College of the Armed Forces (ICAF), the management school for the military, has been conducting a correspondence course in national security management at the graduate level since 1950. Over 21,000 people have completed it, and 5000 are presently enrolled.[173] ICAF is revising existing courses and formulating new ones in a 3-level program for military and civilian middle managers. A new, six-month course is in 2 parts:

> Unit I, The Environment of Defense Management with two elements, an Orientation which presents the managerial and economic concepts behind the interdisciplinary approach to management in the Department of Defense and Defense Plans, Policies, and Decision-Making

172. General J. P. McDonnell. "National Military Strategy for the Aerospace Age." Supplement to the Air Force Policy Letter for Commanders, 5-1967 (May 1967) 8-14, at 14.

173. Anon. "Industrial College Shoots for Middle Managers." Armed Forces Management, vol. 13, no. 6 (March 1967) 83, 84, 86, 88.

174. Ibid, p. 83-84.

175. Scot MacDonald. "Data Processing Joins the Marine Corps for Battlefield Support." Armed Forces Management, vol. 13, no. 6 (March 1967) 41-46, at 43.

176. Lt. Col. Ernest M. Magee. "The Evolution of NCO Academies." Air University Review, vol. 17, no. 6 (Sept-Oct. 1966) 56-61.

> which introduces the correspondence student to the concepts, principles and policies (such as PPB and Systems analysis) which underlie and direct Defense management.
>
> Unit II, The Management of Defense Programs, which deals with management in functional areas such as research and development, procurement, production and supply.[174]

Other "packages" include a monograph series to up-date a student's knowledge of new and significant developments in his functional area and those related to it, and 15-man seminars focused on specific management problems in which rank is forgotten. The Marine Corps requires all general officers and selected Colonels to attend the DOD Computer Institute or its equivalent. Lt. Gen. Chapman has said:

> It is no longer enough for Marines to know tactics, fire control and close air support.... (There) is the need for a more complete understanding and appreciation of the developments in Command and Management processes and techniques. . . . The generation of that combat power available for application at a particular point in time will depend on the commander's management skill, his skill in allocating and utilizing assigned resources over a period of time before the acid test of battle.[175]

The Marine Corps' Project CAMP (Command and Management Presentation) is a program for communicating information to all officers and senior staff NCOs at all major ports and stations in the U.S., and at Fleet Marine Force Pacific headquarters by visiting teams. Attendance at the 5-hour briefing is mandatory. A second briefing on systems details is planned. The Air Force NCO (noncommisioned officer) academies are based on the principle that the authority vested in NCOs differs only in degree from that of commissioned officers.[176] The closeness of NCOs to their subordinates makes their a vital role in the effective operation of Air Force systems. Several of the academies opened in the early 1950's. Today's accredited academies must schedule 225 hours of Air Force-approved subjects over a period of at least 5 weeks. The curriculum emphasizes principles of leadership, management, and communicative skills, both oral and written.

It has been hypothesized that the ranks of middle management will grow rather than decline with technological advancement. Max Ways believes that "the size of management should be roughly proportionate to the rate of innovation rather than to the amount of physical output." [177] The manager, however, as well as the inventor, will have to be creative. Again, military experience illustrates how human decision making "collaborates" with mechanized information systems for effective operation. Managers in the Air Force Hi-Valu program (for control of aircraft spares and missile parts) have learned to apply the "principle of calculated neglect" and the "principle of maldistribution of quality losses." "With a little organization," Lt.Col. Henry Scheingold writes, managers can "multiply the effectiveness of available time by as much as 15 times." [178] However, Scheingold notes,

> The manager must keep in mind a most important point: the B task ignored by a subordinate today may become the A task for the attention and action of the manager tomorrow. The manager who continually avoids the difficult and the distasteful will, on inspection, probably find that he is also avoiding the necessary and important - the Category A tasks. [179]

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177. Ref. 165, p. 86.

178. Lt. Col. Henry Scheingold, "Needed for Good Management: Neglect and Maldistribution." Air University Review, vol. 17, no. 5 (July-Aug. 1966) 75-77, at 75.

179. Ibid., p. 76-77.

180. Joseph L. S. Terrell. "An Army Exercise in Managerial Mobility: ATAC Rolls in, MOCOM Moves Out." Armed Forces Management, vol. 13, no. 6 (March 1967) 77, 79, 80.

Viewpoint determines whether the installation of a new system will be painful or a management opportunity. Maj.Gen. Lapsley, chief of the Army Tank-Automotive Command (ATAC), the automotive center for the DOD, exploited the phasing out of the Army Mobility Command (MOCOM) to overhaul some operations.[180] (Through the application of selective management, i.e., decentralization of operational authority and direct communication on operational matters among subcommands, it is said that MOCOM phased itself out). Maj.Gen. Lapsley also upped the personnel training program (in-house and at universities) by 350% more training hours than a year ago. He requires "spoof runs," systematic and periodic checks of stored inventory and procurement information to insure its validity. The Honorable John S. Foster, Director of Defense Research & Engineering, in establishing policy for the management of R & D, stated:

> There are more than 60 different management techniques currently active within DOD. ... Each technique of itself can be considered as a useful management tool.
>
> .....
>
> Our management problem arises from the fact that, while the concepts are excellent, the sum of the implementation of each technique represents a 'straight jacket' if applied, as they often are, in total to the complex, multi-faceted R&D program. The characteristics of the R&D Program demand flexibility in the application of a management technique to different R&D projects. No one technique or combination of techniques can be established as the system to be used for all R&D projects. This approach can be a trap, substituting an exercise in management techniques for management judgment and responsibility. Simple but critical questions like 'What are the objectives of the program?", 'Can you do it?', 'How much will it cost?' tend to be unanswered.
>
> To better utilize the various concepts, yet avoid a rigorous exercise of technique, I propose that we permit a flexible management approach, adapted to the objectives and needs of each R&D effort.[181]

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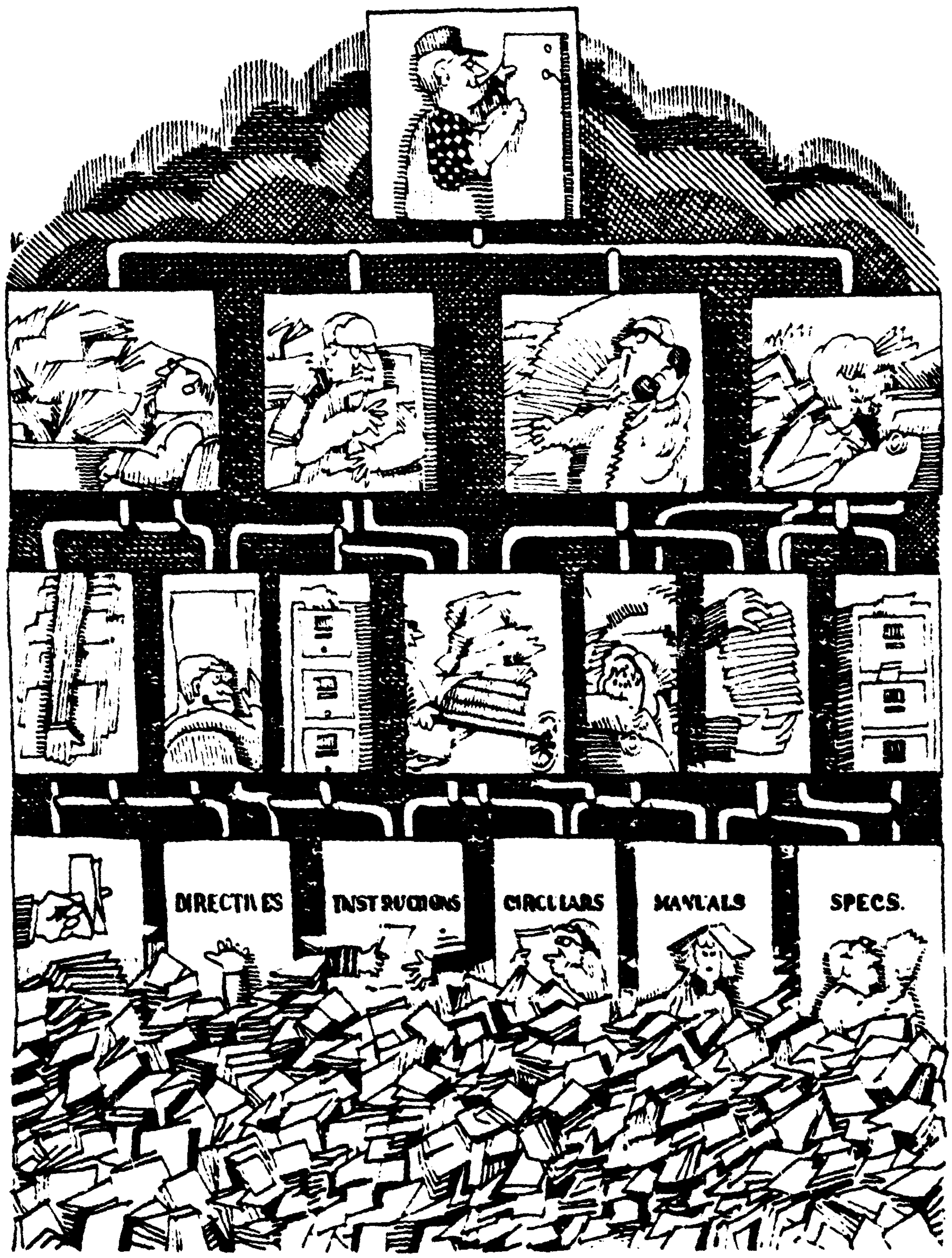
181. Anon. "The Way to Run a Program." Armed Forces Management, vol. 13, no. 7 (April 1967) 26-27, at 27.

Move the Information .....

Machines, in essence, may be management's liberators, but the future for managers depends on the willingness of managers-in-name to make managers-in-fact of themselves.



Armed Forces Management, May 1967

Trends in educating people

Any exposition (written, oral, kinesic) is, in a sense, a tutorial effort. Exploring methods of instruction was not new to the ancients in their attempts to transmit information, to provoke intellectual inquiry, to promote comprehension and understanding of concepts and ideas. The term "curriculum reform" is popular today, but it is a misnomer except as it is part of a continuity. Experimentation with teaching methods, teaching materials, the substance of what is taught, and even the teaching environment, should be in any good teacher's "bag of tricks" to the extent possible. Compulsory education of children of all groups in a society is recent. This may also be a misnomer, though, because education, in the sense of cultivation and training of the mind, has not necessarily resulted from compulsion.

James Conant, Jerome Bruner, and Jean Piaget, among others, have contributed importantly on matters concerning educational institutions, methods of instruction, learning, and intelligence.[182-187] The term "curriculum reform" relates to what Conant might call a belated awareness of educators of the need for overhaul of many aspects of our educational system. Curriculum builders view their goal as

> emphasis on principles rather than facts, on learning through problem solving rather than by precept, and on individual differences.[188]

They are trying to up-date and reorganize information so as to transmit primary elements: concepts, key ideas, principles, and modes of inquiry.

> It is assumed that understanding these elements (rather than merely possessing the facts) gives the student the intellectual power to attack unfamiliar problems and enables him to grasp intuitively the relationship of new phenomena not previously encountered to phenomena already

> experienced. Ability to think inductively becomes a built-in goal, and teachers are encouraged to let students discover meanings for themselves.[189]

Extensive concern about education stems from information about people obtained during World War II. A Fund for the Advancement of Education report furnishes the setting for today's activities:

> The recruitment of young men for the armed services had revealed shocking inadequacies in the science and mathematics backgrounds of high-school graduates. They were due partly to the limited quantity of work in these fields and partly to the quality of the teaching. As scientists became increasingly aware of this situation, some of

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182. James B. Conant. The American High School Today, A First Report to Interested Citizens. New York: McGraw-Hill Book Company, Inc., 1959.

183. James Bryant Conant. The Comprehensive High School, A Second Report to Interested Citizens. New York: McGraw-Hill Book Company, 1967.

184. Jerome S. Bruner. Toward a Theory of Instruction. Cambridge: Belknap Press of Harvard University Press, 1966.

185. Jerome Bruner, ed. Learning About Learning, A Conference Report. Washington, D.C.: U.S. Office of Education, 1966. OE-12019. (Available from GPO, $1.00)

186. Jean Piaget. Judgment and Reasoning in the Child. Totowa, N.J.: Littlefield, Adams and Co., 1966. (Trans. by Marjorie Warden. Reprinted by arrangement with Humanities Press, Inc. First published in English in 1928)

187. Jean Piaget. The Origins of Intelligence in Children. New York: W. W. Norton and Co., Inc., 1963. (Trans. by Margaret Cook. Copyright 1952 by International Universities Press, Inc.)

188. John I. Goodlad, et al. The Changing School Curriculum. New York: Fund for the Advancement of Education, Aug. 1966. At p. 15.

189. Ibid, p. 15.

190. Ibid, p. 11-12.

them began to sense their responsibility toward the problem. Their subsequent involvement in pre-collegiate curriculum reform has been both a factor producing change and a significant characteristic of the movement.

But curriculum reform probably would have evolved much more slowly and quietly had there not been a number of other contributing causes. The anticipated post-war economic collapse, predicted frequently and gloomily, did not materialize. An expanding, prosperous middle class of ambitious young men and women saw education as the means to even better things for their children. They turned to their schools - often new schools in new communities, with young teachers and young administrators - with great expectations. These educators responded, reaching out eagerly to become co-workers in the trial use of materials prepared or backed by illustrious scholars in prestigious universities, an association that was not lost on college-conscious parents. The first round of school curriculum reform, then, was a middle-class and upper-middle-class affair, embracing primarily the college-bound students. The cry of the disadvantaged was as yet only a whisper.

While new communities were springing up, old values were crumbling. Job opportunities took young couples away from familiar haunts to challenges they had not faced before. A new kind of unemployment appeared: unemployment in the midst of plenty because of job obsolescence. Very little was "for sure." People were beginning to realize that a fast-changing culture demanded both adaptability and a rational approach to new problems. The old ways of keeping school would not suffice, either.

