Special Libraries and Information Services in India and in the U.S.A.

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Contents

IN MEMORY OF

VIOLA SUSAN SHAW

Who was full of life
and was interested in her friends
to the very end.

1. Organization of Science in India

Early History

In ancient India significant advances had been made in mathematics, astronomy, chemistry, medicine, and certain branches of biology. From about the third century B. C. close contacts with Greeks and from the eighth or ninth centuries A. D. with the Arabs, resulted in much exchange of scientific ideas and knowledge with the Middle East and Europe. The study of science and medicine continued to the end of the 12th century. This was followed by a period of general stagnation and scientific activities had practically ceased at the time of the rise of the European nations in the 17th and 18th centuries.

Nineteenth Century

With the growing influence of the British, the teaching of English started from about 1813 and at the initiative of some Indian leaders and Christian missionaries the Hindu College was established in Calcutta in 1817 as the first institution for teaching English, history, geography, mathematics, elementary science, etc. In 1837 English replaced Persian as the official language in law courts.

Back in 1784, however, the Asiatic Societ of Bengal was established in Calcutta by Sir William Jones who was a scholar and a judge of the Supreme Court. This society during the first century of its existence provided a house for meetings, a library, and a collection of ancient coins and medals as well as archaeological, technological and geological collections. The Journal of the Royal Asiatic Society of Bengal (started in 1832) was the first periodical in India for dissemination of the results of scientific work in the country. It published papers on zoology, botany and anthropometry with some papers on physics, meteorology, chemistry, geology and medical sciences

2. Library Services in India

In the previous chapter, I have given a brief account of the development of science and of the growth of academic and scientific institutions in India. As a corollary to the establishment of the institutions a number of libraries came into existence during the same period.

The third edition of the Indian Library Directory, issued by the Indian Library Association in 1951, and Libraries in India issued by the Government of India, Ministry of Education in 1952, have been the primary source of information about libraries in India up to the middle of this century. Both are outdated, but no attempt has yet been made to publish a comprehensive directory of the libraries in India. However, to give an idea of the origin and growth of libraries during the nineteenth century and the first half of the twentieth century, I have tabulated the information from these two source books.

Distribution of libraries by different categories and year of establishment

Year of establishment	Govt	Univ	Coll	Spec	Pub	Total	Cumulative Total
1781-1790					1	1	1
1791-1800							1
1801-1810					1	1	2
1811-1820			4		3	7	9
1821-1830			2		1	3	12
1831-1840			6		1	7	19
1841-1850			6	2	6	14	33
1851-1860	2	1	10	7	10	30	63
1861-1870	2		5	2	17	26	89
1871-1880	2	2	15	2	17	38	127
1881-1890	2		27	2	21	52	179
1891-1900	4		19	7	20	50	229
1901-1910	7	1	15	7	32	62	291
1911-1920	7	4	43	27	60	141	432
1921-1930	8	6	43	39	25	121	553
1931-1940	17	1	66	32	14	130	683
1941-1950	39	11	263	92	9	414	1097
date not known	26		19	5	9	60	1157
	116	26	543	225	247	1157	

3. Bibliographical Services in India

The scientists and technologists in India, though largely dependent on scientific literature and technological reports generated in Western countries, felt from the very beginning the need of some bibliographical control of Indian science literature. Scientists themselves undertook the responsibility in the absence of competent librarians and some have compiled well documented retrospective bibliographies on specific subjects. Given below is a selection of earlier bibliographies compiled by the scientists and scientific workers.

Earlier Bibliographies

1. Professional Papers on Indian Engineering. Classified list of papers. vols. 1-7. Roorkee, 1863-70.

2. Oldham, R. D. Bibliography of Indian Geology, being a list of books and papers published prior to 1887. Geological Survey of India, Calcutta, 1888, p. 145.

3. Sinclair, W. F. "Some New Books on Indian Zoology." Jour. Bombay Nat. Hist. Soc. 5:176-184, 1890.

4. Oryza, Sativa "Literature on the Races in India." Agriculture Ledger 16:1-594, 1910.

5. Blatter, E. "Bibliography of the Botany of British India and Ceylon." Jour. Bombay Nat. Hist. Soc. 20:79-176, 1911.

6. Imperial Department of Agriculture in India dealing with cotton 1906-1926. Indian Central Cotton Committee Bulletin No. 8, Bombay, 1927.

7. Sohoni, V. V. "Bibliography of Meteorological Papers in the Publications of the Asiatic Society of Bengal, 1788-1928." Jour. Proc. Asiatic Soc. Bengal, p. 454-502, 1929.

8. Shaw, F. J. R. & Bose, R. D. "List of Publications on the Botany of Indian Crops." Imperial Agricultural Research Institute, Pusa, Bull. No. 202, 1930.

9. Sinton, J. A. "Bibliography of Malaria in India." Records Malaria Survey of India, No. 1, 1930.

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4. Indian National Scientific Documentation Centre

After independence in 1947, the Council of Scientific and Industrial Research, established in 1942, gave high priority to developing a network of scientific laboratories in India. This accelerated scientific research activities in India and, as a corollary, demand for increased scientific information and active documentation service began to be felt In this situation it was felt necessary to establish a national documentation center to supplement the limited library facilities available in various research institutions.

At the recommendation of the Advisory Committee appointed by the Government of India in 1951, the Council of Scientific and Industrial Research established the Indian National Scientific Documentation Centre (INSDOC) in 1952. INSDOC was placed under the administrative control of the Director of the National Physical Laboratory, and was assigned the following objectives:

1. To receive and retain all scientific periodicals which may be of use to the country;
2. To inform scientists and engineers of articles which may be of value to them by issuing a monthly bulletin of abstracts;
3. To answer specific inquiries from the information available in the centre;
4. To supply photocopies or translations of articles required by individual workers;
5. To be a national depository for reports of the scientific work of the nation, both published and unpublished; and
6. To be a channel through which the scientific work of the nation is made known and available to the rest of the world.

In order to fulfill the functions mentioned above Insdoc attempted, from the very beginning, to build up a rich collection of scientific periodicals and other research communications. To avoid duplication of research materials available in several older research libraries in the neighborhood, and to use its limited book budget judiciously, INSDOC assessed the resources available at the Indian Council of Agricultural Research, the Indian Agricultural Research Institute (both having good collections in agriculture and biological sciences) and the Library of the Director General of Health Services (for literature on

5. Defence Scientific Information Centre

The Scientific Information Bureau which has been in existence since 1958 as a Division of the Defence Science Laboratory was converted, in May, 1967, to the Defence Scientific Information and Documentation Centre (DESIDOC), under the Research and Development (R & D) Organization, Ministry of Defence. The mission of DESIDOC is to collect, collate, and disseminate scientific information to research scientists, armed forces, management people, and other users.

DESIDOC is organized into the following divisions or cells: Publications & Printing Division, Documentation Division, Translation Division, Information Surveys & Research Cell, and Special Cell.

Publication Division

R & D achievements, scientific information and new developments, in the country and abroad, are disseminated through the following publications.

1. Defence Science Journal. A quarterly publication with two half-yearly supplements. The quarterly issues publish original research communications and the supplements provide review articles. All branches of science and technology related to defence problems are covered in this periodical.
2. Abstracts of R & D Projects. An annual publication giving the summary of progress on research and development projects undertaken by the various R & D establishments and laboratories. The publication is intended to serve the interest of all users in Defence Services/Establishments. A supplement to the Abstracts containing progress on selected projects is also issued in August of each year as a classified publication.
3. R & D Bulletin. A publication to disseminate achievements of R & D Establishments/Laboratories to the user services and to apprise them of the trend of research and development carried out on various important defence problems. This too is a classified publication.

6. Indian National Bibliography

The most noteworthy bibliographical activity of post-independence in India is the publication of the Indian National Bibliography.

The Indian National Bibliography, started in 1957, records books, pamphlets, and other documents published in the country in English and in fourteen Indian languages. It is based on materials received in the National Library under the Delivery of Books and Newspapers (Public Libraries) Act of 1954. The following types of publications are, however, excluded from the bibliography: (1) Musical scores, (2) Maps, (3) Guides to text books, (4) Ephemeral literature, and (5) Periodicals and newspapers, except the first issue of a new title.

The A. L. A. rules for author and title, 1949, and the rules for descriptive cataloging in the Library of Congress are followed. The entries are printed in Roman script and in English so that they may be used outside India.

The National Bibliography is a classified bibliography, arranged according to subject. It is divided into two sections: general publications and government publications, including those of quasi-government bodies. Each section is divided into two parts: classified and alphabetical. In the classified sequence the full descriptive entries are arranged according to Decimal Classification. The colon number is also assigned to each entry. Under each specific subject the entries are arranged alphabetically by the names of authors. A shorter entry is given in the alphabetical part under the name of the author, short title, imprint, and class number. The entries in the classified section are arranged according to the Dewey Decimal Classification. The subject index follows the chain procedure developed in India by Dr. Ranganathan.

The Bibliography is provided with an exhaustive index of author, title, subject, series, etc. The Bibliography was originally a quarterly but it has been issued monthly since 1965. A cumulated annual

7. Documentation on Social Sciences

Social Science Research Centers

Despite the fact that the social sciences have developed greatly during the last two decades there has been no general survey of achievements and trends in the social sciences in India.

However, increased attention to teaching and research in several disciplines of the social sciences is evidenced by the fact that all 62 Indian universities have departments providing facilities for teaching and research in some fields of the social sciences. The central and state governments and the Research Programmes Committee of the Planning Commission are providing funds to the universities for social studies and for acceleration of social science research in general.

The government itself, through its own specialized agencies and institutions, is giving increased attention to research which is mostly applied in nature and has been designed to provide adequate data for the measurement of economic and social development in the country.

No attempt has been made by the social scientists to write trend reports and to record the history and progress of research in different disciplines of the social sciences such as sociology, social psychology; criminology; cultural and social anthropology; demography; economics, statistics; public administration; political science; international relations; international and constitutional law; economic and social history; human, economic and political geography. Nor has any attempt been made by the social scientists and documentalists to record systematically the social data made available in the process of numerous surveys and experiments.