Meanwhile, knowledge was piling up at an intimidating rate. But sheer accumulation presented only part of the problem. All knowledge is subject to revision following new insights into the nature of phenomena. A fact is a fact from some but not all perspectives - and then often only temporarily. This notion is profoundly stimulating to some people but devastatingly upsetting to others. To cope with the explosion of knowledge, the curriculum needed fresh infusions of content and a comprehensive re-organization.[190]

In giving all Johnnys the opportunity to read, we have discovered that some learn to read faster than others. Some don't want to learn to read, at least not according to methods by which we have been teaching them. And Johnnys differ in what they like to read and why they like to read (and why they don't). The Conants and the Bruners and the Piagets have known, but now Mr. and Mrs. Teacher, from little schoolhouses to mighty universities, are becoming increasingly aware that there is no Standard Johnny. Moreover, of relevance to this paper, Mr. Employer and Mr. Congressman, as well as Mr. and Mrs. Teacher, are beginning to realize that Johnnys can be imaginative, creative people, permitted exposure to subjects, training methods, and environments that are conducive to Johnny ways of learning and doing. The information processing field owes its rudiments and quantum jumps to Johnnys like Charles Babbage, John von Neumann, and Warren McCulloch.

We are beginning to realize that we are all Johnnys. Rapid technological advances are responsible for this only in that they challenge us to exploit our information processing capabilities. We have produced these advances, and we

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191. Germaine Krettek and Eileen D. Cooke. "ALA Washington Notes." Wilson Library Bulletin, vol. 41, no. 7 (March 1967) 743, 746.

192. Anon. "Federal Money for Education: Programs Administered by the U. S. Office of Education, Fiscal Year 1967." American Education, vol. 3, no. 2 (Feb. 1967). Also issued as a separate, OE-11010.

193. Commission on Science Education Newsletter, vol. 3, no. 2 (April 1967). (Available from the American Association for the Advancement of Science). See also, J. David Lockard, comp. Report of the International Clearinghouse on Science and Mathematics Curricular Developments. College Park, Md.: University of Maryland, Science Teaching Center, 1967. This document summarizes the activities of about 80 U. S. projects and about 130 overseas efforts.

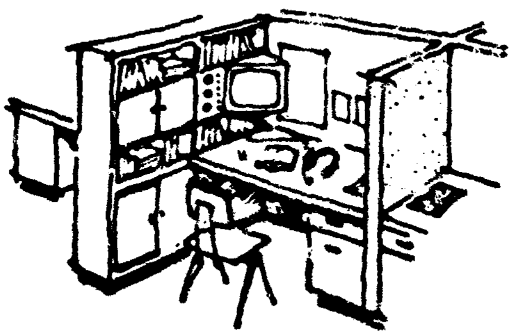
are responding to the challenges we have posed for ourselves because we want to do so, each of us for his own Johnny reasons.

President Johnson's budget, submitted to the Congress in January 1967, includes requests for the following items:

$1,674,650,000	- Elementary and Secondary Education Act
$ 53,400,000	- Educational Improvement for the Handicapped
$ 44,200,000	- Adult Education Act of 1966
$ 92,750,000	- National Defense Education Act (Titles III and XI)
$ 36,000,000	- National Teacher Corps
$ 278,300,000	- Higher Education Act (Titles I, II-A,B,C, III, IV-C, V-C, VI-A through V)
$ 440,000,000	- Higher Education Facilities Act (Titles I, II)
$ 68,000,000	- Library Services and Construction Act (Titles I, II, III, IV)
$ 36,525,000	- International Education Act
$2,042,500,000	- Economic Opportunity Act [191]

Appendix B lists programs of interest to librarians, obtained from an American Education tabulation of Fiscal Year 1967 appropriations.[192]
It is not the purpose of this paper to consider research in education (including programmed instruction and computer-assisted instruction) applied to elementary and high school curricula. A brief chronology of this work and an indication of its range are given in the April 1967 issue of the Newsletter of the AAAS Commission on Science Education.[193] A recent Education Development Center publication summarizes a wide variety of programs in the natural, physical, mathematical, and social sciences alluded to in the Fund excerpt above that bear the imprint of "illustrious scholars in prestigious universities."[194] Under the headings, "programmed instruction" and "computer-

assisted instruction," the bibliography of this paper enables the reader to "dig deeper." The section, "educating computer scientists," below, does go beyond a strict interpretation of these words to indicate the conceptual background for programmed instruction and computer-assisted instruction and some of the applications of these methods to education outside the computer sciences per se. It is my opinion, however, that neither the practitioners nor the users of the computer sciences can afford to be parochial. The information sciences teach that synergism occurs at interfaces.



194. Anon. Education Development Center, Inc., Work in Progress, 1967. Newton, Mass: Education Development Center, 1967. (Issued in limited edition pending publication of a more complete description of activities)

195. George E. Forsythe. "A University's Educational Program in Computer Science." Communications of the ACM, vol. 10, no. 1 (Jan. 1967) 3-11, at 3, 4.

educating computer scientists

The computer sciences face less of curriculum reform than of establishment. This discipline is a child of the technological advances accelerated by World War II. Its evolution has been uneven. Prof. George Forsythe recently outlined Stanford University's plan for a computer sciences program that reflects some of the developmental factors. One is the definition of scope. Stanford's is:

> the art and science of representing and processing information and, in particular, processing in formation with the logical engines called automatic digital computers. Computer science deals with such related problems as designing automatic digital computers and systems, the design and description of suitable languages for representing both processors and algorithms, the design and analysis of methods of representing information by abstract symbols, and of complex processes for manipulating these symbols. Thus, a central theme of computer science is analogous to a central theme of engineering science - namely, the design of complex systems to optimize the value of resources. Perhaps the main difference is that computer scientists work with a very abstract medium (information), and design systems typically far more complex in detail than most elaborate engineering systems.
>
> Computer science must also concern itself with such theoretical subjects supporting its technology as coding and information theory, the logic of the finitely constructable, numerical mathematical analysis, control theory, switching theory, automata theory, mathematical linguistics, graph theory, and the psychology of problem solving. Naturally these theoretical subjects are shared by computer science with such disciplines as philosophy, mathematics, engineering, operations research and psychology.[195]

Prof. Forsythe thinks, however, that the term could be broadened to "computer and information sciences" in view of the "ultimate purpose of computer science ... to understand the behavior of information and the laws which govern its processing." (The Air Force Directorate I work for chose the name, information sciences, in 1962 as the best descriptor of our aims).

To enable establishment of a viable program, Prof. Forsythe posits the following essentials:

a. formation of an independent department
b. co-establishment of a strong computation center
c. recruitment of faculty whose backgrounds incorporate the diverse disciplines that contribute to the computer sciences
d. development of courses for needs of all student groups
e. conduct of research as well as education

Stanford's program, inaugurated in January 1965 after a three-year gestation period, is more than a plan for education in a discipline. It includes provisions that recognize the unique social responsibility that the computer sciences share with

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196. Ibid, p. 8.

197. Franz Hohn. "The First Conference on Training Personnel for the Computing Machine Field." American Mathematical Monthly, vol. 62, no. 1 (Jan. 1955) 8-15.

See also J. S. Frame, et al., comp. Professional Opportunities in Mathematics, A Report for Undergraduate Students of Mathematics. Buffalo: Mathematical Assn. of America, 6th ed., 1964. Information (written by different mathematicians for each specialty) is given on opportunities for careers in mathematics, qualifications required, college curricula, and salaries that can be expected for occupations in teaching, mathematical and applied statistics, industry, government, and the actuarial profession. The introduction notes: "The recent phenomenal rise in the field of automation and computing has been a significant factor in this greatly increased need for mathematicians both at the bachelor's level of training and more especially at the higher levels." (Available from MAA, 25¢)

198. Ibid, p. 12.

such vocational-type professional fields as law, medicine, and librarianship. It is one pragmatic approach to a curriculum for an emerging field of study. Prof. Forsythe notes:

> One of the criticisms of the Stanford program is that the syllabus for examination is oriented mainly toward heuristic programming and cognitive processes, rather than more standard topics in non-numerical computer applications. There appears to be little attention to problems of memory organization, manipulation of structured information, vector manipulation, processing of trees and graphs, sorting algorithms, information search procedures, and so on. ... (T)he syllabus is indeed rather one-sided in its emphasis. The true reason, of course, is that a faculty teaches best what it is most interested in, and that part of our program has mainly been developed by persons interested in heuristic processes.[196]

To prepare all students for "a computerized world" requires courses for at least three types of groups: those whose specialties are in other technical fields and those who are in non-technical fields as well as those who specialize in the computer sciences. Stanford takes as a dictum that information processing is part of everyone's daily functioning in one way or another. As all types of information banks become amenable to mechanization, an understanding of how machines can serve as tools becomes a universal sine qua non.

Educators have been concerned about computer sciences curricula for some time. Manpower needs motivated the First Conference on Training Personnel for the Computing Machine Field, co-sponsored by Wayne (State) University, the Association for Computing Machinery, the Industrial Mathematics Society, and the Professional Group on Electronic Computers of the IRE in June 1954.[197] The report notes the chagrin of some participants

> that many mathematicians view the whole science of computation as being somewhat beneath their consideration. Indeed, this attitude was felt to have constituted

a serious impediment to progress in view of the influence exerted by such mathematicians on graduate students.[198]

This negative attitude persists in some university departments and has resulted in the rise of applied mathematics groups under various names in various departments. A pilot project begun at the University of Michigan in 1959 under Ford Foundation sponsorship spearheaded the introduction of computers into engineering education.[199] Though approximately 30% of the students in all engineering schools were required to take an introductory course in digital computation by 1962, problems involving the organization of computing facilities and education of faculty limited the nature of student-computer interaction to routine problem solving. Toward making the computer a more challenging tool in the education process, 29 faculty members from 24 universities produced, during a 9-week summer session in 1965, five volumes of

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199. Donald L. Katz. "The Place of Computers in Engineering Education." Journal of Engineering Education, vol. 56, no. 8 (April 1966) 293-296.

200. D. L. Katz, et al. Computers in Engineering Design Education. Vol. I - Summary. Vol. II - Chemical Engineering. Vol. III-Civil Engineering. Vol. IV - Electrical Engineering. Vol. V - Industrial Engineering. Vol. VI - Mechanical Engineering. Ann Arbor: University of Michigan, March 1966.

201. William F. Atchison, et al. "An Undergraduate Program in Computer Science - Preliminary Recommendations." Communications of the ACM, vol. 8, no. 9 (Sept. 1965) 543-552.

202. G. E. Forsythe, ed. "A Report of Two Symposia on the Impact of Computing in Undergraduate Mathematics Instruction." Communications of the ACM, vol. 9, no. 9 (Sept. 1966) 662-670.

203. Conference on Graduate Academic and Research Programs in Computing Science. A four-day workshop, hosted by the Computing Center of the State University of New York at Stony Brook, 5-8 June 1967, under a grant from the New York State Science and Technology Foundation. Proceedings will be published.

documented design problems for chemical, civil, electrical, industrial, and mechanical engineering courses.[200] The Curriculum Committee on Computer Science of the Association for Computing Machinery has been working on curricula for about five years. A 1965 report of the Committee gives preliminary recommendations for an undergraduate program in the computer sciences.[201] The report notes that, at the time, 15 and 30 universities, respectively, were offering Ph.D. and master's degrees, and 17 colleges had begun and others were planning undergraduate programs. The key role of mathematics in the computer sciences stimulated two 1966 symposia, co-sponsored by ACM, the Society for Industrial and Applied Mathematics, and Florida State University.[202]

A recent landmark conference knit many of the pieces together. Under sponsorship of the New York State Science and Technology Foundation, about 60 educators from the United States and Europe recently discussed a range of topics related to "Graduate Academic and Research Programs in Computing Science."[203] In reviewing existing programs, Frank Beckman of Columbia University identified four problems areas involved in curriculum development:

a. the need to select program objectives, not courses
b. decisions regarding organization of faculty
c. decisions regarding selection of faculty (based on a and b)
d. identification of appropriate research topics for graduate students

Prof. Beckman observed that programs have been established within engineering schools, liberal arts schools, and graduate schools and within various departments in these schools or as separate departments or "institutes." The general consensus was doubt that a single correct organization could exist or could now be recommended because of different university structures and objectives.

Workshops at the conference on masters and doctoral programs set parameters for the training of five types of individuals: (a) the predoctoral candidate, (b) the doctoral candidate, (c) the technical professional (programming, problem solving), (d) the technical administrator (business and education), and (e) specialists from other fields. The (c) and (d) categories envision terminal masters programs for industry, government, and university needs. Clarification of areas of specialization suggest three emerging "classes" of computer scientist: theoreticians; systems-oriented people; and applications-oriented people. A strong mathematics capability is considered a pre-requisite for all computer-sciences specialization.

A majority of conference attendees favored joint faculty appointments (computer sciences department plus the computation center or another department). They emphasized the need to preserve distinctions between the activities of computer sciences faculty and computation center staff. Faculty teach and conduct research (in common with other faculty); computation center staff provide service (in common with other university-wide facilities). Though computer sciences departments and computation center facilities are administratively co-joined in some universities, the separateness of role (as well as of managements and budgets) appears essential to the maturation of academic programs and faculty organization. Advisory committees for the computation center is the de facto device for involving and informing university department users about services and

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204. Journal of Engineering Education, vol. 56, no. 8, April 1966.

205. David L. Parnas. "On the Use of the Computer in Engineering Education without a Programming Prerequisite." Ibid., 313-315.

resource allocation policies. Prof. Calvin Gotlieb of the University of Toronto, and others, advocated separate computation facilities (for computer sciences departments and other groups) to the degree that these are required for unique, essential purposes (computer sciences research, hospital data processing, etc.).

The conference discussion included much deliberation on computer sciences as an intellectual entity; on its relations to mathematics, electrical engineering, and other disciplines; and on its social impacts. In characterizing distinctions, for example, L. A. Zadeh of the University of California, Berkeley, observed that mathematics yields precise truths that are provable, whereas these are few in the computer sciences. Stanley Gill of Imperial College, London, called attention to the heavy demand that users have for the "information engineering" aspects of computer sciences and the present and future effects of some systems on the lives of millions of people. Prof. Gill stated that computer scientists must have more than a "veneer of knowledge" about society's needs. They also have the responsibility of defining what computers should be made to do.

The remainder of this section is illustrative of some of the what's and how's of bringing people and computers together.

The use of computers can be fun as well as intellectually stimulating to students. This is the message of several papers in the April 1966 issue of the Journal of Engineering Education.[204] David Parnas of Carnegie Tech describes the strategy of a course in logic design.[205] A pre-requisite is special problem-oriented simulation software (the language, Boole), that simplifies programming so that the student can concentrate on the purpose of the course, learning the elements of logic design. Students learn by doing. They are given a large-scale problem to be completed by the end of the course for which they need class instruction as they progress. From a well-metered combination of instruction and design simulation problems, Prof. Parnas observes that students

> are able to ask penetrating questions by associating the theoretical results on the blackboard with their practical problems. They know that their work will be thoroughly evaluated and devote an unprecedented amount of effort to the course. By their own estimation, they are motivated to greater effort than in any previous educational experience.

Behind Dartmouth College's success with a time-sharing system is the specially designed language, BASIC, that is an approximation to ordinary English plus algebra.[206] It is taught to freshmen mathematics students (80% of Dartmouth's students elect a mathematics sequence) in two evening sessions, and then they are on their own. John Kemeny and Myron Tribus report that 95% of the students use the computer on homework assignments. Many students, in their junior year, write 2 to 3 programs a week as part of their course work. The authors add:

> We have grown accustomed to seeing music majors transcribing themes on the digital computer, English majors studying sentence structure, engineers making heat-transfer calculations, mathematicians exploring the behavior of primes, and some members of the administration beginning to keep their records - all of them working si-

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206. John G. Kemeny and Myron Tribus. "The Dartmouth Time-Sharing System." Ibid., 326-328.

207. Ibid, p. 327.

208. Anon. "Harvard Learns Math From California." Ibid, p. 325.

209. Jeanne C. Adams. "Teaching Scientific Programming Assisted by the Computer." Computers and Automation, vol. 16, no. 3 (March 1967) 20-22.

multaneously and, sometimes, in one room at the same time.[207]

The youngest programmer on record is ten years old. Large-class experiments have been conducted with wheeled-in teletypes, an overhead projector, and a Thermofax for making transparencies from the teletype output. Dartmouth's GE-265 system can accommodate 40 simultaneous users. A GE-635, installed in November 1966, is expected to be operational by the fall of 1967 and will have a capability of up to 200 lines.

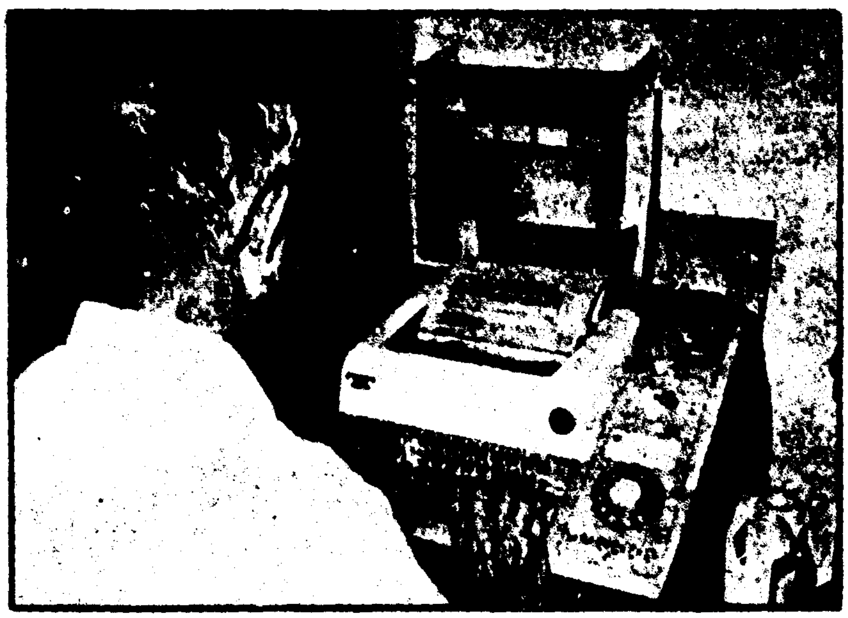
At Harvard University, Anthony Oettinger's seminar on "Technological Aids to Creative Thought" taps Glen Culler's programs stored in the University of California, Santa Barbara, computer to help solve calculus and statistics problems.[208]

In a laboratory environment, Jeanne Adams reports a similar successful experiment.[209] The National Center for Atmospheric Research (NCAR) in Colorado had trained small numbers of students during the summers of 1963, 1964, and 1965 in NCAR's computer facility. For the summer of 1966, NCAR sent offers to 48 universities for applicants. From 29 responses from 20 schools, NCAR selected 8 students, 3 with Master's degrees, all of whom had read some Fortran manuals but had little programming experience. As at Carnegie Tech and Dartmouth, the NCAR teaching approach is learning by doing. One of the few firm instructions to the students on the first day was: "Get a program on the computer today. Any program." Students were able to have rapid turnaround time (5 to 30 min.) and the instructor was always available to answer questions. The experiment had two goals: to enable students to learn to use Fortran or Ascent as a symbolic skill, and to enable them to learn how the computer could be used as a tool in meteorology. After initial sessions, each student was assigned to an NCAR scientist for whom he worked during the rest of the summer. Both goals were accomplished. Students began to view programming as a way of expressing problems for solution, i.e., as an expressive technique rather than a set of rules. They learned to write sophisticated, useful programs, one producing "movies" on an on-line plotter.

The foregoing uses of computers in education are not strictly classifiable as "CAI" (computer-assisted instruction). As Gloria and Leonard Silvern define CAI in a special issue of the Proceedings of the IEEE on computers,

> the term CAI should be reserved for those particular learning situations in which a computer contains a stored instructional program designed to inform, guide, control, and test the student until a prescribed level of proficiency is reached.[210]

CAI's ancestor is PI (programmed instruction), defined by the Silverns as instruction "without the presence or intervention of a human instructor."



210. Gloria M. Silvern and Leonard C. Silvern. "Programmed Instruction and Computer-Assisted Instruction." Proceedings of the IEEE, vol. 54, no. 12 (Dec. 1966) 1648-1655, 1651.

In CAI, the computer replaces a programmed text or a simple teaching machine. CAI, in common with other forms of computer use in education, is demarcating types of man-machine relationships that can ultimately exploit the particular capabilities of each.

The Silverns' survey notes that of 21 invited papers at a conference on automated instruction in 1961, only 6 concerned CAI. Only 15 institutions are listed as conducting CAI research by mid-1966. The Silverns wryly remark that too frequently, research on CAI and curriculum development are performed under separate roofs in the same institution, an observation that could be extended to other research on learning and characteristics of human information processing as well. CAI hopes to explore the use of a variety of media at remote stations -- cathode-ray-tube displays, light pens, computer-stored sound, console-stored sound, console-stored slides, films and motion pictures, as well as keyboards. Few studies have been made of the simultaneous use of multiple media, and results are conflicting. Crucial to meaningful CAI are the programs. Inconclusive results of many predecessor PI experiments could be repeated in CAI. The Silverns forewarn on the need for a new type of individual tney call the Instructional Programmer whose role is lesson planning. They list the following as his functions:

a. analysis of the task
b. establishment of the behavioral objectives (quantitative and qualitative)
c. establishment of the criterion tests that measure behavioral objectives
d. development of course outline
e. writing steps in the lesson plan
f. evaluation, debugging
g. validation on a representative student sample
h. GOTO f.

As in other areas of computer use for problem solving, the Silverns advocate a special-purpose language and software system for instructional programmers, who can then concentrate on the problem rather than machine peculiarities.

At least one dour note has been sounded on CAI. Robert Strum and John Ward of the Naval Postgraduate School returned to programmed instruction after a six-month attempt to apply IBM's COURSEWRITER system to engineering problems. They attribute failure to the following causes:

1) poor man (author and student)/machine communication
2) inability of the system to interpret student answers
3) the immense effort required to prepare course material for the system; and
4) the high cost of hardware and of program preparation.[211]

They aimed for use of the language of engineering with a minimum number of special conventions. They found a modified type set of 88 characters only marginally adequate, with typing difficulty compounded by sets of simultaneous equations and matrices. They had no visual display. They comment that, "in the context of engineering education, a correct answer does not indicate much about a student's work and a wrong answer, standing alone, indicates virtually nothing." Programs must be able to measure performance in more subtle ways. This experiment, however, does not seem to warrant the conclusion that CAI lacks potential in today's engineering classroom. In principle, CAI offers more opportunities than PI for indivi-

211. R. D. Strum and J. R. Ward. "Some Comments on Computer-Assisted Instruction in Engineering Education." IEEE Transactions on Education, vol. E-10, no. 1 (March 1967) 1-3.

212. Wilbur Schramm. "Programmed Instruction, Today and Tomorrow." In Wilbur Schramm, ed. Four Case Studies of Programmed Instruction. New York: Fund for the Advancement of Education, June 1964. (This is a reprint of a Nov. 1962 paper, otherwise out of print). (Available from the Fund without cost)

dualized learning and inquiry because of the many branchings (alternative paths) that computer programs could produce that would be too cumbersome in a programmed text. The Silverns indicate that neither instructional programming nor computer implementation is easy. Their experience shows that one typical instruction step could consist of 6 to 20 CAI program statements. If a typical student responds to about one step per minute, one hour of CAI could require 360 to 1200 statements (equivalent to 600 to 2000 punched cards). This does not include statements for remedial instruction, out-of-class assignments, etc. Additionally, software and media appropriate to the task are as essential for CAI as for other computer applications. The Strum-Ward results may only underscore an old maxim: the proper tools are needed to do a proper job.

Programmed instruction, defined by Wilbur Schramm, is a

> learning experience in which a "program" takes the place of a tutor for the student, and leads him through a set of specified behaviors designed and sequenced to make it more probable that he will behave in a given desired way in the future - in other words, that he will learn what the program is designed to teach him. ... The program is the important thing about programed instruction. It is usually a series of items, questions, or statements to each of which, in order, the student is asked to make a response. His response may be to fill in a word left blank, to answer a question, to select one of a series of multiple-choice answers, to indicate agreement or disagreement, or to solve a problem and record the answer.[212]

Susan Markle's programmed text on programming, Good Frames and Bad: A Grammar of Frame Writing, describes and illustrates the programming "styles" (linear, intrinsic, and variants) that have been developed over the last 40 years.[213] These styles putatively reflect theories of how people learn or should learn and how subjects should be taught.

213. Susan Meyer Markle. Good Frames and Bad: A Grammar of Frame Writing. New York: John Wiley and Sons, Inc., 1964.

Most of the claims for and criticisms against PI can be found in descriptions of Four Case Studies of Programmed Instruction published by the Ford Foundation Fund for the Advancement of Education. 214 Pros and cons are not reviewed here because, abstracted from their contexts, they would be gross oversimplifications that nullify significance. PI materials have been used as substitutes for conventional texts, to supplement lectures and

214. Ibid., ref. 212.

215. Karl U. Smith and Margaret Foltz Smith. Cybernetic Principles of Learning and Educational Design. New York: Holt, Rinehart and Winston, Inc., 1966. (See Chapter 10)

216. Leo E. Persselin. A Guide to Programmed Learning and Teaching Machines in the United States Air Force. El Segundo, Calif.: Aerospace Corp., 1962. Rept. ATN-63-(9990)-1. AD-400,475.

217. Anon. Programmed Learning. Washington, D. C.: Department of the Air Force, Jan. 1967. AF Manual 50-1.

218. Anon. Programmed Instructional Materials Report, RCS: AF-T34. Texas: Air Training Command, Randolph Air Force Base, Dec. 1966. (Distribution subject to ATC Regulation 170-4)

219. C. H. Hendershot. A Bibliography of Programs and Presentation Devices. San Antonio: National Society for Programmed Instruction, 1964 and supplement. & E. H. Goodman, ed. Automated Education Handbook. Detroit: Automated Education Center, 1965. (References 14 and 15 in Ref. 210)

220. Augustin A. Root. "The ASEE Programmed Learning Project, 1965-67." Journal of Engineering Education, vol. 57, no. 6 (Feb. 1967) 428-432.

221. Ibid.

222. Charles E. Wales. "Programmed Instruction: Key to Engineering Education for Tomorrow." Journal of Engineering Education, vol. 57, no. 6 (Feb. 1967) 433-436.

223. B. Jeppsson and J. T. Wallmark. "An Experiment with Support Programming of a Textbook." IEEE Transactions on Education, vol. E-9, no. 4 (Dec. 1966) 182-187.

conventional texts, for remedial purposes, for course reviews, for independent study, and as bases for CAI programs.

Sydney Pressey displayed his first teaching machine in 1924. After World War II, he, for the Navy, and one of his students, for the Air Force, began work on applying self-instruction techniques for training purposes.[215] The voluminous Guide to Programmed Learning and Teaching Machines in the United States Air Force surveys research and applications current in 1962, primarily directed to the training of personnel for operating and maintaining highly complex weapon and electronic systems.[216] Air Force Manual 50-1 states Air Force policy to apply programmed instruction where feasible.[217] Current experience with 289 programs was recently cataloged.[218]

Computer programming has been a popular target for programmed instruction. The Silverns report 35 off-the-shelf courses by March 1966, that can be bought or obtained from computer manufacturers and are designed to teach specific programming skills. They reference compilations of curriculum materials that report 9 courses in electricity, 14 in electronics, and 7 in mathematics related to computer maintenance.[219] The ASEE Programmed Learning Project, initiated in 1965, expects to have 3 semester-length courses in engineering education ready for classroom testing by the fall of 1967.[220] A directory to 23 "units" of materials prepared by members of the Project was recently published.[221]

Experience with programmed instruction materials is as enthusiastic as that with CAI, but with similar provisos. Charles Wales distributed a 400 question-and-answer set to sophomore engineering students as a home-use supplement.[222] His 1963 findings of consistently better performance of students who used the materials, that carried over to other courses they took, were confirmed with a revised and expanded set of programs in 1965. In Sweden, where upper-classmen attend only about 30% of scheduled lectures, a variant on programmed instruction was tried.[223] Three booklets that supplemented the regular text in a course on solid-state electron physics for electrical-engineering undergraduates were sold to students who wished to pay for them (a screening method). Grades showed that students who preferred home study benefited the most from the materials. Their use did not appear to add to study time.

The development of PI materials, however, is time consuming, one hour requiring up to 40 hours of preparation.[224] Cautions in preparation echo those for CAI:

"It's the latest thing in automatic projectors."