The data on growth of the social science research centers in India have been quoted from Social Science Research Centres in South Asia: A Directory of Institutions, compiled by the UNESCO Research Centre on Social and Economic Development in Southern Asia in 1965, and from annual reports of several institutions. The major areas

8. Education in Library Science and Documentation

In 1910, the first center for training in librarianship in India was initiated by an American librarian, Mr. W. A. Borden, who was appointed by Maharaja Sayaji Rao Gaekwad of Baroda as the Director of the State Library Department in Baroda. This attempt, however, met with little success. In 1915, a second library school was organized at Punjab University, Lahore, by another American librarian, Mr. A. Dickinson. The school continued successfully till the partition of India.

Madras University, under the able leadership of Dr. Ranganathan, organized its first course leading to a Certificate in Librarianship in 1929, and it became a regular program in 1931. In 1937, the University converted the Certificate course into a one year post-graduate diploma course. Andhra University in Waltair started a diploma course in librarianship in 1935. In the same year, the Imperial Library (now the National Library), under the sponsorship of the government, organized a training course leading to a Diploma in Library Science. The course was discontinued in 1945 when Calcutta University decided to start a diploma course in library science.

In the 1940's, several Indian universities realized the need of starting formal education in library science. Banaras Hindu University in 1941, Bombay University in 1944, Calcutta University in 1946, and Delhi University in 1947 started post-graduate diploma courses in library science.

In later years, the demand for trained personnel increased with the growing number of libraries and several other universities decided to have faculties of library science. At present, twenty-six universities offer one-year courses in library science leading to a Bachelor's degree or a post-graduate diploma. Names of the university library schools and the dates of the beginning of the one-year courses (leading to a degree or a diploma) are as follows:

Aligarh (1958), Andhra (1935), Banaras (1942), Baroda (1956),

9. Research in Library Science

While library education in India was formalized at the university level in the late 1930's, the curriculum remained at the library technician level; it was designed to train for routine library jobs rather than producing scholarly librarians who would be able to contribute to the development of library science. There is little scope or encouragement for research activities. None of the library schools at the university level have funds for research projects or experimental work. This is due primarily to the educational system of the country, and is partly due to dependence on Western countries for technical know-how. Though the overall picture is not very encouraging, the research contributions of Dr. Ranganathan in library science in general, and in classification in particular, gained a very distinguished position for the Indian school of thought. Dr. Ranganathan worked single handed for many years, using the Madras University Library, where he was the Librarian, as his laboratory for experimentation and research. He developed new concepts and a methodology which gained him international recognition.

Dr. Ranganathan in 1963 wrote that the starting of research in classification in India may be said to have been the formulation, between 1928 and 1930, of the "Five Laws of Library Science." The Laws based the entire edifice of library practices on normative principles.

His Colon Classification (1933), which appeared about the same time, had roots running deeper than the schemes of classification themselves. The ideas developed in Dr. Ranganathan's Prolegomena of Library Classification (1937) gave a great stimulus to further investigation into the problems of classification. His concept of five fundamental categories (PMEST) Personality, Matter, Energy, Space, and Time in his Library classification: Fundamentals and Procedure (1944) furthered this development. Dr. Ranganathan himself said that these ideas favored classification research but were only the very

10. Role of Library Associations

Indian Library Association

Several state library associations--Andhra Pradesh Library Association (1914), Maharashtra Library Association (1921), Baroda Library Association (1924), Bengal Library Association (1925), Madras Library Association (1928), Punjab Library Association (1929)--are forerunners of the Indian Library Association, the national professional body established in 1933. The Association began with the following three objectives:

1. Furtherance of the library movement in India;
2. Promotion of the training of librarians; and
3. Improvement of the status of librarians.

In 1949, two new features--research in library science, and cooperation with the international organizations--were added and the Association redefined its objectives as follows:

1. Promotion of the library movement in India;
2. Promotion of the foundation of a trained class of librarians in India;
3. Promotion of research in library science;
4. Improvement of the studies and conditions of services of librarians; and
5. Cooperation with international organizations with similar objects.

Since its formation, the Indian Library Association has been holding biennial conferences to vitalize library activities in India and to bring about a common platform for all librarians. The subjects discussed at these conferences (cited below) and some of the major decisions made have brought about improved library service.

1933 Idiosyncracies in reading material
1937 Pitfalls in library administration
1940 Individuation in library science
1942 Reference service and reference books
1944 Library classification
1946 Library cataloging
1949 Library service in India
1951 Public library provision; Documentation problems
1953 Depth classification; Reference service and reference material

Part II: The U. S. A.

11. Prolegomena

In a brief memo in April, 1967, Dr. Ralph R. Shaw, Dean of Library Activities, University of Hawaii, invited me to come out from my routine activities in a special library and spend a few months observing current documentation activities in the United States. This was followed up by a formal communication from Dean Neal Harlow, Graduate School of Library Service, Rutgers University, confirming financial arrangements for three months' travel in the United States to observe current trends in documentation activities and to write a report on the basis of my experience.

This gave me an opportunity to revisit the country after sixteen years. (I was a student at the School of Library Service, Columbia University, in 1951.) In India, the information handling processes are manual and mostly handled in special libraries. I have described the special library and documentation activities in India in another part of this work. Except for doing work with a few experimental models, Indian librarians and documentalists have had very little practical experience with data processing equipment for information handling and other library activities. I went to the United States knowing very little about computer-based information systems, and I am not hesitant to add that I still know very little of the mechanics of machine methods. However, I accumulated a substantial volume of documents and references, which I tried to digest in order to get a clearer understanding of present trends and a projection of future computer-aided information retrieval activities and automated library services in the United States. My advisers at Rutgers scheduled my program of visits to different libraries and information centers, both in federal and non-federal bodies. They also put me in touch with several educators and experts engaged in teaching and research in library and information science.

During my three months' tour, I visited a number of fully or

12. Special Libraries and Technical Information Centers

In the United States, the nineteenth century saw the beginning of public library service and with the twentieth century, a new type of library--the "special library"--began to serve readers in special subject areas. It would thus meet the need of business and professional men, public administrators, manufacturers, and scientists. Early in this century, John Cotton Dana, the prime mover for a special libraries association in the United States, recognized the special library as the best answer to the needs of specialized groups. He defined the special librarian as "the modern man of affairs." With a view to uniting on a national basis all the libraries attached to special departments and devoted to special subject fields, he formally proposed the establishment of the Special Libraries Association in July, 1909. Dana admitted the lack of inclusiveness in his definition of special library and pointed out that special libraries are so varied in their character and in the use made of them that no definition would satisfactorily include all of them. Even during this early period of development, Dana and several other pioneers spoke about the possibilities of special services, the development of library systems, and the coordination of libraries and information clearing houses. It is easy to identify these early ideas with some very modern developments in documentation that are based upon similar clearing houses and coordinated activities, now called the "network concept."

The first directory of special libraries, which appeared in the second issue of Special Libraries in April, 1910, recorded a list of nearly one hundred such libraries in the United States.

Otlet used the word "documentation" in 1907 (two years prior to Dana's move for special libraries in the United States) when he needed a term to cover the activities both in libraries and in archives. He called the international congress held in Brussels in 1910 the "Congress de bibliographie et de documentation," thus combining two words which had different meanings and were mutually exclusive.

13. Libraries and Machines

Jesse H. Shera[1] in a recent article "Librarians Against Machine" mentioned the slower rate in environmental changes for automated information retrieval and accused the professional librarian of being orthodox and skeptical about adopting the newer computer technology for information handling and library service.

The attitude of earlier librarians towards the use of machines, however, presents a somewhat different picture. From the very beginning, librarians recognized the need for improved techniques for information processing and servicing and, wherever possible, they experimented with the application of technology to improve library service. The use of the typewriter as a possible tool for cataloging was mentioned as early as 1877 at the New York Conference of Librarians. H. Taylor,[2] in 1915, invented the perforated stencils which have more recently been called "peek-a-boo" cards. In 1920, H. E. Soper[3] invented a mechanism for information retrieval which was an improvement on Taylor's perforated stencils. E. Goldberg,[4] in 1931, patented one of the earliest devices for scanning and selecting from film strip and photograph copying. In 1936, Ralph Parker[5] experimented with the application of Hollerith cards to circulation systems at the University of Texas. The circulation system of the Montclair Public Library introduced the Hollerith punch card machine in 1941.[6] The University of Florida also experimented with a mechanized circulation system at about the same time.[7]

During the late 1940's, technological advancement brought to market more sophisticated Hollerith and other unit record machines for sorting and reproducing. Though these machines were not primarily designed for bibliographical purposes, some of the librarians and documentalists began to experiment with the application of data processing equipment to handle library operations.

The first successful application of punch cards in printing book catalogs was made in 1951 at King County (Washington) Public Library.

14. Library Education and Information Science

The Education for special librarianship has remained a subject for discussion and debate since the inception of the Special Libraries Association in 1909. One group voiced their criticism by pointing out that the principles and techniques of general librarianship as expressed in the core curriculum are not readily applicable to special library practice and the library schools have not accorded special librarianship the attention it deserves. Another equally strong group, however, argued that the special librarianship constitutes only several specialized applications of the principles and techniques common to all areas of librarianship. They went on to say that the necessity for special instruction has been occasioned by the particular contexts in which special library services are to be provided. True specialization, they said, can be attained only through internship within library specialities. Such dialogue continued but no dynamic education program could be formalized for several decades.

Librarians, however, gradually began to play an increased role in the process of systematization and communication when the first conference on scientific information, sponsored by the Royal Society in 1948, emphasized the need for integrating scientific and technical information and bibliographic work with the different stages of increased scientific research and experimental work. The recommendations of the conference encouraged several active groups to give systematic thought to deeper analysis in indexing and to experiment with machine methods for the rapid retrieval of a larger volume of scientific and technical information.

The growing volume of scientific literature in a variety of formats, the increased acceptance of the newer communication channel in the form of technical reports, research memoranda, the deeper insight into the several indexing methods, and the technological developments for automated information storage and retrieval since the 1950's further amplified the fact that special librarians needed a co-

15. Trends in Research and Development

As stated in an earlier chapter, after the Royal Society Conference on Scientific Information in 1948, several active groups of librarians and scientists began to give systematic thought to deeper analysis in indexing methods and to experimentation with data processing equipment for bibliographic control of the increased volume of literature in a variety of formats. This was long before the education on newer information retrieval systems could be formalized. In earlier years, in the absence of adequate financial support and facilities, research and experimentation on information retrieval remained mostly at the individual level and outside the universities. This situation, however, quickly changed after the establishment of the National Science Foundation (NSF) in 1950.