Audiovisual Instruction, Feb. 1967

224. Ibid.

225. Ref. 220, p. 428.

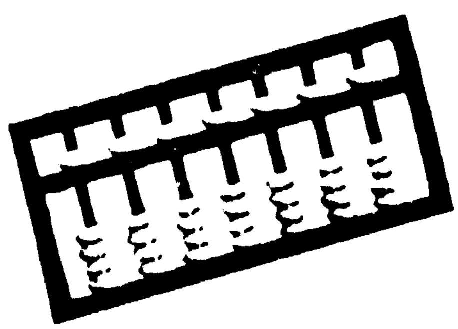
a. Clear specifications of program objectives and criterion tests, i.e., what is the program to achieve and can this be measured?

b. Careful evaluation of student-generated data, i.e., what errors do students make, and why, as well as their scores.

c. Use of realistic problems, i.e., does learning stimulate students to look for other information on related topics, to <u>want</u> to know more?

d. Organization of content. A rule of thumb is to program 30-40 minute episodes that are self-contained and control information flow to accord with people's capacities for processing information.[225]

Programmed instruction is, in one sense, no different from conventional instruction. In both, the above goals must be met. However, failure of PI, and more particularly of CAI, to meet these goals is more immediately discernible because the organization and content are more exposed. This imposes greater demand on the "instructional programmer" and the teacher, both in the creation of these materials and in providing supplementary guidance to the student. The most important question in new curriculum development may be: are educators prepared or preparing for it?



educating librarians

The descriptor, "librarian," was selected for the heading of this section deliberately. It is now popular to use such terms as "library scientist," "documentalist," "information specialist," etc. Distinctions may exist, and if they do, they will become clearer than I think they are now with, perhaps, different meanings. At the present time, the terms seem an outgrowth of a phenomenon that should be short lived. The phenomenon has been an unprecedented infusion of poorly trained people into libraries (sometimes called "nonconventional" or "information centers") catering to non-book materials, principally "technical reports," over the past 20 years. As previously discussed, these libraries obtained their professional staffs primarily from the ranks of the subject specialists whom the libraries were established to serve. These people had varying degrees of knowledge about library organizations and methods, usually gleaned informally from their own use of libraries. Few library school courses were introduced, save over the last few years, to train students for this new type of library. Perhaps courses could not have been developed while these libraries were in the throes of becoming, seeking out their scopes, their roles, and effective operating procedures. I suspect that librarians would have been more prominent in the evolution of these libraries had they been better trained (amplifications follow). Nevertheless, some library schools are now evincing willingness to review their curricula and to reconsider some goals.

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226. Mary V. Gaver. "Inaugural Address." ALA Bulletin, vol. 60, no. 11 (Dec. 1966) 1171.

227. D. J. Foskett. "Readers' Needs in Industrial Libraries." The Library Association Record (British), vol. 59, no. 11 (Nov. 1957) 353-358, at 355.

Sincere inquiry, self-criticism, assessment, and evaluation pervade much of the current literature on libraries, library schools, and the profession called librarianship. In her inaugural address to the American Library Association in July 1966, Mary Gaver raised the following questions:

> How are we to prepare administrators, personnel directors, public relations specialists, audio-visual specialists, subject specialists for school and college libraries, the many varieties of information scientists, as well as technicians and others who are needed to man libraries of all kinds? Shall we continue to pretend that the graduate library schools alone can or should do this job? Shall we continue to ignore the undergraduate programs, as well as the graduate programs, for instructional materials specialists, which are already preparing most of the librarians to man the burgeoning school libraries of the country? How are we to prepare professionally qualified staff for their emerging new role in our rapidly changing world?[226]

Answers may lie in a combined attack on curricula and the librarian's "attitude of mind:"

> It has been claimed that this "attitude of mind" is what characterizes an information officer even more than subject knowledge, and that mere training as a librarian does not produce such an attitude.[227]

Russell Shank provides some clues for a new look at all education in librarianship:

> Organized, academic training programs for librarianship have one year to convert a college graduate into a professional librarian. . . . In that one year, the idea is to impart enough fundamental skills and knowledge, jargon and attitudes, theories and premises, to allow the graduate to operate at a reasonable, but probably minimum, level of performance, upon graduation. . . . The whole fifth-year library education program is based on the premise that at least the first year on the job after graduation will be a part of the new librarian's professional educational experience. . . . Because of the pressures of limited time, cou-

> rses in administration, cataloging, classification, bibliography, reference and advisory services, history of books and libraries, book selection and collection development principles, and so on, must be taught at the general level. At best the library school can merely indicate some of the influences acting on the operations of different types of library activities in different institutional settings that will affect decision-making processes.[228]

Attitudes are reflected in a number of pros and cons. On education, Rose Sellers maintains that library schools should continue to provide "general, elastic, and 'liberal'" instruction to prepare students "not only for the first job but for all of them."[229] She considers education in a profession a lifelong process, graduation from school marking only the beginning of this process. She relies on good administrators to provide proper atmospheres in which newcomers can develop their capacities. She strongly advocates a bachelor's degree in liberal arts "unadulterated by a vocational inlay" as the price of admission to library school, "and that those which now require undergraduate courses in library science as prerequisites will see the error of their ways." On the other hand, Pierre Papazian believes that librarians are "committing suicide on the installment

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228. Russell Shank. "Administration Training in Graduate Library Schools." Special Libraries, vol. 58, no. 1 (Jan. 1967) 30-32, at 31-32.

229. Rose Z. Sellers. "A Different Drummer: Thoughts on Library Education." Journal of Education for Librarianship, vol. 6, no. 3 (Winter 1966) 161-166.

230. Pierre Papazian. "The Old Order and the New Breed, or Will Automation Spoil Mel Dewey?" ALA Bulletin, vol. 60, no. 6 (June 1966) 644-646.

231. Ibid, p. 644.

232. Harold L. Roth. "Education for Special Librarianship." Journal of Education for Librarianship, vol. 7, no. 1 (Summer 1966) 3-5.

plan."[230] He says library schools should produce professionals that are equally conversant with traditional and mechanized libraries. He notes:

> There is no reason why libraries cannot take their rightful place in this new library and information field. After all, librarians are, in a basic sense, information specialists - they deal with information or recorded knowledge in all of its various forms. Librarians, more than anyone else, are familiar with the problems encountered in the acquisition, processing, storage, retrieval, and dissemination of recorded knowledge. If problems arise which cannot be resolved through conventional methods, then libraries must use other techniques.
>
> I have seen enthusiastic machine-oriented people with no library background try to design systems for libraries. Often the results of such computer systems are disappointing and not comparable to human efforts, simply because the designer did not consult with a librarian to understand the problems he was trying to solve. The librarian should be an important member of the design team for any library system, but to qualify, he should know enough about computer systems to work intelligently with the computer specialist.[231]

In a mid-region are those who must cope with special library situations. The Subcommittee on Special Library Education of the Council of National Library Associations has prepared statements for practical programs for training special librarians in a number of subject fields. Harold Roth, a member of the Subcommittee, suggests that basic courses of library schools not be changed, but that some general courses be replaced by specialized ones for persons training for special libraries.[232] Erik Bromberg's survey of the syllabi of courses on special libraries shows the many differences of approach across the country and the attempt of some to create "a kind of miniature library school curriculum" within the general one.[233] A footnote remark is perhaps Bromberg's most significant statement:

233. Erik Bromberg, "Quick Look at Courses on Special Libraries." Special Libraries, vol. -, no. 1 (Jan. 1967) 22-23.

> The philosophic tenor of a course is not indicated by a syllabus. The theme of my course, for instance, is that, while in practice public and college librarianship (like education in general) is a very valuable manifestation of welfare statism, industrial librarianship in a competitive world is exemplary of capitalism and has to be practiced in that manner.[234]

Whether true in an absolute sense or not, this statement pointedly reflects sharp differences among libraries and, by implication, the need to make these differences real to students so that they not be 100% neophyte on entering their first job. Should library schools make ignorance and inability to cope with practical problems a virtue?

Librarians are, in fact, beginning to look at themselves not only as organizers of knowledge, but as possessors and disseminators of knowledge. They are beginning to put themselves into the context of today's world. Noting that advancing technology has produced a redefinition of subject matter and a new division of labor in many professions, Paul Van Riper adds:

> Librarians have risen relatively late to this challenge. The concept of "a librarian" as a single entity, a uniform product, equally competent in all aspects of the profession, is now completely outmoded. Like hospitals, libraries as institutions are now demanding a broad range of skills, many of them highly technical and deserving of specialized training in their own right. Just as hospitals now involve a complex relationship among doctors, lay administrators, nurses, technicians, clerical personnel, and others, so do libraries. Moreover, even the primary and

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234. Ibid. p. 22.

235. Paul P. Van Riper. "The Dimensions of Manpower: Problems and Policies." Wilson Library Bulletin, vol. 41, no. 8 (April 1967) 800-809, at 807.

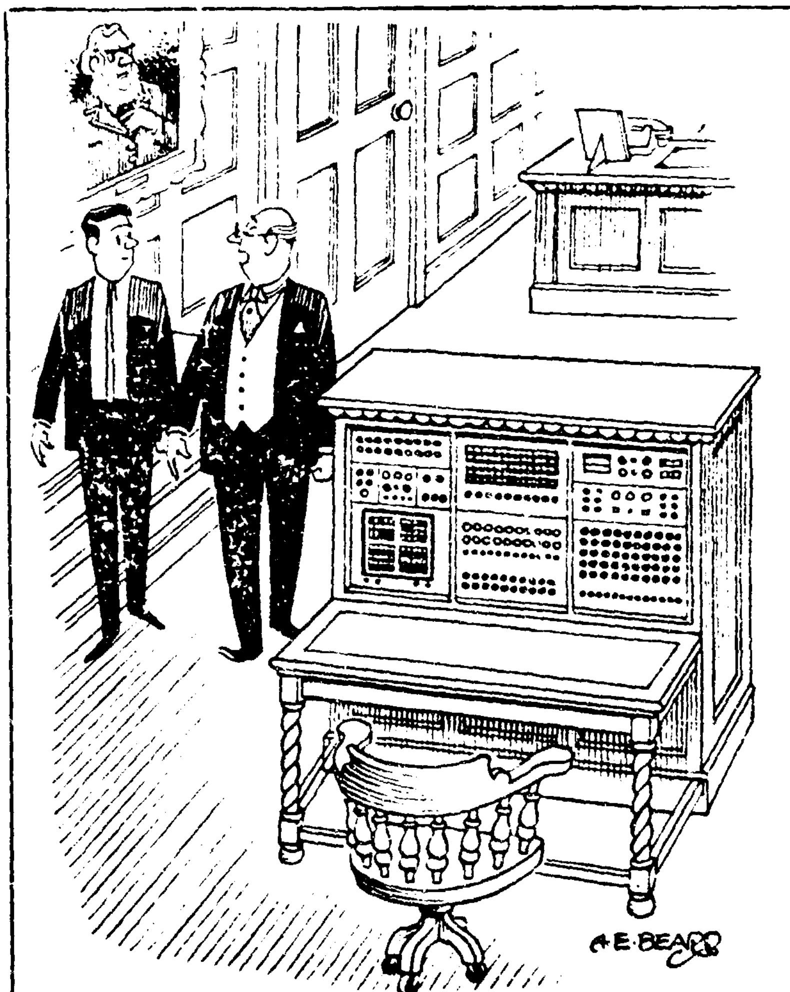
historic library function is changing. Once repositories primarily of books and periodicals for those who chose to enter their somewhat forbidding confines, libraries now have positive obligations to disseminate knowledge. The recent article in WLB (Sept. 1965) on "A Role for Librarians in the Relevant War Against Poverty" is a case in point. The complete fulfillment of this more positive concept of the profession is also requiring librarians to become not just familiar with, but competent in, the newer information storage and dissemination techniques associated with automation, data processing, and high speed computers. But these techniques have and are being developed by others than librarians, with the result that the function of the librarian becomes more and more ambiguous.

To be sure, many librarians are aware of these problems. But it is not possible to do much about the manpower requirements of a profession, much less professional education and training, unless ambiguities in role are clarified. Librarians are not alone in facing this problem; the same is true, for example, with engineers. But what was once a relatively homogeneous role concept is now shattered. Someone must put the pieces together in a new and sensible pattern. Either the librarians will do this for themselves, and quick, or the newest and most exciting fringes of the profession will be nibbled away under other occupational auspices.[235]

Librarians are beginning to look at the institutions they help build and serve with an eye to distinctions and social responsibilities. Margrit Kraft writes:

"Libraries" is an abstraction with no reference to today's reality. In this reality we have public libraries, college libraries, research libraries, school libraries, and special libraries. A curriculum devised to serve some non-existing abstraction cannot possibly satisfy a complicated reality.

The different types of libraries do have a common element. They all have collections which in one form or another preserve the emanations of the human mind. Whether collections are on stone or clay tablets, on papyrus or paper, on film or on discs is irrelevant. Their purpose is to preserve not the form but the content, and through this to allow knowledge to advance.[236]



"We're proud of our old established business traditions here but you'll find we still move with the times."
© DATAMATION

Datamation, May 1967

236. Margrit Kraft. "What Would You Do With Brighter People?" Journal of Education for Librarianship, vol. 7, no. 1 (Summer 1966) 21-28, at 22.

237. Leon Carnovsky. "Changing Patterns in Librarianship: Implications for Library Education." Wilson Library Bulletin, vol. 41, no. 5 (Jan. 1967) 484-491, at 488, 489.

238. Joseph C. Donohue. "Librarianship and the Science of Information." American Documentation, vol. 17, no. 3 (July 1966) 120-123.

239. Ref. 236.

Noting growth in school and university populations, "new industrial needs for information of the most arcane sorts," increasing federal government involvement in improving library resources, and rising metropolitanism, Leon Carnovsky says:

> This interest .. has stimulated state library and extension divisions to the point where, far from constituting the weak link in the chain of library service, as they were characterized some thirty years ago, they are likely to be the key element in most, if not all, states. The state library will continue to be ancillary to local collections, but in a far more significant sense, because the social demand will be greater. But it will also be far more active in planning more effective local services through systems, and in assistance to individual libraries, because it will have the funds available to translate such planning into action. Thus, as I see the pattern emerging it takes the form of strong and dynamic leadership and library provision at the state level; the slow but real development of the larger unit through federation and cooperation, in the interest of the serious reader at school and postschool levels; and the vast expansion of school libraries and strengthening of academic libraries. The implications for library education are clear; the graduates of library schools should not only be aware of these developments, they should be prepared to play a part in speeding their accomplishment and to participate in imaginative planning.
>
> .....
>
> Once more it should be noted that the whole pattern of intercommunity dependence should be ventilated in our library school teaching, and the matter of use and cost should be a fruitful field for study by the graduate library schools.[237]

Some curriculum changes have been made. Joseph Donohue's recently reported 1963-1964 survey shows the addition of at least one course in information sciences in 23 schools and some interdisciplinary activity in linguistics, mathematics, science and engineering, and the social sciences.[238] These, however, are stop-gaps, education "'grudgingly and tardily patched to meet the needs of the moment'"239 and thus perpetually out-of-date. Raynard Swank's plan for the future involves reassessing the core courses. He recommends blending the old with the new, the new based on the following four changes that have occurred in librarianship itself:

> First is the expansion of librarianship, with respect ... to the range of functions within it and of interests without. By functions within I mean new or alternative or more intensive kinds of services - selective dissemination of information to readers, the delivery of photocopies to offices and laboratories, literature searching, and other activities of which many are embraced by the rubric 'documentation." By interests without I mean other fields of information service, such as information centers (as Weinberg defined them), data banks (in social and political fields), management information systems (in business), and command and control systems (in the military)...
>
> Second, in this process of expansion, librarianship is again reaching out to other disciplines for new knowledge and methodologies. In the nineteen thirties we found new strength in the social sciences - sociology, education, communications, and statistics. Today, in the quest of advanced technologies, we are searching out mathematics,

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240. Raynard C. Swank. "Documentation and Information Science in the Core Library School Curriculum." Special Libraries, vol. 58, no. 1 (Jan. 1967) 40-44.

241. Ibid, p. 41.

242. C. D. Batty. "Librarianship by Degrees." The Library World (British) vol. 68, no. 798 (Dec. 1966) 155-158, 160, 161, at 155.

243. Mary Helen Mahar, ed. The School Library As A Materials Center, Educational Needs of Librarians and Teachers in its Administration and Use. Proceedings of a Conference, 16-18 May 1962. Washington, D. C.: U. S. Dept. of Health, Education, and Welfare, Office of Education, 1964. Circular No. 708, OE-15042. (Available from GPO, 50¢)

244. Samuel Sass. "Library Technicians - Instant Librarians?" Library Journal, vol. 92, no. 11 (1 June 1967) 2122-2126.

> electronics, business and industrial management, linguistics, philosophy, and psychology.
>
> Third is the emergence of additional, exacting specializations in librarianship, especially in the area of information science, in cluding operations research, systems analysis, and mechanization.
>
> And fourth is the development of librarianship itself as a more rigorous discipline. The growing complexity of the profession requires the discovery and application of more precise methodologies for the study of library affairs.[240]

Many librarians and those of us who have entered the information sciences by other routes can share Dean Swank's opinion that the three elements --

> recorded knowledge and its users, its intellectual organization, and the service agencies -[241]

are the building blocks for all information-processing systems and constitute the common base for librarianship and the information sciences.

Open questions remain with respect to the willingness of today's librarians to revise existing services, to accept contributions from non-librarian professionals and non-professionals, and to re-train to acquire new knowledge. C. D. Batty writes:

> It is important, then, to ask ourselves what the library is for, what librarianship is about. Unless we do so we run the risk of designing our training to suit the library needs of today when it is in the libraries of tomorrow that today's students will spend most of their working lives. [242]

The proceedings of a 1962 conference, for example, go beyond the nominal restriction to "school libraries" in considering education, on-the-job training, and services to augment the library as a materials center.[243] Samuel Sass properly decries the "sudden spurt" of institutions granting two-year library technician degrees and producing students who don't have rudimentary knowledge of library processes and tools.[244] Nevertheless, well-trained nonprofessionals are being, and can be, employed in many operations (e.g., cataloging, interlibrary loan, reference) under professional supervision. John Dawson suggests that the role of the professional librarian

> should be in planning; in the selection of materials and of courses of action; in the training, supervision, revision, and inspiration of the nonprofessional and the student assistant. Librarians, in short, should be librarian-managers or bibliothecal specialists.[245]

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245. John M. Dawson. "Not Too Academic." College and Research Libraries, vol. 27, no. 1 (Jan. 1967) 37-39, 55, at 39.

246. Ref. 228.

247. Elizabeth M. Walkey. "Communicating With Management." Special Libraries, vol. 57, no. 8 (Oct. 1966) 565-568.

248. Jesse Shera. "Keynote Address." Special Libraries, vol. 57, no. 5 (May-June 1966) 310.

249. Jesse Shera. "Without Reserve: The 'Trickster' in Library Research." Wilson Library Bulletin, vol. 41, no. 5 (Jan. 1967) 521, 533.

250. Kathleen Molz, ed. "A Kaleidoscopic View of Library Research." Wilson Library Bulletin, vol. 41, no. 9 (May 1967) 896-949.

251. Howard W. Winger. "Theses and Reports Accepted by Graduate Library Schools in the United States and Canada: 1964-65." The Library Quarterly, vol. 36, no. 1 (Jan. 1966) 38-47.

252. Janet P. Jaffe. "Theses and Reports Accepted by Graduate Library Schools: 1965-66." The Library Quarterly, vol. 36, no. 4 (Oct. 1966) 325-332. Through gross stretches of the imagination, I identified 63 of the 255 items reported for 1964-65 (26%) and 47 of the 195 items reported for 1965-55 (25%) as related to some aspect of research. Of these, I found a total of 12 concerned with indexing and classification, 25 on systems design and analysis, and 20 on user needs, the totals summed over both years. The doctoral dissertations numbered 19 from 6 schools in 1964-65 and 11 from 3 schools in 1965-66.

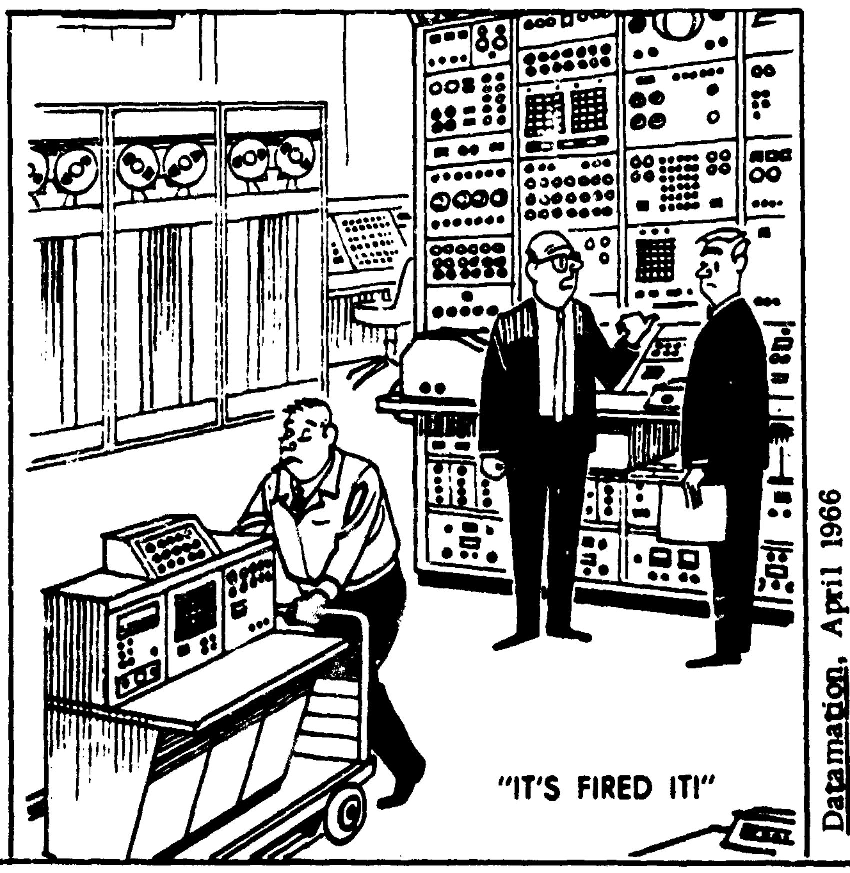
How well is the librarian adapted to management and supervision? He is not even preliminarily prepared by 11 of 36 accredited library schools, according to Russell Shank's survey.[246] Elizabeth Walkey, however, succinctly describes benefits to status, resources, and operations, not to mention survival, that can accrue when a librarian understands and applies principles of effect management communication.[247] In his 1956 SLA Convention address, Jesse Shera said:

> Librarianship cannot be fully comprehended until it is studied in relation to the total communication process by which society achieves and disseminates knowledge. until we understand the role of the library in the transmission of knowledge from individual to individual and from group to group.[248]

Research will be needed to achieve this goal. Not of the "trickster" sort,[249] but research reaching toward such needs as are described in an extraordinarily fine set of statements in the May 1967 issue of the Wilson Library Bulletin. Though Robert Muller notes (and perusal of recent thesis topics confirms[251,252]) that research is not a significant part of today's library school environment, its reinstatement appears essential. However,

> The mere acquisition of skill in research techniques, important as it may seem, is less crucial than the ability to raise the right kinds of questions, and that it is less important to learn how to apply technology or techniques than it is to learn how to assess their value. Library education should be taught, not as Bible-truth, but as an area of knowledge and theory that is subject to continuing reappraisal and renewal. The responsibility for institutional renewal, however, does not rest only upon those directing library education, but is predominantly a responsibility of library management. Only as library management succeeds in overcoming the forces inhibiting the raising of troublesome questions of a fundamental sort, and does so continually, will our libraries be institutions that properly fulfull their obligations to society.[253]

If library curricula adapt to the hosts of new materials and to the new types of demands for information that are being made, a new corps of librarians will emerge. They will be able to cope not only with present problems, but they will also be able to bring order to continued growth. If library schools, and librarians, do not meet today's challenges, other groups under different names eventually will. The result will be the same, the availability of appropriate education and training for people who will staff the information facilities of the future.



253. Robert H. Muller. "The Research Mind in Library Education and Practice." Library Journal, vol. 92, no. 6 (15 March 1967) 1126-1129, at 1128.

254. Gene Bylinsky. "Help Wanted: 50,000 Programmers." Fortune, vol. 75, no. 3 (March 1967) 141-143, 168, 171, 172, 176.

255. Anon. "Computer Sciences at Purdue." IBM Computing Report, vol. 3, no. 1 (Jan. 1967) 8-11. At p. 11.

the people gap

"Help Wanted: 50,000 Programmers"[254] is more than a good headline. It reflects a critical shortage in but one job category, but the old saw, "good people are hard to find," characterizes people needs in all skilled occupations in the information sciences. People are not only hard to find; they don't exist. Samuel Conte heads the Computer Sciences Department of Purdue University, one of the first to introduce a separate computer sciences curriculum (1962). He commented recently:

> The situation will get worse as more computer science departments open up. It will begin to get better in perhaps five years as new computer science programs begin to graduate students in significant numbers. Most students who get PhD's go into academic life, but so far there have not been enough of them to alleviate the shortage of quality faculty." (MS graduates tend to go into the aerospace industry, the computer industry, or to programming firms)
>
> Until very recently, our universities were not training programmers and computer scientists at all. Graduates from mathematics, engineering, and other disciplines who became interested in computer science either learned by self-study or by on-the-job training. I am convinced that for the professional programmer, whether in applications or systems, computer technology is moving too rapidly for self-study to be effective and that specific education in computer science will be essential. I believe too that industry will come to rely more and more on graduates of computer science departments to meet their needs in computer-related activities.[255]

Purdue awarded 30 MS degrees and 2 Ph.D.'s in 1965. Current graduate enrollment is over 100. The Biological Sciences Communication Project (BSCP) at George Washington University recently published results of a survey of information sciences curricula at universities. Of 41 responses (68 questionnaires sent), 35 positively reported giving some instruction, 15 treating information sciences as a separate discipline.[256] BSCP also investigated information sciences training programs sponsored by industry. Of 49 respondents (106 questionnaires sent), 25 neither provided nor supported training. Those with programs emphasized indexing, general library training, system design, and computer programming, instruction usually being given by a member of the company staff.

Dick Brandon gives s( )e projections for the industry:

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256. Marilyn C. Bracken and Charles W. Schilling. Survey of Practical Training in Information Science. Washington, D.C.: George Washington University, Biological Sciences Communication Project, April 1967. See also Wilson Library Bulletin, vol. 41, no. 8 (April 1967). The issue is devoted principally to the topic "Manpower and the Library Profession." Additionally, Samuel Sass discusses the issue, "Library Technicians - Instant Librarians?" and Carlyle J. Frarey "The Placement Picture - 1966" in Library Journal, vol. 92, no. 11 (June 1, 1967) 2122-2126 and 2131-2136, respectively.

257. Dick H. Brandon. "Jobs and Careers in Data Processing." Computers and Automation, vol. 15, no. 9 (Sept. 1966) 24-28. At p. 24.

258. Anon. "World Report." Datamation, vol. 13, no. 3 (May 1967) 93.

259. Edwin Castagna. "National Inventory of Library Needs." The Bowker Annual of Library and Book Trade Information. New York: R. R. Bowker Company, 1966. At p. 4-6.

260. Ibid, p. 17. This figure excludes 15,000 to 20,000 part-time and partially trained librarians.

261. Anon. "8th Annual Report On EDP Salaries." Business Automation, vol. 13, no. 6 (June 1966) 36-47, 64,65.

> Between now and 1970 the number of electronic computers in use in the United States will nearly double, from some 28,000 to more than 55,000. By 1970 an additional 130,000 systems analysts, about 100,000 more programmers, and 55,000 managers and supervisors will be needed to provide the specialized sort of computer-based data processing systems required. And we have not yet mentioned such other jobs as console operators, unit record equipment operators, keypunch supervisors, librarians, and control clerks, to name but a few. [257]

The United States is not alone. Britain's Department of Education and Science manpower report anticipates needs for 11,000 systems analysts, 19,000 programmers, and 16,000 operators by 1970. [258] Brandon believes that finding people for the technical areas of planning and management will be the most difficult, and the search will continue well into the 1970's. "A good technician is not always a good manager." Data in Bowker's Annual give the picture for librarians. Edwin Castagna, reporting on ALA's National Inventory of Library Needs, puts the national shortage at 100,000.[259] The 1965 library force (professional librarians, defined as individuals with 15 or more semester hours of library science) in all types of libraries was 76,700.[260]

The tables in Business Automation's eighth annual nationwide EDP survey list wide ranges in salaries in various job categories.[261] (Some of the job descriptions used by Philip H. Weber and Associates in conducting the survey are given in Appendix C). Fig. 9 from the survey shows one significant trend -- up. The survey polled 2324 data processing users from business, government, and education, and encompasses 92,000 employees in over 25,000 jobs in 81 categories in 427 cities. Of 3806 computers listed in the returns, 70% were IBM's (1481 IBM 1401's). Only 6 of the users reported having real-time systems in operation. For a salary contrast, Castagna puts the average

	EDP Mgr.		Mgr. Sys. Anal.		Mgr Progr'g		Mgr. Acct'g	
	1965	1966	1965	1966	1965	1966	1965	1966
Boston	249	321	220	274	189	225	183	202
Chicago	277	322	238	275	212	218	205	204
Cleveland	263	281	210	296	183	211	214	208
Denver	250	270	229	261	189	204	175	172
Des Moines	229	265	186	250	166	180	175	182
Detroit	271	352	248	291	219	219	241	246
Hartford	276	323	247	259	215	208	194	184
Los Angeles	294	331	262	310	231	249	227	230
Milwaukee	297	294	240	260	203	203	228	186
Minn. /St. Paul	240	283	213	242	182	209	195	205
New York	334	363	284	292	230	235	237	213
Philadelphia	288	375	239	282	226	223	195	185
Portland, Ore.	214	295	185	244	181	193	158	163
San Francisco	273	302	249	256	217	232	195	195
Washington	255	337	242	287	211	250	183	201
Average	268	314	233	273	204	215	200	198