From the beginning, the National Science Foundation recognized the need for improvement of science information systems. Early in its history it began to support research on the process of information and document handling, on improved methods of abstracting and indexing, on use of mechanical and electronic data processing equipment for information retrieval, on methods for speeding up the publication of the results of research and for fostering the translation of foreign scientific documents.

To coordinate research and developmental activities in information science and to disseminate the research results, the NSF in November, 1958, published the first of a series of pamphlets on the scientific information activities of federal agencies. And, in order to communicate national and international developments in scientific and technical information retrieval, the Foundation began issuing a bimonthly publication, Science Information News, in February, 1959. This later became Scientific Information Notes. Current Research and Development in Scientific Documentation and Non-conventional Scientific and Technical Information Systems in Current Use are two NSF publications which record statements of research activities in scientific

Appendix

1 Libraries and Technical Information Centers in Industry
.1 Bell Laboratories, Technical Information Libraries
.2 ESSO, Technical Information Division
.3 SK&F, Science Information Division
.4 LMSC, Technical Information Center
.5 IBM, ASDD, Research Library
.6 IBM, TJWRC, Research Library
.7 IBM, Technical Information Retrieval Center

2 Technical Information Centers under Federal Agencies
.1 NASA, Scientific and Technical Information Systems
.2 NLM, MEDLARS Information Systems Division

3 Technical Information Centers under Private Agency
.1 Institute for Scientific Information

4 Special Libraries
.1 Library, School of Medicine, Washington University
.2 John Crerar Library

5 Developmental Projects
.1 Library of Congress, Automation Program
.2 Library of Congress, National Referral Center
.3 MIT, Technical Information Project (TIP)
.4 MIT Project: INTREX

Bell Telephone Laboratories
Technical Information Libraries

Bell Laboratories has the largest industrial research library in the United States. The library system embraces a network of 19 library units, in ten states, serving more than 5,000 scientists, engineers, and technicians engaged in the Company's research and development activities. Though each library is oriented to meet the special needs of that particular center, acquisition, cataloging, publication, translation, technical reports, and systems studies are centralized to provide the same standards of service and integrated library facilities.

The total book resources of six of the major library units have been integrated in a union card catalog system. A computer-generated printed catalog is being developed to extend this facility to all Bell Laboratory facilities. The library system is provided with computer-produced catalogs and indexes to journal holdings, company reports, computer programs, translations, and other information.

All the libraries and library users have access to CORNET, the corporate network linking Bell Laboratories locations together, as well as to the American Telephone and Telegraph Company and to Western Electric Company. The larger libraries are equipped with a Telereference facility which is a message recording system available to any employee at any time from anywhere.

A system that links the three largest libraries--at Murray Hill, Holmdel, and Whippany, New Jersey--to an on-line, real-time computer, services over 400,000 transactions a year in these three libraries. It handles library loans, reservation of materials and inquiries.

A group of system analysts and programmers are working in the Bell Laboratories Library to design and implement new information handling techniques and services with computer-aided systems. The intellectual part of the documentation activities is handled by

senior scientists who are working on the Library staff as information scientists and literature analysts. This group handles more difficult information requests, prepares comprehensive and critical literature searches on demand, compiles bibliographies, and carries on continuing reviews of the literature on subject areas in which the Company is interested. Several foreign language experts are also attached to the Library to translate documents from other languages. The translators provided more than 7,000 pages of translations of technical documents in 1966. The photoduplicating service copied 170,000 articles and technical reports in 1966 to meet the researchers' needs.

To disseminate the current technical literature, eight announcement bulletins are regularly issued by the Technical Information Libraries. Three of them are computer-printed and indexed and several others are in the process of being transferred to a computer base. The Library Bulletin announces new books, journals, and other reading materials and also lists TIL translations and bibliographies. The scope of some of the other bulletins is wide and general in nature but some are on specific subjects. The bulletins cover computer programs, published literature on the physical sciences, biological sciences, management literature, and government documents both unclassified and classified. Bell Laboratories' internal scientific and technical communications are covered in Technical Memoranda Index and Bell Laboratories Talks and Papers. These bulletins announced over 83,000 items in 1966. Six other bibliographical publications are issued by the Technical Information Libraries at irregular intervals or prepared on specific requests. The Technical Reports Center at the Whippany Library is the clearing house for technical documents. The Center organizes, announces, and distributes the technical reports collected from government agencies, military organizations, and other sources.

Another computer-aided alerting service, the MERCURY system, has been developed for the dissemination of internal technical documents to the Bell Laboratories' scientists and engineers. This mechanism has systematized the distribution of papers among those who have expressed an interest in receiving papers on specified sub-

jects, or projects, or by specified authors or departments. The MERCURY thesaurus is a hierarchically structured subject vocabulary especially designed for the purpose, and the matching of the document against the researcher's profile is done by computer. The computer generates the distribution list and printed labels for mailing the document and prints an explanation to tell the recipient why he is receiving that document.

In Bell Technical Information Libraries about 200 different library operations and services have been automated. These include permutation and citation indexing; the production of bibliographies, catalogs and announcement bulletins; inventory control; request processing; statistics gathering and analysis; the selective dissemination of information; the developing real-time loan and reservation system, etc.

The Bell Laboratories Library is in the process of developing an integrated system, named BELLMATIC, to provide (a) computer editing and production of announcement bulletins, (b) a personalized alerting service and (c) a wide range of logical search and retrieval operations. The primary input to the system will be up to 30,000 current technical papers scanned from selected journals and deeply indexed using a technical thesaurus developed to reflect Bell Laboratories' technical interests. The input mechanism is a typewriter coupled to an incremental tape recorder. The personalized alerting service will be coordinated with the announcement bulletin wherein the subject interests of the participants are to be matched against the descriptor sets for each announced item in order to direct the user's attention to items of interest to him.

Bibliographical References

1 Kennedy, R. A. Information handling and use at Bell Telephone Laboratories (Talk presented at the American Book Publishers Council, Conference on Information Science and Technology, New York, March 15, 1967).

2 Bell Telephone Laboratories. Description of MERCURY including the new psychology section of thesaurus (MERCURY Bulletin No. 2, January 15, 1967).

ESSO Research and Engineering Company, Linden, N. J.
Technical Information Division

The Technical Information Division (TID) of ESSO Research and Engineering Company is responsibile for organizing the flow of information into and within the Company and among its affiliates. To discharge its functions the TID is staffed with information scientists or information researchers, as they are called, who are qualified and competent as scientific people in other research divisions. These information researchers have the primary responsibility of seeing that all pertinent information, both current and past, from all available sources should not only reach the researcher's desk promptly but should also be analyzed and synthesized for convenient use. The information researchers, or other members of the group having special knowledge of information handling and literature searches, also guide the individual research scientists in making their own searches as required.

The functions of the Technical Information Division have been grouped under four major heads: Information acquisition, Information analysis, Information dissemination, and Information system research. The Company's technical library, which was established in 1919, is now part of the Technical Information Division. The library has over 50,000 volumes of books and bound periodicals, over 70,000 patents from the United States and other countries, and a large volume of published reports and preprints. The library also subscribes to about 600 technical journals. It is responsible for the acquisition, storage, technical processing, and dissemination of published literature to support the research activities of over 2,000 scientists and engineers engaged in research at ESSO and its affiliates. A separate Reports Collection Unit stores, indexes, and retrieves the Company generated research and engineering reports and memoranda.

The TID-generated technical abstracts bulletins, technical reports indexes and other bibliographic publications are prepared and

edited by the information researchers.

In the petroleum industry there is a heavy dependence on the API Central Abstracting and Indexing Services which publishes the weekly API Abstracts of Refining Literature and API Abstracts of Refining Patents, covering the basic current literature and patents of Company interest on crudes and related raw materials, petroleum products and processes, chemical products and processes, highpolymer products and processes, specialty products, catalysts, analyses and tests, engineering, corrosion, pollution problems, safety and contributing sciences. The API also provides computer-based indexes to API literature and patent abstracts in the form of an alphabetical subject index, a dual-dictionary coordinate index, and computer search tapes for bibliographic control of petroleum literature. However, the Technical Information Division found it necessary to issue ESSO Technical Abstracts, a monthly bulletin, to supplement these API bulletins by covering additional journals, preprints, patents, and government reports in the petroleum and related areas. Another TID bulletin (semi-monthly) deals with EREC library acquistions and new company papers.

The Technical Information Division also publishes several sponsored abstracts bulletins which include the Transportation and Storage Bulletin (monthly), Iron and Steel Manufacturing Bulletin (monthly), Agricultural Chemicals (monthly) and Synthetic Fuels (monthly). The distribution of these bulletins is limited to the specialists who are engaged in research in these areas.

The monthly Technical Reports Index with a semi-annual cumulative index is the key to Company and affiliate reports that contain data from research and development programs in the fields of petroleum and chemical processes, products, and engineering. Each index contains a list of reports, an author index, and an alphabetical subject index.

The Technical Information Division computerized the information on research and engineering reports and memoranda generated in the Company in 1962 and the index to the literature and patents abstracted by the TID in 1964. The input cost of the Technical Reports Index with 30 indexing terms per document is $20.00 and the

input cost of the abstract literature with 8 indexing terms per document is $3.00 ($18.00 including abstracting costs). The computer systems have also been used by the Library for journal ordering and routing. The equipment used are the Flexowriter punched tape-to-card converter and the IBM 7094 and IBM 1401 computers.

Eight years ago, at the Fifth World Petroleum Congress, W. T. Knox, then Director of the ESSO Technical Information Division, described the functions and activities of the information-research scientists and engineers in the ESSO Research and Engineering Company and concluded with the following words:

> Information-research activities have already demonstrated large returns, by virtue of stimulating closer attention to the published information, by uncovering valuable leads to new processes and products by developing new techniques for handling information, and by providing well-rounded, complete surveys of pertinent research areas. The excellent results thus far obtained through the use of information research scientists and engineers would appear to make this new technique worthy of serious consideration by all members of the petroleum industry.[1]

Bibliographical References

1 Cloud, G. H. and Knox, W. T. "Information Research: a new tool for the petroleum industry" (Paper presented at the Fifth World Petroleum Congress, 1959).