Fig. 9 — FIFTEEN-CITY COMPARISON OF TOP EDP JOBS
(Average Weekly Salaries, 1965 and 1966)

262. Ref. 260, p. 17.

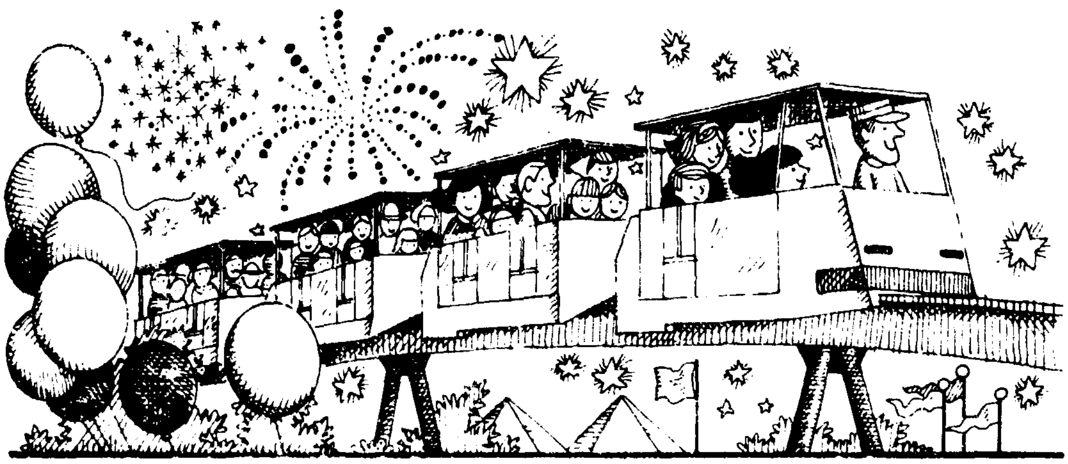
263. Ref. 256, p. 10.

264. James R. Killian, et al. Toward Better Utilization of Scientific and Engineering Talent, A Program for Action. Report of the Committee on Utilization of Scientific and Engineering Manpower. Washington, D.C.: National Academy of Sciences, 1964. NAS Publication No. 1191. At p. 48.

beginning annual salary for professional librarians at $6000. The low and high for library directors in the affluent state of California were $9000 and $14,592, respectively, in 1965.[262] The BSCP study shows a salary range of $8000 to $12000 for information sciences Ph.D.'s.[263]

The beginning of understanding, perhaps, comes with knowledge of what is. On the advice of Jerome Wiesner to President Kennedy in 1961, a Committee on Utilization of Scientific and Engineering Manpower was appointed by the National Academy of Sciences. The Committee's recommendations include gathering, analyzing, and coordinating reliable data for "carefully thought-out policies and strategies for human resources development and use."[264] For the library and information sciences, several hopefully significant studies are planned or underway. The Library Research Center, University of Illinois, is currently conducting a survey of personnel in academic libraries under U.S. Office of Education auspices. The American Federation of Information Processing Societies will soon begin a survey of information processing personnel under the sponsorship of the Advanced Research Projects Agency through the Air Force Office of Scientific Research. AFIPS represents the major professional societies in the U.S. in the computing, data processing, and documentation fields. Its study will include an analysis of the data. Additional Office of Education-sponsored manpower studies are planned.

Little reference has been made in the literature to people who have been called the "computer bums." I have no statistics on their number. They are mainly university dropouts and display many of the characteristics of initiative, imagination, and creativity behaviorists extol. They are far from lazy, frequently contributing much unpaid effort in computer centers. Why do university programs fail to retain them? An Office of Education survey indicates that of 3.8 million students in the ninth grade, about 2.9 million (77%) may graduate from high school, 1.7 million (44%) will probably enter college, and 780,000 (21%) may obtain the bachelor's degree.[265] The "computer bums" and other gifted dropouts may constitute tractable groups of people from whom much could be learned in our inquiry into education and the utilization of human resources.



265.Anon. "USOE Report Studies College Dropout Rate." North Carolina Public School Bulletin, vol. 31, no. 7 (March 1967) 13.

Postscript

This paper could have continued ... on pressing social issues such as continuing education,[266] the role of the federal government in promoting technological change,[267] the individual's rights of privacy vs. national data centers[268] ... on topics related to information systems research such as fourth-generation hardware and software, classification theories and principles, methods of indexing, matching services to users[269] ... on economic considerations such as copyright restrictions vs. free and unrestricted dissemination of information[270] ... on national and international development programs,[271] etc. But my regular job is a timekeeper, and I must return to it.

This paper discusses a phenomenon that parallels, thus far, the birth and maturation period of a human being. Many of us are its parents, in one way or another. In a few years, hopefully, youngsters will sit at consoles who will be no older than the first of the time-sharing systems, and we will have programs ready for them. Not programs solely to study learning and behavior, not programs of several hundreds of instructions of the stimulus-response type in narrow subject areas, but programs sufficiently broad in coverage and adaptive to the youngster's abilities as to pass the Turing test -- interaction will be like conversing with a human.

In this paper, I said the computer could be a liberator. Throughout man's history, his mind has been in bondage to the necessity to labor for physical survival. Comparatively few people have been able to afford the luxury of the pursuit of knowledge, and most of those who have left us the heritage of their thought have done so at the expense of the labor of others. Not all men who could are or will be interested in

266. Strategies and procedures in planning and effecting changes in education, for school children to adults, and the responsibilities of local and regional education and political groups, are discussed in a collection of well-considered papers in Edgar L. Morphet and Charles O. Ryan, eds. Implications for Education of Prospective Changes in Society, Reports Prepared for the Second Area Conference, Designing Education for the Future, An Eight-State Project. Denver: Project on Designing Education for the Future, Jan. 1967. (Available on request from Project Office, 1362 Lincoln Street, Denver, Colo. 80203)

267. Ref. 8 is the citation to the Report of the National Commission on Technology, Automation, and Economic Progress. The Commission also directed publication of the studies prepared for its consideration. These discuss a range of activities, actual and projected, with respect to all elements of society on topics reflected by the volume titles: Technology and the American Economy. Studies Prepared for the National Commission on Technology, Automation, and Economic Progress. Vol. I - The Outlook For Technological Change and Employment. Vol. II - The Employment Impact of Technological Change. Vol. III - Adjusting to Change. Vol. IV - Educational Implications of Technological Change. Vol. V - Applying Technology to Unmet Needs. Vol. VI - Statements Relating to the Impact of Technological Change. Washington, D.C.: The Commission as above, Feb. 1966. (Available from GPO, I - $2.25; II - $2.50; III - $1.75; IV - $1.00; V - $1.75; VI - $1.50)

The Annual Report of the National Science Foundation reviews the impact that this agency's program is having on the national scientific enterprise. See Leland J. Haworth, dir. National Science Foundation, Sixteenth Annual Report for the Fiscal Year Ended June 30, 1966. Washington, D.C.: National Science Foundation, Jan. 1967. Rept. NSF-67-1. (Available from GPO, 55¢) It may be noted that $11.6 millions were spent on "science information activities" during FY 66 (or 2.5% of the $466.4 total budget) (p. 3). Additionally, $8.9 millions were invested in 30 university computing facilities (p. 63), and $12.9, $13.0, and $19.2 millions were allocated, respectively, for research in mathematics, the social sciences, and engineering (p. 4), disciplines that are strong contributors to the information sciences.

using their minds, as not all men are interested in athletics, or music, etc. However, in our generation, we see increasing numbers of people whom machines have freed from physical labor turn to another product of machines -- the book. And what a heterogeneous lot these people are! No longer only the sons of the rich and the politically powerful. No longer only men who were willing to endure poverty and become outcasts to study and to experiment. Sons of the unskilled, sons of the illiterate, are no longer exceptions in our universities. More than economics, higher earning potential, brings them there. It is not for money that many men devote increasing portions of their time to reading and research, for they receive no wages for much of their effort. (It is not for salary or promotion or commendation that I have written this paper). Let behaviorists supply explanations for the attraction of man to intellectual inquiry. Suffice it to say that it demonstrably exists. The computer is today's tool that could be the adjunct man needs to his own information-processing apparatus. To date, the computer has been used for scientific computations and business data processing, some of which would have been impractical to try to accomplish manually. But creative information processing by machines is in its infancy. The phenomenon of computer processing needs wisdom, perception, and imagination to mature further. It needs help from its old parents, and it needs new parents. This paper has attempted, in part, to provide an account for planned parenthood.

268. See Kenneth E. Clark, et al. Privacy and Behavioral Research. Panel Report Prepared for the Office of Science and Technology. Washington, D.C.: Executive Office of the President, Feb. 1967. The report considers issues of privacy "intimately associated with behavioral research." However, the authors view the discussion as equally applicable to data collection for other purposes. They state: "The right to privacy is the right of the individual to decide for himself how much he will share with others his thoughts, his feelings, and the facts of his personal life. ... If society is to exercise its right to know, it must free its behavioral scientists as much as possible from unnecessary restraints. Yet behavioral scientists, in turn, must accept the constructive restraints that society imposes in order to establish that level of dignity, freedom, and personal fulfillment that men treasure virtually above all else in life." (p. 2-4)

269. The National Science Foundation (NSF) publishes a good reference to the gamut of activities constituting the "information sciences," "computer sciences," and "library sciences." See Current Research and Development in Scientific Documentation, No. 14. Washington, D.C.: National Science Foundation, 1966. Rept. NSF-66-17. (Available from GPO, $2.00). NSF also periodically publishes a guide to "nonconventional" systems that have been installed in libraries and technical information centers. The fourth volume in this series was recently distributed: Nonconventional Scientific and Technical Information Systems in Current Use, No. 4. Washington, D.C.: National Science Foundation, Dec. 1966. Rept. NSF-66-24. (Available from GPO, $1.75). Summaries for the 175 systems in this volume include discussions of the nature of the document input, the indexes procedures employed, and the services provided.

270. A solid discussion of this topic is contained in Julius J. Marke. Copyright and Intellectual Property. New York: Fund for the Advancement of Education, Jan. 1967.

271. The manpower surveys referred to in "the people gap" in the text of this report are expected to provide valuable data for strategic planning on the national scale. The NSF-sponsored Visiting Scientists Program conducted by the Association for Computing Machinery (ACM) enables distinguished individuals to visit U.S. campuses to help promote research and education in the computer sciences. A brochure on this program is available from the ACM, 211 East 43rd Street, N.Y. 10017. See also Computopics, vol. 8, no. 8 (March 1967), a publi-

cation of ACM's Washington, D. C., chapter, that is a special issue containing a Career Guidance Bibliography and is available from ACM for 50¢. U. S. professional societies and individuals are active participants in two international organizations, the International Federation for Documentation (FID) and the International Federation of Information Processing Societies (IFIPS). Both societies are actively engaged in people and information exchange programs and in matters concerning education and training. The first IFIPS special interest group, called IAG (IFIP Administrative Data Processing Group), was recently formed. It is particularly emphasizing the collection and dissemination of information on ADP systems and the training of teachers and students in ADP. See IAG-communications, no. 1 (May 1967), expected to be a bimonthly. The monthly periodical, Bibliography, Documentation, Terminology, is a unique source of information on many national and international activities in the information and library sciences. (The periodical is available on request to archives, libraries, documentation centers, etc., from UNESCO, Place de Fontenoy, Paris 7e, France).

By wisdom a house is built,
and by understanding it is established;
by knowledge the rooms are filled
with all precious and pleasant riches.

Proverbs 24: 3, 4

APPENDIX A

"Future Steps," Excerpt from

Summary of Activities Toward Interagency Coordination,

Senate Rept. No. 369, p. 14-19 (Ref. 3)

Future Steps.—There is need for the following types of actions:

1. Control of physical items.

(*a*) A mechanized inventory of scientific journals and other publications issued serially.

(*b*) A cooperative cataloging system leading toward a mechanized national union catalog as well as specialized catalogs.

(*c*) An effective coordinated acquisitions program—which can be initiated after the above two activities have become effective.

(*d*) An effective transmission network for facsimile and microform.

2. Control of information contents of items.

This needs to be achieved at two levels: (*a*) general characterization of the contents of a book or article, and (*b*) identification of specific data, ideas, etc.

(*a*) In regard to (*a*) above:

(1) Development or improvement of comprehensive indexes on broad discipline and mission-oriented bases.

(2) Realistic articulation of the above with specialized indexes.

(3) Upgrading, including mechanization, of abstracting-indexing services.

(*b*) In regard to (*b*) above:

(1) Expansion and improvement of the National Data Reference System.

(2) Extension in depth and improvement of specialized indexes and abstracts.

(3) Improvement and extension of critical reviews.

(4) Expansion and integration of specialized information centers that analyze, evaluate and repackage information for a specific group of users.

Local Access.—Throughout the country, a coordinated system is required to replace the present jumble of regional depository libraries, report, information, and other centers which are now sponsored by a wide variety of Federal agencies at many locations. At present, Federal depository library collections are particularly incomplete. Executive agency depository collections are fragmentary in that they only make available the product of a single Government agency. In the case of the 12 centers under the auspices of the Department of Commerce, the output of only 3 or 4 agencies is made available. No executive depository collection gives access to what the total Government literature offers on a given subject. Government Printing Office depository libraries are also fragmentary. For the most part, they provide public access only to selected documents printed by GPO and not to the many Government documents being printed independently of GPO. In using any one depository library for Government publications, then, the user finds only partial access to the Government literature.

As the Department of Commerce expands its services at the grassroots through colleges of engineering and other nonprofit enterprises, there is a particular need for a Governmentwide rationalization of programs of information in the field.

The Ultimate Goal.—It is important that the above and other steps be taken as part of a comprehensive Washington-50-State plan, rather than as a series of separate actions.

From the very first hearings on information conducted by the committee in March 1958, the concept of a Federal and national "plan"—of a "system" or a "network"—was stressed. At that time, few of the Federal agencies were prepared to accept the thesis that an interagency plan was necessary, much less feasible. The committee emphasized, however, that nothing less than a plan would suffice to deal with what was already becoming a "flood" of scientific and engineering information and data. The inundation which the committee foresaw has now come to pass.

Throughout the world, upwards of 35,000 scientific and technical journals, alone, pour out in excess of 600,000 original papers each year.[18a]

Over the years, the rising torrents of typed, printed, photocopied, audiovisual, and spoken information have served to change the minds of lagging agencies.

Value of Creative Federal Unity.—The subcommittee has urged that Federal agencies aim at what has been termed a "synergistic" effect from their information programs. Through this effect, the sum of Federal information activities would become greater than the total of its separate parts. The reason would be the addition of an "extra" element which becomes possible when a creative unity is achieved in information programs. This "extra" element would result from a dynamic fusion of the best elements of information activities, resulting in a new and more valuable whole.

At present, the sum of the separate agency information programs is far less than the total of its parts. The reason is that there is enormous overlap and disuniformity between the respective programs. Instead of the addition of an "extra" element, there is a degree of subtraction because of excessive redundancy and disparity.

Special effort will have to be made to reduce needless redundancy and disparity. The effort must, by definition, be on an interagency basis.

A natural tendency develops for each information organization to fix its allegiance solely upon its own agency. But a higher allegiance must simultaneously be developed—a desire to serve the needs of the Federal Government as a whole.

Information As a Resource.—Information is an agency resource, a Federal, National and international resource.

Modern information technology has made it possible to place much of the accumulated knowledge of the human race within the reach of a man's fingertips, so to speak. The potentialities of this access to power are awesome, in terms of improving the well-being of our own and other people, as well as in terms of improved education for young and old alike.

If man's collected knowledge is to become truly accessible, plans and programs must be made, priorities assigned and resources allocated.

"In-House" Needs.—Within each department, individuals responsible for information within the principal Federal departments and agencies should be part of management's top team, at the equivalent of Assistant Secretary level.

Information advances cannot come about down-the-line unless there is a strengthening of the in-house technical competence of Federal agencies. Often, highly sophisticated reports prepared by private companies on contract or grant cannot be evaluated by Federal in-house personnel because the latter lack the background and competence to do so. The Federal agencies will always be heavily dependent upon the technical skills of highly advanced private enterprise firms. But the taxpayer cannot get his money's worth from information grants and contracts unless Federal personnel are paid the necessary salaries to encourage them to remain in Federal service and are given in-house training to up-grade their skills.

System of systems.—It is not enough that each Federal department have a modern information system. Each such system must be a system of subsystems which link the major components of the agency—its bureaus, divisions, institutes, and other subunits. In turn, each department's system should be part of a "system of Federal systems" with maximum compatibility and convertibility.

Analyzing costs.—As desirable as these goals are, it is important that progress be made toward them on the basis of careful analyses of costs and benefits. The goal is not to purchase more hardware in the form of computers; the goal is to secure service by whatever means will do the best job at the least cost. For many small organizations, electronic data processing equipment is not necessary and cannot be justified on the basis of costs in relation to benefits. But, for larger organizations, computers are indispensable, particularly if their operating time is fully shared.

Interlocking Federal Units.—A Federal system of systems would assure an integrated management of the book, serial, report, and other holdings of (*a*) the three National Libraries—Library of Congress, National Agricultural Library, and National Library of Medicine.

(*b*) Federal information organizations, including libraries of the Cabinet departments and independent agencies.

(*c*) Specialized information centers maintained and supported by Federal departments and agencies in university and other centers.

Ideally, this interlocking set of systems could exchange magnetic tapes and microforms so that any one system could almost automatically get the fullest benefit of the totality of information available from all other systems with minimal need for intervention of manpower between systems.

High-Speed Transmission.—Paradoxically, the Nation is still only in a "pony express" stage, in certain respects. Exchanges between systems today are by mail. Copies of the literature, microfiche, and computer tapes are exchanged, but there is a timelag.

The means for infinitely more rapid exchange already exist. Through microwave links and cables with broadband capacity operated by commercial carriers, the information systems of Federal agencies and major contractors can be tied together so that computer "talks" directly to computer.

An Air Force scientist in California should be able within minutes to query the memory of NASA's machine system in Bethesda. An engineer at the Marshall Space Flight Center in Alabama should be able to obtain a specific piece of information from a contractor's information system in New Jersey.

Such a high-speed network would turn all related information systems into local resources, regardless of geographical location.

The basis for fast visual communication already is accepted: the microfiche. It is a transparency which can be scanned remotely, through the network's broadband channels.

The method for locating a bibliographic reference in someone else's computer already exists. A method can be developed by which the operator in Oregon punches the reference into his keyboard, pushes the "operate" switch, and calls up on his screen the referenced document from a file in Florida. If the document is in fact useful, punching a "reproduce" button on the console should drop a microfiche reproduction into the operator's hands within seconds.

Extra Machine Services.—The more work a machine can do, the less will be the number of errors resulting from human handling, the faster the response and, in some cases, the less the cost. With interconnection of machines, and ability to reproduce by remote command, other services become possible:

(*a*) Automatic transfer of new indexes from machine to machine as new reports are fed into the system;

(*b*) Automatic transmission of microfiche to principal points where they are needed for local use;

(*c*) Automatic machine determination of distribution patterns for each new item;

(*d*) Storage of whole abstracts in central machine systems, reproducible on call from any point in the system;

(*e*) Automatic machine-controlled duplication of the exact number of microfiche needed for a particular report;

(*f*) And—someday—the machines should be able to do their own relatively sophisticated indexing.

Nonprinted Media.—The entire scientific and technical information field is concentrated primarily on the printed word. While exceptions can be cited, they are just that—exceptions. There is no adequate counterpart for storage and retrieval of information that exists in the form of engineering drawings and blueprints, motion picture film, oral tapes of seminars and other discussions, or of physical models.

The subcommittee envisions a system that brings such communication forms under the same bibliographic control used for the printed word, with a compatible method of retrieval. There is a hint of possible developments in recent improvements in Diazo negatives. A summary of motion picture footage with selected frames reproduced on microfiche could tell an individual whether he should call for a copy of the actual film. Engineering drawings could be reproduced on microfiche, in sections if necessary. These media could be indexed using the vocabulary developed for the printed word. There seems to be no easy solution for oral media, except to play them into the long-awaited "voicewriter" that produces the printed copy.

Recall of Total Content.—All systems at present depend on the art of the indexer. But even with an ideal communications language, the index could not be the perfect system of retrieving information since it depends on arbitrary selection of keywords and phrases, not on context.

On the horizon is a machine system capable of scanning entire reports at the speed of light, comparing their content with an information definition that can be as long, or as involved, as is necessary to express the user's needs.

A bibliographic search would mean running entire libraries through the machine, producing all references that could be correlated with the required subject.

The Ultimate System.—When machines of sufficient capacity to store complete libraries are available, and when machine programers can write the programs to use the capacities, we will be able to retrieve actual information, not merely the references to such information.

The Challenge to Agencies.—None of the above goals may be characterized as "visionary." The principal impediment to their realization is not the need for still more innovative "hardware," as important as that is; the foremost need is for will on the part of top management within agencies to achieve these goals and to ask allocation of the necessary resources.

In this process, there is not the slightest excuse for prodigality, but there is every reason for boldness and a willingness to experiment soundly.

Savings almost beyond comprehension may become possible—savings in manpower, materiel and perhaps most important, in time. The savings will not be automatic; at times, they may even prove illusory because hidden costs develop. But over the long run, the savings will be real and substantial.

APPENDIX B

TYPE OF ASSISTANCE	AUTHORIZATION	APPROPRIATION
GROUP I: FOR CONSTRUCTION		
Public libraries	Library Services and Construction Act—Title II	40,000,000
GROUP II: FOR PROGRAMS, INSTRUCTION, AND ADMINISTRATION		
School library resources and instructional materials	Elementary and Secondary Ed. Act—Title II	102,000,000
Teacher institutes	National Defense Education Act—Title XI	30,000,000
Librarian training	Higher Education Act of 1965—Title II	3,750,000
Acquisition of educational media	Higher Education Act of 1965—Title VI-A	14,500,000
Workshops, institutes in educational media	Higher Education Act of 1965—Title VI-B	2,500,000
College library resources	Higher Education Act of 1965—Title II	25,000,000
Public library services	Library Services and Construction Act—Title I	35,000,000
State institutional library services	Library Services and Construction Act—Title IV-A	375,000
Occupational training and retraining	Manpower Development and Training Act of 1962	123,700,000
Researcher training	Cooperative Research Act (amend. by ESEA-Title IV)	(See III-35)
GROUP III: FOR TEACHER TRAINING AND STUDENT ASSISTANCE		
Educational media personnel training grants (institutes)	Higher Education Act of 1965—Title VI-B	2,500,000
Librarian fellowships and traineeships	Higher Education Act of 1965—Title II	(See II-26)
GROUP IV: FOR RESEARCH		
Curriculum research (demonstration and development)	Cooperative Research Act	3,000,000
Curriculum research (dissemination)	Cooperative Research Act	2,415,000
Educational media research	National Defense Education Act—Title VII	4,400,000
Library research and demonstration	Higher Education Act of 1965—Title II-B	3,550,000
Research and Development Centers	Cooperative Research Act (amend by ESEA—Title IV)	29,800,000

EXCERPT FROM "Federal Money for Education: Programs Administered by the U. S. Office of Education, Fiscal Year 1967."
American Education, vol. 3, no. 2 (Feb. 1967)

APPENDIX C

JOB DESCRIPTIONS OF PHILIP H. WEBER AND ASSOCIATES

Used in Business Automation's

EIGHTH ANNUAL (1966) EDP PERSONNEL SURVEY*

EDP Manager

Plans, organizes and controls the overall activities of electronic data processing including systems analysis, programing, and computer operation activities through managing subordinates or by direct supervision. Personally handles major personnel, administrative and data processing problems. Maintains continuous control of all activities under his direction through management reports and direct supervision. Confers with and advises subordinates on administrative policies and procedures, technical problems, priorities and methods, and through subordinate supervision is responsible for the overall direction of the various functions to ensure that the activities assigned are completed in the most competent, effective and efficient manner. Consults with, advises, and coordinates between his groups and other departments as necessary for the proper integration and correlation of the functions and activities assigned. Reports to higher level middle management and/or top management on data processing plans, projects, performance, and related matters.

Assistant Manager of Data Processing

Under general direction, assists the manager in planning, organizing and controlling the various sections of the department. Usually has departmental line responsibility but in certain instances may only have departmental staff responsibility. Participates in research and procedural studies. Develops analyses on existing and newly developed equipment and techniques. Consults with and advises other departments with regard to feasibility, systems and procedures, and records control studies and problems. May act for the Manager in his absence.

Technical Assistant to the Manager

Under general direction, provides technical assistance for planning and directing the installation, and the modification and operation of electronic data processing systems. Analyzes proposed and actual projects in terms of machine capabilities, costs and man and machine hours to determine the feasibility of electronic data processing. Usually has only departmental staff responsibility, but may have technical function responsibility. Plans and recommends machine modifications or additional equip-

*Ref. 261

ment to increase the capacity of the system. Prepares cost estimates for current and proposed projects, reflecting the cost of equipment and man and machine hours required. Directs compilation of records and reports concerning production, machine malfunctioning, and maintenance. May advise or consult with Manager, section managers and other departments on organizational, procedural and work-flow plans. May apply knowledge of higher mathematics, operations research, statistical analysis, or numerical analysis techniques to solve business and technical problems.

Coordinator of Data Processing

Under general direction, coordinates activities of the electronic data processing operations with the other organizational departments. Usually has only departmental staff responsibility. Assists in establishing systems analysis, programming and computer operations priorities in order to provide effective service to all users. Recommends standard policies and procedures for providing routine service. Maintains contacts with all using departments, other management services and computer department sections to coordinate activities for the best results with the least possible delay. Participates in evaluating the contribution of the electronic data processing operations to the over-all organization program, improving the service where and when possible, and extending its use where feasible.

Work Process Scheduler

Under general direction, schedules operating time of the over-all electronic data processing activities in order to ensure that the data processing equipment is effectively and efficiently utilized. Responsible for keeping unutilized time to a minimum by maintaining liaison with section managers and reassigning unused time. Coordinates preventive maintenance requirements with operating requirements.

Manager of Systems Analysis

Plans, organizes and controls the activities of the Systems Analysis Section in the establishment and implementation or new or revised systems and procedures concerned with electronic data processing. *Usually considered as being in full charge of all systems analysis activities.* Responsible for feasibility studies and systems design involving electronic data processing and makes recommendations on the action to be taken. Assigns personnel to the various projects and directs their activities. Consults with and advises other departments on systems and procedures. Coordinates section activities with the activities of other sections and departments. Prepares activity and progress reports regarding the activities of the Systems Analysis Section. Reports to the Manager of Data Processing.

Lead Systems Analyst

Usually considered as the assistant manager of systems analysis, or has full technical knowledge of the activity comparable to a senior but also has supervisory duties of instructing, directing and checking the work of the other systems analysts, including the Senior Systems Analysts. Assists in planning, organizing and controlling the activities of the section. Assists in the scheduling of the work of the section and the assigning of personnel to the various projects being studied or processed. May act as systems project manager. May coordinate the activities of the section with other sections and departments. May act for the Manager in his absence.

Senior Systems Analyst

Under general direction, formulates logical statements of business or scientific and/or engineering problems and devises procedures for solutions of the problems through the use of electronic data processing systems. *Usually competent to work at the highest level of all technical phases of systems analysis while working on his own most of the time.* May give some direction and guidance to lower level classifications. Confers with officials, scientists and engineers concerned to define the data processing problem. Prepares charts, tables and diagrams to assist in analyzing problems, utilizing, if necessary, various business, scientific and/or engineering mathematical techniques. Devises logical procedures to solve problems by electronic data processing keeping in mind the capacity and limitations of equipment, operating time and form of desired results. Analyzes existing system logic difficulties and revises the logic and procedures involved as necessary. Develops logic and procedures to provide more efficient machine operations. Prepares computer block diagrams. May assist in the supervision and preparation of machine logic flow charting.

Systems Analyst—A

Under general supervision, determines computer system specifications and record layouts and develops procedures to process information by means of electronic data processing equipment. *Usually competent in most phases of systems analysis to work on his own and only requires some general direction for the balance of the activities.* Confers with organizational personnel to determine the problem and type of data to be processed. Analyzes problems in terms of systems requirements, and modifies the systems design to take the maximum advantage of the existing data processing equipment. Where necessary, recommends equipment modifications or additions to enable an efficient and effective systems application. Prepares a definition of the problem together with recommendations for the equipment needed for its solution from which programing prepares machine logic flow charting and machine instructions, Advises and consults on the implementation of systems applications. Devises data verification methods and standard systems procedures.