Smith, Kline and French Laboratories, Philadelphia
Science Information Department

At the Smith, Kline and French Laboratories (SK&F) the handling of all scientific information is centralized in the Science Information Department, which reports to the R & D Division.

The Documentation Section of the Science Information Department handles the acquisition, storage, dissemination, and retrieval of the scientific literature. The other sections of the Department are the Biomedical Sciences, Physical Sciences, Statistical, and Product Surveillance Sections. Senior information scientists who are high level specialists in various subject disciplines, having almost the same order of scientific recognition as the laboratory and clinical scientists, are attached to these sections. These people join the research and development teams and shoulder the responsibility for critical evaluation and the creative use of information in furthering the teams' scientific activities. All the technical information, including experimental and clinical data accumulated on a project, is digested by information scientists in the research team in order to be communicated to, and interpreted for, other members of the team. In the Statistics Section of the Science Information Department, statisticians apply statistical techniques to research and development problems and guide the bench scientists in designing laboratory tests and clinical trials. They also help in evaluating test results. SK&F is the only company of its kind to centralize all biostatistical operations in the information group.

The Library, which is a unit under the Documentation Section, handles the acquisition and processing of books, journals, and other published material. It is also charged with responsibility for systematization and storage of the departmental files of the company.

A group of junior scientists with experience in information handling scan the current literature received in the Library for information pertaining to current research and development projects in

which SK&F scientists are engaged. The material of specific interest to a research team is immediately passed on to the appropriate science section of the Science Information Department and the senior information scientist working in the group passes it on to the team members.

For communication of the current scientific literature of more general interest to the scientific community of the company, junior information scientists attached to the Documentation Section abstract and index such literature and it is issued in the Weekly Literature Information Bulletin for distribution throughout the company. The staff of the Documentation Section also makes retrospective literature searches on demand.

The Documentation Section is also responsible for the collection, analysis, and storage of the large volume of unpublished internal technical reports and clinical data generated in the company. The information in these reports and data files is coded and transferred to punched cards, or, in some cases, to computer tapes for quick machine scanning. Mechanization is limited to the handling of internally generated data and data from case reports submitted by investigators working with new drugs.

The punched card equipment is located in the Science Information Department and is used by its data processing group. The computer tapes are searched on the company's central computer.

The Science Information Department of SK&F has organized its information facilities so that it can play a vital role in planning and implementation of research and development work. It contributes at each stage of the research and development process by manipulating, interpreting and evaluating the needed information. The degree to which the senior information scientists participate in such functions is one of the outstanding features of the SK&F organization. The Science Information Department has access to a complete range of IBM data processing equipment, such as key punch, verifier, reproducing punch, card providing machine, IBM 407 accounting machine, and the IBM 101 electronic statistical machine, as well as the IBM 1401, IBM 1410, and LPC-30 computers.

Bibliographical References

1 Rockwell, Harriet E. Information for Research and Development (Science Information Department, Smith, Kline and French Laboratories, 1961).

Lockheed Missiles & Space Company, Sunnyvale, California
Technical Information Center

The library resources of the Technical Information Center of the LMSC, the largest in the aerospace industry, are organized into reports, books, and periodical collections to meet the research needs of approximately 11,050 scientists, engineers, and administrative personnel of the organization.

In the collection of reports, which forms the critical and vital source of scientific and technical information, there are over 400,000 technical reports, either generated by LMSC or by outside agencies, both governmental and private. These are in original form as well as in Defense Documentation Center (DDC) reproductions and NASA microfiches. The collection is growing at the rate of 60,000 items per year.

Complete collections of Department of Defense (DoD) generated or funded research reports in microfiche format, AEC-sponsored unclassified technical reports, and NASA unclassified reports, are available in neighboring libraries under certain conditions.

Literature searching:

The scientists, engineers, and other research personnel at LMSC do not normally involve themselves in literature searches, since these searches, can be done more economically and efficiently by the information specialists attached to the TIC. These information specialists, or literature searchers, as they are called, all have extensive experience in literature search techniques as well as in screening, reviewing, and synthesizing pertinent literature. The requesting scientist or engineer is provided with abstracts on standard 5 x 8 inch cards, with each citation giving enough information for the reader to determine whether he needs to read the full item. At the end of the search, the information specialist indexes the compiled abstracts and prepares an annotated bibliography for publication. These published bibliographies are sent to all Lockheed Technical Information Centers and are also distributed to major federal documentation

centers. More than 500 annotated and indexed subject bibliographies have so far been generated by the TIC literature search personnel in direct support of research, development, and other specialized efforts of LMSC.

Information Retrieval

A system for applying computer operations to various information services is being developed at the LMSC Technical Information Center. The Machine Application to Technical Information Center Operations (MATICO) has been planned for implementation in stages; it will implement such advanced information retrieval concepts as selective dissemination of information, autoabstracting, and automatic literature search. During the past two years, a system has been developed for preparing catalog cards and a Key-Word-in-Context (KWIC) index to technical reports. In this phase of the operation, the titles of new publications are also generated on a separate tape that produces the Key-Word-in-Title listing. The MATICO system is compatible with those of NASA and other governmental information centers using magnetic tape for storage and retrieval. An on-line information retrieval system with a dialogue capability to assure accurate and rapid response to the question asked is under development.

Library Catalog in Microform

The computer-produced library catalog has 1,600,000 retrieval points to provide multiple access for quick identification of resources in the collection and for rapid dissemination and retrieval. It is the first of its kind in the United States. The catalog is arranged in six sections: source, title, author(s), contract number, subjects, and report numbers/call number. It is reproduced on 16 mm microfilm form, which compresses these 1.6 million retrieval points into 40 cartridges. Each cartridge contains 100 ft of film bearing 1,800 two-column pages of computerized catalog text produced by the SC 4020.

A complete, cumulated, and corrected microfilm catalog is produced quarterly. Computer processing time together with duplicate microfilm processing, label generation, cartridge loading, and distribution to the operating location takes ten work days.

Between periodic microfilm catalog production runs, users are kept informed of titles added to the collections by New Reports & Books, which is produced semi-monthly by a computer in KWIC format.

To minimize the queuing problems due to multiple simultaneous use of the catalog, multiple microfilm readers and catalog cartridges have been installed for library users. In addition, the cataloging staff in the library has two sets of microfilm cartridges and two readers and the literature searchers have been provided with one set of cartridges and one reader for independent use. The microfilm catalog is reported to be less costly than a computer-produced card catalog or a computer-produced book catalog.

The new microfilm catalog has been accepted both by the scientists and the library staff, including literature searchers attached to LMSC, as the system has demonstrated that it has reduced look-up time and is easy to operate. According to TIC, the microfilm system gives an annual net saving of $13,000 because (1) card filling costs are eliminated; (2) the cost of catalog cases is eliminated; and (3) there is a great saving in the space that would be required for a card catalog.

An additional advantage of the computer-produced microfilm catalog is that the printed book catalog could be produced at a much lower cost by using the microfilm master as the printing base. W. A. Kozumplik, in his article, "Computer-produced Microfilm Library Catalog,"[1] has worked out the comparative cost of the book catalog using the microfilm master and the copyflow process and using the computer printout and multilith. He estimated that the use of the microfilm catalog as the printing base would lower the printing costs of the book catalog by two-thirds.

The data processing and other equipment used at the LMSC Technical Information Center are the IBM 826, the IBM 7094, the Stromberg-Carlson 4020, the IBM 360/30, the IBM 360/50 and the Bell and Howell reader printer model 531.

Bibliographical References

1 Kozumplik, W. A. and Lange, R. T. "Computer-produced Microfilm Library Catalog" (American Documentation 18(2):67-80, April, 1967).

2 Lockheed Missiles and Space Company. Pamphlets on the Technical Information Center, and literature search.

IBM Advanced Systems Development Division, Los Gatos, California
Research Library

The small Research Library of the IBM Advanced Systems Development Division (ASDD) adds about 1,500 books and 3,000 reports annually to its collection, subscribing to approximately 650 current journals and servicing between 500 and 600 specialists attached to ASDD.

Through the efforts of the Librarian, Miss M. Griffin, all the major operations in the Library have been automated, using the computer configuration available at this research center. It is used for the processes involved in order work, preparation of the book for circulation, including the book label, circulation cards, catalog and other inventory for bibliographic control and dissemination. It is also used for serials control, including subscription, registration, routing, bindery information, and circulation. According to Miss Griffin, the computerized library system has reduced the amount of time required for acquisition and processing, has minimized errors in recording, has provided computer assistance in indexing, has brought about faster retrieval of information, and in general has brought the Library closer to the readers. This totally automated library system is based on the IBM Administrative Terminal System (ATS) and is typewriter-linked to an IBM 1460 data processing system for bibliographic input, an IBM 7090 computer for processing and sorting, and an IBM 1401 computer for output. The computer time allotted for library operations is about 30 minutes each working day. The reason for using such a variety of systems is that all this equipment is available at ASDD.

The Library is engaged in developing systems on an IBM 360 for real-time bibliographic searching, using an IBM 2260 display station in which the user will enter his request in natural language, and is also developing systems for batch searching for comprehensive bibliographies. All the record keeping now being processed on a variety

of data processing systems will be converted to the IBM 360 when it is in operation.

The system design and the mechanized operations in the Library have been detailed in a manual[1] to serve as a helpful guide to other librarians.

Bibliographical References

1 International Business Machines Mechanized Library Procedures for the IBM Advanced Systems Development Division Library, Los Gatos, California (International Business Machines Corp., 1967).

IBM, Thomas J. Watson Research Center, Yorktown Heights, New York
Research Library

This Research Library has a collection of about 25, 000 books, 15, 000 volumes of bound journals, and subscribes to 1, 000 current journals. It serves approximately 1, 100 research scientists and technologists attached to this IBM Center.

The Library started the mechanization of some of its routine operations in 1962 based on a single-card record keeping system for its book collection. The punched card record initiated at the time of acquisition is subsequently verified and modified when the item is in the process of being cataloged. This unit record on a punched card is manipulated by tabulating card machines or by an IBM 1401 computer to produce a processing information list (PIL), [1] the circulation charge card, the book pocket label, the shelflist printout, and a main entry index to the shelflist.

In the circulation control system, the circulation charge card, which is a by-product of the computer-based shelflist card, is used to produce basic loan records-- a record of all books on loan arranged by author, a record of all books on loan arranged by borrower, as well as overdue and recall notices. The records are updated once a week using the computer, and a high speed 1403 printer is used to print the overdue notices at the rate of 600 lines per minute.

For serials control, the automated unit card record is manipulated to provide subscription, binding and printed lists of holdings.

The Library uses punched card data processing machines (Sorter, Tabulator, Collator) and the IBM 1401 computer. The computer is used approximately 3 1/2 hours per week for library operations. According to G. E. Randall, Manager of the Research Library, the use of machines in library operations has considerably increased the accuracy of library records. Thus, library service is more efficient and, at the same time, costs are kept down.

Bibliographical References

1 Randall, G. E. and Bristol, R. P. "PIL (Processing Information List) or A Computer-controlled Processing Record" (Special Libraries, February, 1964, p. 82-86).

2 Randall, G. E. and Gibson, R. W. "Circulation Control by Computer" (Special Libraries, July-August, 1963, p. 333-338).

3 Randall, G. E. "Unit Record System for Serial Control in a Special Library" (IBM Library Mechanization Symposium. Endicott, N. Y., May 25-27, 1964).

IBM Technical Information Retrieval Center

The IBM Technical Information Retrieval Center (ITIRC) located at Yorktown Heights, N. Y., has been operating since 1964 as the central information retrieval and dissemination center for the IBM community all over the world. The ITIRC system is closely linked to more than 40 IBM libraries and over 75 percent of the users of the Current Information Selection Service (CIS) have access to one or more of these libraries. Teleprocessing techniques have been used to link these libraries and make the information retrieval service as effective and current as possible.

At ITIRC, besides literature searching both current and retrospective document announcement bulletins, and micro-processing, one of the major activities of the Center is the current awareness system known as Current Information Selection (CIS) service.

IBM developed the normal text information retrieval system as a result of several years of research and experimentation. The ITIRC implemented this sophisticated system with a successful CIS to disseminate scientific information to approximately 2, 400 IBM scientists and engineers within and outside the United States.

In the information transfer operations, an abstract of 200 to 300 words, all relevant bibliographic data (which include author, title, publishing source, and source codes), and assigned subject index terms of all the documents analyzed in the Center are reproduced in normal text, in upper and lower case format, on magnetic tape. The thesaurus for assigning subject terms contains 8, 000 major entries and 20, 000 to 30, 000 cross-references.

The user profiles and search questions, which are usually

phrased by the scientists in normal English, are converted to machine-readable form by the information specialists in the Center, using the appropriate contextual logic with the necessary words and phrases. In the search system up to 100 retrospective questions are searched in six minutes per tape using the IBM 7090 computer, which prints out the answer. A report is mailed to the requester with an evaluation response card.

In the Current Information Selection service, the individual profiles are matched four times a month against data on current literature which covers IBM documents, IBM invention disclosures, non-IBM documents, and current journals. The abstracts that match the profiles are printed out and promptly mailed to the individuals with an evaluation response card for information and use.

The CIS users normally obtain the IBM reports in which they are interested from their local IBM Library. On request, the ITIRC also provides, in microfiche copies or hard copies, documents which are not covered by copyright.

Between 1,500 and 2,000 new documents are put into the ITIRC information system each month. In 1966 over 500,000 abstracts were sent out to an average of 1,400 users. The input was 12,500 documents. The average user received abstracts of 3 percent of the total documents recorded and announced during the year. The users rated 83 percent of the notifications as relevant to their interest. The database tape is also used for printing special bulletins and library tools (circulation control cards, cumulative indexes, and source code lists) for use in the IBM Technical Libraries in the United States and Europe. ITIRC initially used IBM 7090-1401 computers for information handling. Recently the system has been reprogrammed in the IBM 360 computer, which provides remote inquiry and real-time capabilities. The information specialists and data-processing technicians in the Center are actively engaged in research on hardware and software to improve the systems, using the latest developments in computer technology.

Bibliographical References

1 Magnino, Joseph J. IBM Technical Information Center Retrieval: Progress and plans (Report submitted at the Annual Convention of the American Documentation Institute, October, 1966).

2 Nelson, Paul J. User Profiling for Normal Text Retrieval (paper submitted at the Annual Convention of the American Documentation Institute, October, 1967).

National Aeronautics and Space Administration
Scientific and Technical Information System

The National Aeronautics and Space Administration (NASA) is charged with the responsibility for providing comprehensive bibliographical services covering world literature on aerospace science, by a Federal Act of July, 1958. The information services of NASA are handled by two establishments: (1) NASA Scientific and Technical Information Facility, managed by Documentation Incorporated, a private organization which has been operating under the direction of NASA's Scientific and Technical Information Division since 1962 on contract basis; and (2) the American Institute of Aeronautics and Astronautics (AIAA) whose services have been partly supported by NASA since 1963. These two organizations work in very close collaboration but the areas of work do not overlap.

The NASA Scientific and Technical Information Facility acquires and analyzes the domestic and foreign technical reports and memoranda covering aerospace subjects and prepares two semi-monthly abstracting journals--Scientific and Technical Aerospace Reports (STAR) and CSTAR in which classified or restricted reports are announced. The American Institute of Aeronautics and Astronautics (AIAA) processes the published journal literature on the subject and prepares a third semi-monthly abstracting journal, International Aerospace Abstracts (IAA). The abstracts and indexing worksheets of IAA are sent on to NASA, so that thereafter all processing can be monitored by the same facilities and equipment. The two complementary journals--STAR and IAA, published on alternate weeks, provide comprehensive access to the world's current literature on aerospace science, and technology. STAR contains over 30,000 abstracts of technical reports, memoranda, etc., per year, and the IAA lists over 20,000 abstracts of printed journal literature annually.

The abstracts are mostly informative and are normally limited to 150 words.

When author abstracts or abstracts generated at other centers are not readily available, abstracts are prepared by subject specialists.

STAR and IAA both use the same 34 subject categories. These cover 8 disciplines, 18 different areas of engineering, and 2 interdisciplinary subjects. The categories were developed after thorough analysis of the subjects by STAR and IAA, in consultation with the subject specialists.

A new technique developed in STAR and IAA is the use of an expanded title, called "Notation of Content," containing several words consistent with the system's indexing vocabulary. The Notation of Content is used to feed the computer indexing process, known as SWIFT (Selected Word in Full Title), to give more dependable access than an index derived from the uncontrolled original title.

For efficient retrieval, both the publications STAR and IAA are provided with all possible indexes: (1) subject, (2) corporate author or source, (3) personal author, (4) contract number--in cumulative indexes only, (5) report/accession number, and (6) accession/report number. In IAA, which deals with printed literature, the same indexes are provided except that a simple accession number index is used in place of the accession/report number and report/accession number indexes, and the corporate author and contract number indexes are omitted.

In the printed publications, the indexes are composite terms, phrases, or pre-coordinated terms rather than single words or uniterms. On an average, five such terms are assigned to each title. The indexer also assigns a number of indexing terms that are single words, unbound terms, or uniterms, which do not appear in the published index. These terms, called "machine terms," are stored on NASA's magnetic tapes with other descriptive catalog information for machine retrieval in depth. On an average, fifteen such terms are developed for each document. The vocabulary used for subject indexing, both for published and machine terms, and the cross-references used in STAR cumulative indexes, are directly monitored by the Information Division. STAR uses approximately 18,000 separate subject terms for indexing.

STAR, besides being used as a bibliographic tool for current awareness and search, is helpful for retrospective searching and for prompt issuance of the cumulative indexes. The cumulative indexes are prepared and distributed, with a time lag of two to three weeks, at the end of each quarter.

The NASA also publishes special and continuing bibliographies in areas of special interest to provide for more extensive retrospective searches in these areas. Approximately 500 bibliographies and literature searches are prepared annually. These bibliographies are periodically updated by supplements.

In addition to STAR, and a classified series of STAR, the NASA Facility issues six other publications: (1) Technical Report, (2) Technical Notes, (3) Technical Memorandums, (4) Contractor Reports, (5) Technical Translations, and (6) Special Publications. NASA also puts out four publications which report on technical innovations that may interest industries and technologists. These are: (1) Tech Briefs, (2) Technology Utilization Notes, (3) Technology Utilization Reports, and (4) Technology Survey.

NASA is one of the first organizations in the United States to use microfiche for the storage and dissemination of technical literature. The microcopying system provides microfiche copies of each document abstracted and announced in STAR as well as for the documents in IAA which are not limited by copyright. Microfiche copies of report literature are regularly distributed to approximately 4,000 recipients in NASA research centers and contractor organizations, to 200 universities and large public libraries, to 550 foreign government agencies and institutions, and to 5,000 industrial establishments.

The bibliographic information generated at the NASA Scientific and Technical Information Facility and the American Institute of Aeronautics and Astronautics, stored on magnetic tapes, constitutes a comprehensive, updated, and readily accessible data base to provide a variety of information services, including cumulative indexes, retrospective searches, and the Selective Dissemination of Information (SDI) programs. Over 1,000 scientists and technologists in the various NASA laboratories subscribe to the SDI Service. The returns from the SDI recipients are systematically analyzed and evaluated to

find the effectiveness of the individual profile and the degree of matching obtained in such service.

The computer system operating at the NASA Facility consists of the IBM 1410 linear file search system and the IBM 1401 model II computer. The linear search system improved the capability to produce bibliographies and compilations of file data of all sorts. Photon and GRACE (Graphic Arts Composition Equipment) are used for composition of the printed bibliographies and other publications. Besides the computer printouts, the NASA Facility distributes magnetic tapes containing bibliographic data, together with the computer programs, to serve as the basic data input to several independent systems. About 30 organizations, which include all NASA research centers, a number of major NASA contractors, and several universities, use the NASA data base tapes to organize decentralized services. The tapes are updated twice each month. The search system and the bibliographic services provided by NASA are under continuous evaluation to guide further improvement of the service.

NASA provides one of the most dynamic information handling agencies of the federal government. The information scientists attached to the Facility are continually researching on information transfer problems with the aim of improving services.

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1 Brandhorst, W. T. and Eckert, F. "NASA Search System Analysis Sheet" (American Documentation 16(2):124-126, April, 1965).

2 Eckert, P. F. Development and Operation of Machine Search Systems at NASA's Scientific and Technical Information Facility, Presented at the 150th meeting of the American Chemical Society, Division of Chemical Literature, Atlantic City, N. J., September, 1965.