Prepares computer block diagrams. May assist in the supervision and preparation of machine logic flow charting.

Systems Analyst—B

Under direct supervision, assists higher level classifications in devising computer system specifications and record layouts. *Usually fairly competent to work on several phases of systems analysis with only general direction but still needs some instruction and guidance for the other phases.* Studies and analyzes existing office procedures as assigned. Prepares systems flow charts to describe existing and proposed operations. Prepares comprehensive computer block diagrams in accordance with instructions from higher level classifications. May assist in the preparation of machine logic flow charting.

Systems Analyst—C

Under immediate supervision, carries out analyses of a less complex nature as assigned and instructed. Usually works only on one activity under very close direction with the work being closely checked. Prepares funtional process charts to describe existing and proposed operations. Designs detailed record and form layouts. Details computer block diagrams to reflect specific computer procedures. May assist in the preparation of machine logic flow charting. *This classification is usually staffed by beginners in systems analysis who have had a sufficient educational background and/or experience to qualify them to start in systems analysis.*

Manager of Programing

Plans, organizes and controls the preparation of computer programs for the solution of business, scientific and/or engineering problems through the use of electronic data processing equipment. *Usually considered as being in full charge of all programing activities.* Assigns, outlines and coordinates the work of programers engaged in writing computer programs and routines. Establishes standards for block diagraming, machine flow charting and programing procedures. May write and debug complex programs. Reviews and evaluates the work of the staff and prepares periodic performance reports. Collaborates with systems analysts and other technical personnel in scheduling equipment analysis, feasibility studies and systems planning. Reports to the Manager of Data Processing.

Lead Programer

Usually considered as the assistant manager of programing, or has full technical knowledge of programing comparable to a senior but also has supervisory duties of instructing, assigning, directing and checking the work of the other programer, including the Senior Programers. Assists in scheduling programing projects and in the assignment of personnel to the various projects. Coordinates the activities of the Programing Section with the other sections in the over-all computer department. May act as programing project manager. May act for the Manager in his absence.

Senior Programer

Under general supervision, develops and prepares machine logic flow charts for the solution of business, engineering and/or scientific problems through the use of electronic data processing equipment. *Usually competent to work at the highest level of all technical phases of programing while working on his own most of the time.* May give some direction and guidance to lower level classifications. Analyzes problems outlined by systems analysts in terms of detailed equipment requirements and capabilities. Designs detailed machine logic flow charting. Verifies program logic by preparing test data for trial runs. Tests and debugs programs. Prepares instruction sheets to guide computer operators during production runs. Evaluates and modifies existing programs to take into account changes in systems requirements or equipment configurations. May translate detailed machine logic flow charts into coded machine instructions. May assist in determining the causes of computer operation malfunctions. May confer with technical personnel in systems analysis and application planning.

Programer—A

Under general supervision, analyzes and defines detailed computer systems to develop programs for electronic data processing. *Usually competent in most phases of programing to work on his own and only requires some general direction for the balance of the activities.* Conducts detailed analyses of all defined systems specifications and develops all levels of block diagrams and machine logic flow charts. Codes, prepares test data, tests and debugs programs; revises and refines programs as required and documents all procedures used throughout the computer program when it is formally established. Evaluates and modifies existing programs to take into account changes in systems requirements or equipment configurations. May give technical assistance to lower level classifications.

Programer—B

Under direct supervision, assists in the review and analysis of detailed computer systems specifications and the preparation of the program instructions. *Usually fairly competent to work on several phases of programing with only general direction but still needs some instruction and guidance for the other phases.* Assists in—and in some cases—carries out on his own the preparation of all levels of block diagrams and machine logic flow charts. Codes program instructions. Assists in preparing test data and testing and debugging programs. Assists in the documentation of all procedures used throughout the system.

Programer—C

Under immediate supervision, assists higher level classifications in the analysis of detailed systems specifications and the preparation of program instructions. All work is performed under close supervision. *This classifications is usually staffed by beginners in computer programing who have had sufficient educational background and/or experience to qualify them to start in computer programing.*

Manager of Computer Operations

Plans, organizes and controls the Computer Operations Section in the operation of the computer peripheral data processing equipment. *Usually considered as being in full charge of all activities of equipment operations.* Establishes detailed schedules for the utilization of all equipment in the Computer Operations Section to obtain maximum usage. Assigns personnel to the various operations and instructs them where necessary so they are trained to perform assigned duties in accordance with established methods and procedures. Collaborates with personnel in other data processing sections to coordinate activities. Reviews equipment logs and reports to the Manager of Data Processing on equipment operation efficiency for the section.

Machine Accounting Manager

Under general supervision, directs the personnel of the Machine Accounting Department and manages the preparation of machine accounting transactions, statistics, and other data; produces statistical records and reports, payrolls, and tabulations for various other purposes; directs the development of new or revised procedures; determines the feasibility of converting manual procedures to mechanical methods.

Tabulating Supervisor

Under supervision of the Machine Accounting Manager, plans, schedules, supervises and directs tabulating machine activities involved in the preparation of reports, statements and records; maintains files and assigns personnel to carry out above activities. Coordinates work with other units.

Keypunch Supervisor

Under supervision of the Machine Accounting Manager, plans, schedules, supervises and directs keypunching and verifying activities involved in the preparation of tabulating cards; maintains the corresponding files; supervises assigned personnel to carry out the above activities.

Record Control Supervisor

Under supervision of the Machine Accounting Manager, plans, schedules, supervises and directs the control records activities involved in preparing records for keypunching and for delivery of reports after they are prepared. Maintains necessary files and records and supervises assigned personnel to carry out the above activities.

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I have done a certain amount of screening of references. I have not attempted to make exhaustive literature searches in any of the areas. Therefore, the inclusion of a reference in this bibliography, particularly in the last three sections, does represent a value judgment, although inclusion does not necessarily mean that I agree with what the author has said or done. However, exclusion of a reference does not necessarily indicate a value judgment since it may be a work I am not familiar with.

Papers within compilations (proceedings, etc.) are listed separately and referenced to the main citation.

It may also be wise to add that the section headings don't characterize mutually exclusive areas in my mind. Therefore, assignment of some references reflects subjective choice, but it is hoped this will cause the reader no difficulty. References are alphabetized by first author in each section.

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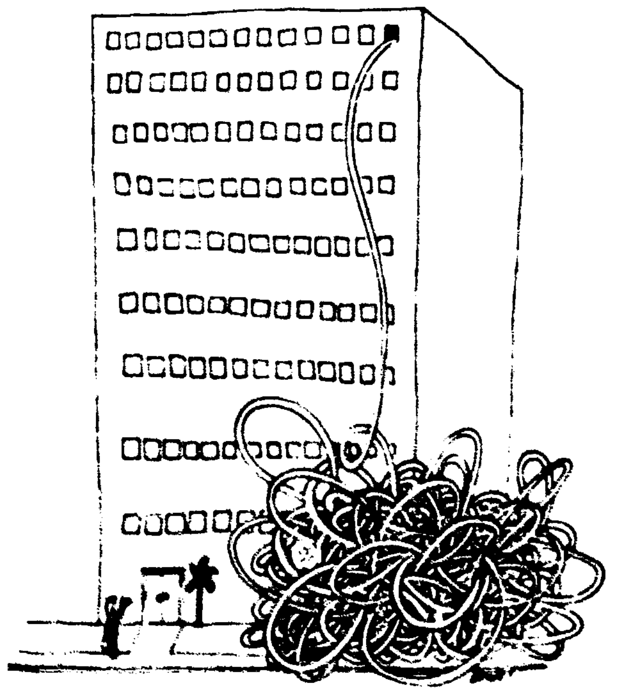

"How many times do I have to tell you? . . . keep the windows shut during readouts!"

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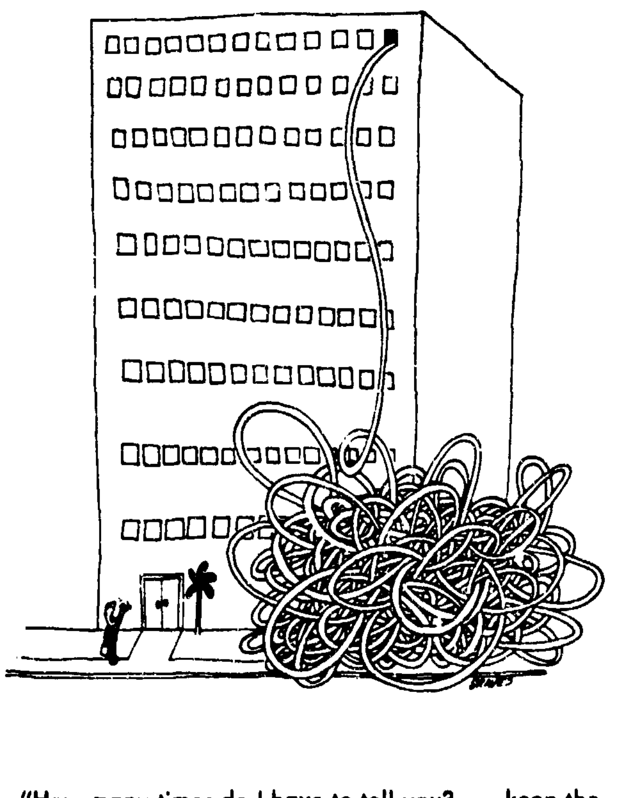

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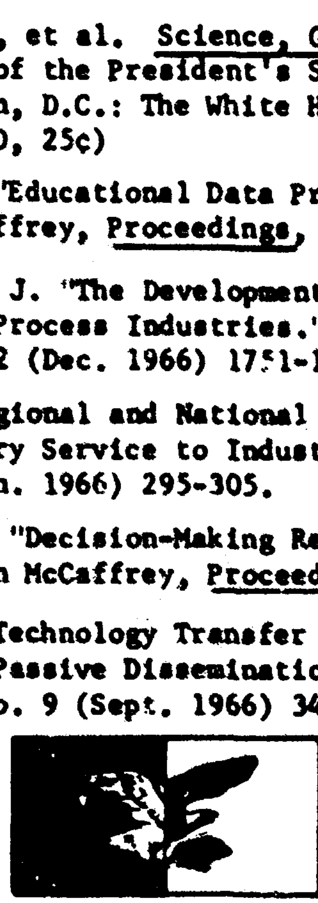

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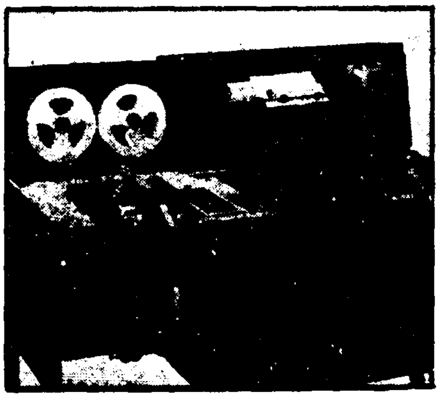

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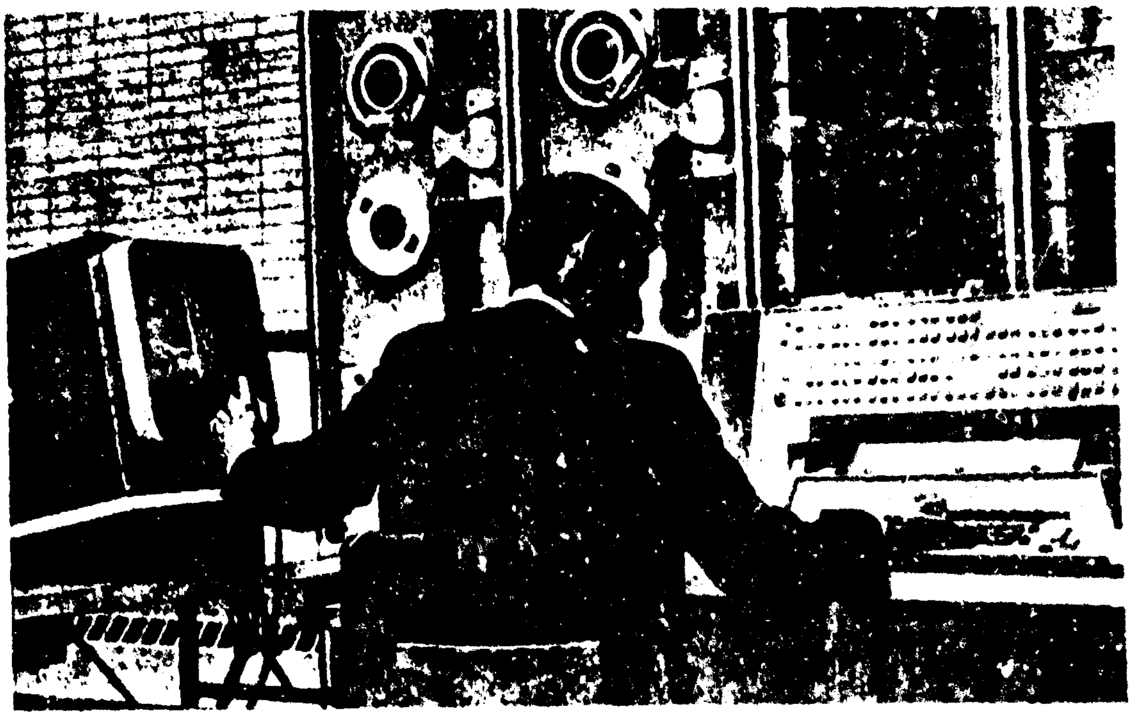

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13. ABSTRACT

This paper records (a) plans and activities in the development and implementation of information systems in a variety of library and information center environments and (b) plans and programs for the education and training of people for the information, computer, and library sciences, and for the systems. The section on systems considers, in turn, the academic library, the public library, the industry-oriented library, and management applications. The discussion of accomplishments for these environments highlights not only mechanization of operations, but also user needs and how they are being met. The discussion includes, for example, summary analyses of Defense Documentation Center operations, California's Dept. of Motor Vehicles automated system, and several surveys of user habits and practices in acquiring information and information services. Curriculum development in the computer sciences is considered with respect to (a) factors arising from its multidiciplinary character and its vocation-type aspects, and (b) its potential impact, via computer-assisted instruction, on teaching methods and fundamental questions concerning education per se. Steps toward curriculum reform in the library sciences are reviewed. A bibliography is included that lists references primarily to the 1966-1967 literature on mechanization of library operations, education for librarianship, systems implementations, and work in programmed instruction and computer-assisted instruction.

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Library statistics						
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