3 Brandhorst, W. T. and Eckert, P. F. The Guide to the Processing, Storage and Retrieval of Bibliographic Information at the NASA Scientific and Technical Information Facility. National Aeronautics and Space Administration, (NASA, CR-62033), July, 1966.

4 SLA Government Information Service Committee "Users Look at Information Centers" (Special Libraries 57(1):45-49, January, 1966).

National Library of Medicine
MEDLARS Information Systems Division

The National Library of Medicine (NLM) originated in 1836 as the Library of the Surgeon General's Office, United States Army. This library, now one of the three national libraries of the United States, is probably the largest medical library in the world. Since 1879, the library has published comprehensive subject indexes to disseminate literature on the biomedical sciences to medical scientists and practitioners engaged in research and investigation.

To handle the ever increasing literature output and to speed up the indexing and processing of bibliographic information, NLM developed a plan for a computer-based information storage and retrieval system called MEDLARS (Medical Literature Analysis and Retrieval System) in 1961. It took three years of work on the system design, study of work flow, computer programming, system testing and other preliminaries before the MEDLARS system could be fully commissioned in January, 1964, to function as a national biomedical information system. The MEDLARS tape file contains citations to biomedical journal articles published since that date (January, 1964). Dr. Cummings, Director of the National Library of Medicine, at a seminar on Electronic Information Handling held at Pittsburg University in 1963, stated the objectives of MEDLARS as follows:

> First, the rapid dissemination of lists of current publications in the medical field, including the monthly publication, Index Medicus, and other regular recurring bibliographies in more specialized areas such as cancer and heart disease. Second, the bibliographic control of the medical periodical literature available for rapid retrieval in response to subject-oriented queries of our computer files. We call such searches demand bibliographies. Third, the wide availability of the MEDLARS data base to other libraries and research institutions which may duplicate the retrieval capacity of this system and make more specialized use of the contents of the file within their own research programs.

MEDLARS is the only library-based computerized system now in operation for the retrieval of references to published biomedical liter-

ature. To fulfill its objectives, the system operates in three major subdivisions: an input subsystem, a retrieval subsystem, and a publication subsystem.

In the input subsystem, professional librarians and literature analysts with strong subject backgrounds scan the medical periodicals, analyze the subject content of each article, and assign appropriate subject headings to it from the Library's controlled vocabulary "Medical Subject Headings" (MeSH) which lists approximately 6,400 terms. On an average, eight subject headings are assigned to each article for printing in Index Medicus. Up to thirty-two additional subject headings are assigned for storage on the computer system for searches in depth. The bibliographic details and the descriptors assigned to each article are punched on paper tape by Flexowriters, then edited and transferred to magnetic tape for incorporation into the "Processed Citation" and "Compressed Citation" data files. The Processed Citation File contains citations for publishing Index Medicus and other recurring bibliographies issued as serial publications. The Compressed Citation File contains citations in depth needed for retrieval of answers to complex reference questions and for compilation of demand bibliographies on highly specific subjects. Currently, 180,000 articles from 2,400 medical journals are processed annually and stored in the computer system; this number is expected to rise to 250,000 articles from 3,000 current journals by 1969. Language experts provide English translations of foreign articles, which are written in 40 different languages and cover a high percentage of the significant literature.

In the retrieval subsystem the search specialists, having extensive training both in indexing and in the logic of computer searching, analyze the requests for bibliographic citations, detail the relevant search elements, and formulate search statements intelligible to the computer system. Formulated search requests are punched into paper tape, edited, and batched for computer processing. The retrieved citations are recorded on magnetic tape and are then printed out in natural language. Demand bibliographies are normally printed on the computer's high speed printer.

In the publication subsystem Index Medicus, Bibliography of

Medical Reviews, and similar recurring bibliographies, are processed for printing from photopositive film. The Honeywell computer-produced magnetic tapes of the Processed Citation File are used for preparation of repro film by a computer driven typesetter, GRACE (Graphic Art Composing Equipment). GRACE converts digital information from the magnetic tape to high quality typography and operates at a speed of about 300 characters per second. It provides 226 different characters, and can produce 23 cm wide positive photographic film or paper. The film masters are used for plate-making, printing, and publication. With the use of GRACE the composing time of each issue of Index Medicus has been reduced from 25 days to 16 hours.

Besides Index Medicus and Bibliography of Medical Reviews, published by the National Library of Medicine, a number of other bibliographic periodicals are issued for the benefit of different institutions using MEDLARS tape. Cerebro-Vascular Bibliography, published for the National Institute of Neurological Diseases and Blindness and the National Heart Institute; Index to Rheumatology, for the American Rheumatism Association, and; Index to Dental Literature, produced for the American Dental Association and the National Institute of Dental Research, are some of these publications.

With a view to decentralizing the MEDLARS search and retrieval capability for wider and more prompt dissemination of medical literature, the National Library of Medicine is making duplicate tapes available to several other libraries for use on local computer configurations. The tapes are updated periodically from the MEDLARS master tapes. The Biomedical Library of the University of California (Los Angeles), the University of Colorado Medical Center (Denver), the University of Alabama Medical Center (Birmingham), the University of Michigan (Ann Arbor), and Harvard University (Boston) are operating as MEDLARS decentralized search centers.

Requests for sharing the MEDLARS' searching capabilities have already been received from more than forty university medical centers, government agencies, and private organizations and the Library is attempting to develop a regional network of MEDLARS Centers to provide rapid access to the world's biomedical literature.

To improve the analysis, indexing, and exhaustive search of in-

creasing biomedical literature, the specialists in medical literature and indexing methods are continually formulating and revising subject headings. A group of highly qualified scientists is working to develop research-oriented descriptors to meet the growing interdisciplinary needs in medical research. This controlled vocabulary, "Medical Subject Headings," is not only the key to the retrieval of information for recurring and demand bibliographies of the National Library of Medicine, but can also be used as subject headings for cataloging books and other printed literature in this library as well as in several other medical libraries.

A team of system specialists is engaged in research to improve the MEDLARS System, using more sophisticated hardware and software, and is also trying to develop systems to mechanize some of the routine operations in the Library, such as acquisition, cataloging, and serials record. The cataloging service will eventually produce catalog cards for use by other libraries and will issue printed book catalogs each year and a cumulated catalog every five years. Projects are also in hand to study the feasibility of on-line indexing and citation output, development of drug information modules, and storage and retrieval of graphic images.

The MEDLARS system now uses Honeywell 800 and Honeywell H-200 computers, the Photon 900 typesetter, the computer-activated optical printer called GRACE (Graphic Arts Composing Equipment), Friden Flexowriters and IBM keypunches and verifiers.

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Institute for Scientific Information, Philadelphia

The Institute for Scientific Information (ISI), established in the late 1950's, is one of the largest information centers in the United States handling scientific information services on a commercial basis. A large number of information scientists with strong backgrounds in science subjects, librarians, system analysts, and data processing technicians are engaged in ISI's retrieval and dissemination activities. Over 1,600 important journals on science and technology are analyzed and processed to provide a number of computer-based literature searching services, plus weekly services of a simpler nature such as Current Contents, Chemical Sciences; Current Contents, Physical Sciences and Current Contents, Life Sciences. The Current Contents series has been well received by the scientific community and it is estimated that over 60,000 scientists use these media for current awareness.

The computer-based abstracting and indexing service Index Chemicus, begun in 1960, reports about 120,000 newly synthesized chemicals each year. It is estimated that more than 10,000 synthetic chemists, pharmacologists, and other scientists throughout the world use the weekly Index Chemicus for information on chemical literature.

The Science Citation Index, a comprehensive multi-disciplinary index to science, is a unique service developed at ISI. Dr. Eugene Garfield described the Citation Index as "an ordered list of cited articles each of which is accompanied by a list of citing articles. The citing article is identified by a source citation, the cited article by a reference citation. The index is arranged by reference citations."[1] The concept of citation indexing is the result of several years of research by Dr. Garfield and his associates at the center.

Another computer-generated bibliographical index provided by the ISI is Permuterm Subject Index, which is integrated with major ISI computer-based services, including the Science Citation Index. It is also integrated with the ISI Magnetic Tapes, the ISI Search Services,

and the ASCA III Services. The Permuterm Subject Index needs to be used in conjunction with Source Index, the companion volume of Science Citation Index. The 1966 Permutern Subject Index recorded approximately 250,000 articles, indexed under an average of 35 permuted pairs of terms, from 1,600 basic journals on science and technology. Since 1965, the ISI has been providing to individual scientists as a personal service, computer-based selective disseminations of information, which goes by the name of "Automatic Subject Citation Alert" (ASCA) and is also based on the citation indexing principle.

ISI also provides some of its services on subscribers' magnetic tapes. Several information centers attached to research establishments and industries find it more economical to request such comprehensive data on tapes and to run the tapes at local computer centers for more specific searches, listing, and selective dissemination purposes. On the ISI citation tapes approximately 64,000 cited references from nearly 5,400 current items are processed and delivered on subscribers' tapes at weekly intervals. In 1967, more than 3,000,000 references, cited by approximately 275,000 source items in 1,600 scientific periodicals, have been stored on magnetic tapes.

Another service on a yearly subscription basis is the "source tapes." Approximately 5,400 current items are transferred and delivered on subscribers' tapes at weekly intervals; complete files covering more than 775,000 source items from the scientific literature published from 1964 to 1966 are also available in annual cumulation.

ISI does not limit its service to the processed information; it provides copies of the articles on demand. To fulfill this responsibility ISI operates the Original Articles Tear Sheet Service (OATS), for which multiple copies of journals are procured and stored in ISI, to provide pages of the required article or articles on demand. This service ensures availability of specific literature without much trouble or delay and without photocopying.

The information scientists and technologists attached to ISI are actively engaged in continuing research on information handling problems and data processing in order to provide better and more economical services.

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Washington University School of Medicine Library

The Library of the School of Medicine, Washington University, St. Louis, under the able management of Dr. Estell Brodman and her associates, has gone through many changes during the last seven years to provide improved service to students, researchers in medical science, and the St. Louis medical community in general.

The Library has about 100,000 volumes, of which 60 percent are volumes of serials, and several thousand reprints and research reports. It receives over 1,500 current journals.

The quinquennial (1961/62 to 1965/66) review of the Library shows a 635 percent increase in the use of reading materials within the Library, a 112 percent increase in demand for interlibrary loans from other libraries, a 572 percent increase in literature searches, a 452 percent increase in the number of bibliographies compiled, and a 789 percent increase in the number of Xerox copies made, with only a 13.5 percent increase in staff. These data reflect not only the increased use of the Library, but also testify to the efficiency of the present operations. In the process of reorganization, the Library changed from the Dewey Decimal System to the National Library of Medicine classification scheme.

On the operational side, the Library changed from the manual record keeping to computers for circulation records, serial records, and acquisition and catalog records. The results of the Library's experiments on machine methods and the cost analysis, published in a series of articles in the Bulletin of the Medical Library Association from 1963 to 1966, provide useful data and serve as a guide for the automation of routine operations in small and medium-sized libraries.

The Library changed circulation control to machine methods, including computer-produced overdue notices and other listings. The Serials Section put all its records of periodical holdings onto punched

cards for conversion onto magnetic tapes. This single input on punched cards is manipulated in a variety of ways to produce PHILSOM (Periodical Holdings in the library of the School of Medicine), periodic announcement lists, a catalog updating PHILSOM, arranged under title and subject, and other records for administrative control of the serials.

As an experiment on machine methods, the Library prepared a computer-generated printed book catalog for books added to the Library during the first nine months of 1965. The catalog was produced on the IBM 1401-1403 and 7072 which were available at the computer center of Washington University. In the preface of the catalog, Dr. Brodman recorded two major findings on this experimental book catalog--one on the readers' reactions and another on the printing costs. She says:

> The scientists at this Medical Center have shown no desire to have a library catalog at their finger-tips, just as readers in the nineteenth century public and even scholarly libraries refused to purchase catalogs of those collections. The Washington University School of Medicine Library has provided free copies of its semi-annual cumulated serial holdings lists... to all departments of the Medical Center for almost 3 years now, and has offered (by signs on bulletin boards) free copies of these lists to any registered reader who has need of them. The response has been deafening by its silence, and the number of copies of these records we produce has therefore steadily diminished. We do not believe a book catalog will be any more desired by our readers.
>
> The printed catalog runs close to 300 pages, or would be close to 250 pages had we photo-reduced it the usual 40 percent. Just printing and binding it, once we had the offset masters produced by the computer, cost about $600 for 200 copies. Were we to print such a catalog each year at our present rate of growth, we would need to budget $800 yearly. But it is unthinkable that we should not wish to cumulate the list. This means that the second year our printed catalog would cost about $1,600, the third year $2,400 and so on in arithmetic progression for as long as we wish to cumulate.
>
> If, however, we printed our catalog annually, whether cumulated or not, we would need to have supplementary catalogs for material added since the publication of the last catalog--whereupon we would be back to the problems encountered by nineteenth century libraries issuing

book catalogs.

These findings may help small and medium-sized libraries to make decisions about computer-generated catalogs in printed form. The manipulation and updating of the catalog from a single input in the computer is claimed to be efficient and economical, but the printing of the book catalog from the computer-generated printouts is said to be expensive.

The Library reprogrammed the acquisitions-cataloging system to take advantage of the University's recently installed IBM 360/50 computer with upper and lower case print chain capability and decided to bring out another experimental printed catalog of books covering all additions to the Library from January, 1965 to February, 1967. The cost of computer time for the updating and manipulation of the catalog data from computer storage for preparation of this second catalog came to $230.00 and the cost of printing and binding came to $1,730.00. It has now been decided to generate the computer-based catalogs quarterly and cumulate them annually. The printing of the catalog in book form was to be determined by demand and costs.

In addition to routine operations, the Library, in 1964, introduced computer-based indexing of personal files, such as published and unpublished reports, and the data and correspondence of scientists. In September, 1965, the Library began a current awareness service for faculty members and researchers at the Medical Center, combining two kinds of information: (1) the results of scanning current literature received in the Library, and (2) information obtained in the weekly service ASCA (Automatic Subject Citation Alertness), received from the Institute of Scientific Information on a subscription basis.

The Library is now engaged in developing systems to use MEDLARS tape when it was made available by the National Library of Medicine.

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The John Crerar Library

The John Crerar Library, established in 1895, to serve the scientists and technologists throughout the United States was the only public library devoted exclusively to science and technology. In 1962, the Illinois Institute of Technology placed its library under the management of the Crerar Library when the Crerar Library moved to its new building on the campus of that institute. The library, now a combination public, academic, and special library, is considered one of the major scientific libraries in the world. The library collection of over one million volumes, includes 13,000 current periodicals, over 125,000 scientific translations from foreign languages collected as depository of the SLA Translation Center, and a large number of technical reports received as one of the Federal Regional Technical Reports Centers. It contains the basic resources to serve students, teachers, and researchers in scientific institutions and industrial establishments.

The Crerar Library recognized the need for special services to support increased industrial research and development, and established its Research Information Service (RIS) in 1947. The major activities of the Research Information Service include literature searches for current awareness service, preparation of abstracting and indexing bulletins, critical evaluation of the literature, compilation of subject bibliographies, and translation of foreign technical literature.

Scientists with high academic qualifications, working as literature searchers in the RIS group, scan over 13,500 periodicals and other serials received in the Crerar Library for the current awareness services. Instead of organizing current alerting or personalized services independently, a number of industrial and research establishments have entered into an agreement with the Crerar Library for such services on a cost basis. Two of the major abstracting bulletins compiled and issued by the RIS are Crerar Metal Abstracts and Leukemia Abstracts. The first one disseminates current information

on certain metals of importance to industrial companies. The latter, supported by the Lenore Schwartz Leukemia Research Foundation, aims to provide free current awareness service to institutions and individuals engaged in research on leukemia.

The RIS staff also provides critical evaluation of the literature on specific subjects for preparation of reviews and subject bibliographies on demand. The language experts on the RIS staff provide English translations of scientific literature in foreign languages when needed. The translation service is supplemented by the large collection of translated documents of the SLA Translation Center managed by the Crerar Library since 1953. The Translation Center, a depository and information center for unpublished translations now has in its collection over 125,000 translations of scientific literature.

Crerar Library in cooperation with the Computer Center at the Illinois Institute of Technology has recently computerized the bibliographic data on translations for preparation of a published index arranged by COSATI subject categories. Since June, 1967 a computer-based semi-monthly publication, Translation Register-Index, has been issued on behalf of the SLA Translation Center.

Photocopying service is another major activity in the Crerar Library. A variety of photocopy services is offered to the scientific and industrial community at reasonable charges.

The Crerar Library, though very large and having a variety of library and information services, has no immediate plans to mechanize its functions. A system analyst, however, has been working as part of the library staff since 1966 to study the flow of work and cost analysis of various operations in the Library. The studies may help in the long run to devise systems for mechanizing the Library's routine operations and record keeping where found to be more efficient and more economical.

Both Dr. Herman H. Henkel, Executive Director, and Mr. William S. Budington, Librarian, believe that in special library service although machines can do part of the work, human judgement is vital.

Library of Congress Automation Program

The largest library automation project now underway in the United States is the mechanization of the major bibliographic operations in the Library of Congress. In April, 1961, the Council of Library Resources, Inc. granted $100,000 for

> ... a survey of automating the organization, storage and retrieval of information in a large research library ... not only from the point of view of the functioning of an individual institution but also from that of a research library whose activities are inter-related with those of other research libraries.

Dr. Gilbert W. King headed a team of technical specialists appointed for undertaking this survey on the basis of operational data and cost of major bibliographic functions in the Library of Congress. The team of experts studied all the problems involved in the automation of library services and in the report Automation and the Library of Congress[1] recommended that certain functions of the Library be mechanized by 1972 to ensure improved bibliographic service to the nation.

The team also studied the economic feasibility of such an automation program, including the estimated cost of hardware and software of the system, salaries, and the maintenance of projected automated services. The costs of the current manual system projected in 1972 were used as basic cost data for comparison. The initial cost to secure system specifications and the conversion of files to machine-readable form was estimated at about $31.6 million. The annual operating cost was estimated at around $4.5 million which is $0.5 million less than the expenditures they projected for the manual system in 1972. On this point, the study team concluded that "even if the costs were the same, the benefits are demonstrably greater in the automated system, since it would provide a wide variety of new services and a greater refinement of existing services."

The King report reached the following general conclusions:

1. Automation can, within the next decade, augment and accelerate the services rendered by large research libraries and can have a profound effect upon their responsiveness to the needs of library users.

2. Automation of bibliographic processing, catalog searching and document retrieval is technically and economically feasible in large research libraries.

3. The retrieval of the intellectual content of books by automatic methods is not now feasible for large collections, but progress in that direction will be advanced by effective automation of cataloging and indexing functions.

4. Automation will enhance the adaptability of libraries to changes in the national research environment and will facilitate the development of a national library system.

5. Automation will reduce the cost-to-performance ratio; however, the Library should aim at the expansion of services rather than the reduction of total operating costs.

Both librarians and scientists in the United States received the King report with great enthusiasm. A conference was held at the Airle Foundation,[2] and several other seminars and symposia were held to discuss the findings of the report. Library experts and systems analysts published their reviews and comments in contemporary library journals.

As a first step to an automation program, the Library of Congress established its Information Systems Office (ISO) with the responsibility of developing a computer system for automation of bibliographic services in seven phases which are as follows: (1) survey of the present manual system, (2) system-requirements analysis, (3) functional description of a recommended system, (4) system specifications for equipment and procedures, (5) system design, (6) implementation of a new system, and (7) operation of the new system.

In 1965, the Information Systems Office made a detailed study of the existing manual operations in the Library of Congress with a view to providing descriptions of all such operations as well as to provide flow charts and other operational data needed to initiate a contract for an automated system. ISO recommended that 15 general areas or processing operations (out of 33 subsystems in the Library

of Congress) and 12 major files, which in one way or other represent the catalog and known holdings of the Library, should be converted to machine readable form to complete the mechanization of the central bibliographic service.

To be more specific, the following areas of the central bibliographic system are under investigation for automation: (1) the order and exchange acquisition activities; (2) cataloging--both descriptive and subject; (3) recording serial receipts and controlling serial records; (4) controlling the binding records in so far as they relate to the bibliographic system; (5) circulation control, including both inventory control of material in the Library and that loaned outside; (6) processing control, i. e., providing controls for monitoring and locating materials in process and not fully under bibliographic control, and (7) provision of outputs to meet the needs of the Library's bibliographic program.[4]

As a part of the total automation of the central bibliographic system of the Library of Congress, the Information Systems Office is engaged in developing techniques for computer manipulation of the card catalog into machine-readable form. Much work has already been done in reevaluating the information which needs to be included in a catalog entry and in designing a suitable format for a machine readable catalog entry. The pilot project MARC[5] (Machine-Readable Catalog) to test the suitability of the format and feasibility of distributing catalog data in machine-readable form, began in November, 1966 to distribute weekly data base tape to sixteen participating libraries selected for experimental work.

The participating libraries use local computer facilities for manipulation of the tape to produce catalog cards, book catalogs, reading lists, etc., on an experimental basis, and then report on their experience, which will serve as a guide for necessary improvements. MARC will continue to be an experimental project until the extensions and modifications are completed. The Library of Congress, however, was expected to be ready by July, 1968 to sell machine-readable records to interested libraries through its Card Division.

It is expected that before long the Library of Congress will distribute machine-readable catalog data to the entire library com-

munity on a fee basis, similar to the present printed card distribution program.

A number of other projects related to the total automation program are either in progress or in the planning stage. The ISO staff is working jointly with the Processing Department to analyze the subject headings used by the Library from the viewpoint of their suitability for machine processing. The LC subject headings have been converted to machine-readable form. This was used to print the 7th edition of the List of Subject Headings. Another project is the analysis of the structure of subject headings and of filing rules to find out what changes are necessary for computer manipulation of catalog records. Both the projects are prerequisite to computer-based bibliographies, book catalogs, and other printed listings.

It is hoped that the automation of the bibliographic system of the Library of Congress will lead to a computer-based library network, linking libraries throughout the country to the Library of Congress.

Barbara Markuson in a recent paper reported on the developmental work in automation at the Library of Congress and remarked:

> Many of the developments which may result from the LC system study may be transferable to other libraries, but many smaller libraries will find these too sophisticated or too costly to use directly ... The experiences within the Library of Congress and in the field, however, should contribute to an increased understanding of the role automation will play during the next few decades.[6]

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Library of Congress
National Referral Center

The National Referral Center for Science and Technology was established in the Reference Department of the Library of Congress in 1963, aided by a grant from the National Science Foundation to put scientists and technologists looking for specialized information into direct contact with those who can provide it.

John F. Stearns, Chief, National Referral Center, described the Center as "... a clearinghouse to provide comprehensive, coordinated access to the nation's resources of scientific and technical information." The information resource has been interpreted as "any organization, facility, or individual willing and able to give authoritative responses to scientific or technical enquiries out of an existing store of knowledge or expertise." The functions of the Center are: (1) the identification of all significant information resources in the field of science and technology; (2) the acquisition, cataloging, and correlation of substantive and procedural data defining the nature, scope, and capabilities of these resources; (3) the provision of advice and guidance about these resources to any organization or individual requiring access to them by responding to requests for referral assistance and by publishing directories and guides in selected subject fields; and (4) the exploration, through actual operating experience, of the roles and relationships that exist or should exist among the many elements of the scientific and technical information complex.[1]

The Center does not, as a rule, attempt to answer the inquirer's questions directly but refers him to governmental or private organizations or to specialists who can provide the needed information. The requests for bibliographical information are referred to the pertinent division of the Library of Congress and other federal bodies engaged in the dissemination of scientific information.

As a clearinghouse the Center is actively engaged in compiling

and updating an inventory of information resources covering different subjects. The inventory includes professional societies, institutes, research bureaus, federal and state government agencies, industrial laboratories, technical and special libraries, information and documentation centers, and abstracting and indexing services.

Besides maintaining the updated inventory of detailed data on special information resources for the Center's own use, a program is underway for the issuance of special directories of such resources in printed form. So far four volumes of the directories of information resources in the United States covering the physical, biological and engineering sciences (Volume 1); the social sciences (Volume 2); water, other than oceanography (Volume 3); and federal government (Volume 4) have been compiled and published. Each resource in the directory is described in terms of subject coverage, collections, services, and publications. These directories serve as useful reference tools in libraries and technical information centers to establish direct inter-communication where possible.

The referral service provided by the Center is continuously evaluated by a follow-up letter sent out approximately 90 days after answering the request in each case. A statistical analysis of the answers received reveals that 77 percent rated the referrals as useful, 15 percent rated them as equivocal, and only 8 percent rated them as of no help. More than 50 percent of the inquiries are from industry. Industrial establishments, particularly the smaller ones which do not have technical information facilities of their own, find the service very helpful.

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Massachusetts Institute of Technology
Technical Information Project (TIP)

Dr. M. M. Kessler has developed, as a part of the MAC Project, an interesting information storage and retrieval system at the MIT Library. This experimental design commonly known as TIP (Technical Information Project)[1] is aimed at evaluating search strategies and studying the role of human factors in literature search, besides investigating computer capabilities and cost analysis. Dr. Kessler described the model of the project in the following words:

> In its present configuration, a user may sit at an electric typewriter, scan a stated range of literature and perform a search based on key words, key word in context, citation index, bibliographic coupling, author, location and various combinations of these. The response is printed back on the same typewriter within seconds of the request. The inter-relation between the user and the system is free of intermediaries and is accomplished by means of language very close to natural English.[2]

The experiment is based on physics literature published in twenty-one core journals on the subject. The specific journals were chosen on the associative statistics of the various journals determined by the frequency of inter-journal references.

In his article "Some Statistical Properties of Citations in the Literature of Physics,"[3] Dr. Kessler has given a very clear explanation of the statistical techniques he used in determining the family matrix of the journals.

The bibliographic information (author, institutional affiliation of the author, title, location) of each article, the citations (journal, volume, page), the location of the article in Physics Abstracts, and the available subject index information, are all punched on cards and after verification transferred to magnetic tape for storage. The computer edited tape is then transferred to an assigned location on the computer disc memory for manipulation and search. Storage on the computer disc is growing at the rate of 1,500 items per month which

is about 50 to 60 percent of all papers abstracted in Physics Abstract.

The computer configuration is the time-sharing central computer IBM 7090 and one hundred remote typewriter consoles. These consoles are distributed at various faculties and other locations around the MIT campus.

A set of programs has been developed under the general name SHARE and the set is available to all users at the remote consoles. By typing "RESUME FILE" the user may receive the updated list of journals and other titles in the computer disc memory. The user may also get the list of programs, with short descriptions, by instructing the typewriter console to print that.

The use of typewriter terminals linked to a central computer has no doubt enlarged the scope of computer use in information processing. The use of terminals circumvents the delay in delivering bibliographic information from the remote area to a main processing center.

Dr. Saunborn C. Brown's experiment[4] with the TIP service for updating the bibliographic data of his book on plasma physics is an interesting record of the efficiency of this experimental search system.

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Massachusetts Institute of Technology
Project: INTREX

At the Massachusetts Institute of Technology a fundamental research program on information transfer systems named INTREX (Information Transfer Experiments)[1] has been started under the guidance of Dr. C. F. J. Overhage. Dr. Overhage and a group of his associates at the MIT School of Engineering are investigating, in collaboration with the MIT Libraries, long-term solutions for the operational problems of large libraries and development of on-line time-shared computer systems as a tool for more efficient direct communication between the user and the stored information in memory disc files.

The research and development activities of Project INTREX have been divided into four areas of work: an augmented catalog; full-text access; fact retrieval; and network integration. The overall objective is to design a new library service that might become operative at MIT and elsewhere by 1970.

Dr. Overhage describes the library of the future in the following way:

> In the university of the future as it is visualized at MIT, the library will be the central facility of an information-transfer network that will extend throughout the academic community. Students and scholars will use this network to gain access to the University's total information resources, through touch-tone telephones, teletypewriter key boards, television like displays, and quick made copies. The users of the system will communicate with each other as well as with the library; data just obtained in the laboratory and comments made by the observers will be easily available as text books in the library or documents in the departmental files.
>
> The information traffic will be controlled by means of the University's time-shared computer utility, much as today's verbal communications are handled by the campus telephone exchange. Long distance service will connect the University's information transfer network with sources and users elsewhere.[2]

The INTREX research team is now actively engaged in setting up

a model library which will modernize current library procedures and in which experiments can be carried out on newer systems on information handling technology and on other new ideas.

In the area of augmented catalogs, a cataloging manual standardizing the catalog entries in machine-readable form and the design of the augmented-catalog storage and retrieval system have been completed. The research team is working on the experimental design of a computer-stored augmented catalog for materials in selected areas of science and technology and is exploring techniques that may ultimately lead to an ability to provide rapid access to full textual material at remote terminals.

A display console for an on-line computer system is also being designed and tested as a part of the augmented catalog program since the existing on-line computer terminals do not meet the requirements for the console to be used for user interaction with an augmented catalog. The semiannual activity report of the Project gives a clear idea of the console design and its capability:

> The efforts are directed towards designing a console which uses a cathode-ray-tube display with approximately 2,000 alphanumeric-character capacity. A data-communication rate between central computer and console groups of 200 characters per second is envisioned. Several character sets should be possible in addition to the English alphabet. User communications are entered by means of a typewriter key board, and special function buttons designate frequently encountered commands. The user's message is displayed on the cathode-ray-tube prior to the transmission to the time-shared computer, and editing of displayed commands is possible. As the user's conversation with the catalog system progresses, certain data supplied by the computer may be stored locally for future reference, edited as required, and eventually printed in hard copy form.[3]

Experiments are also being made to determine the speed capabilities, quality of output, and other operating characteristics of a display system which consists of a television display tube with a flying-spot-scanner.

In the area of full-text access, a comparative study is being made of various off-line storage media such as microform, magnetic media, and photo-optical devices to determine the suitability of these

media when used in a library. Various optimum parameters for display equipment, such as the number of scan lines, brightness, contrast and techniques for obtaining low cost hard copy, are also under investigation. An experimental system has been designed to transmit microfilm images and to produce facsimile reproduction at the receiving stations. It is predicted that in the future the time required to gain access to a document or to information may be eliminated by generating microform or hard copies at a distance by signals transmitted over electrical circuits in either analog or digital form.

In the area of fact retrieval, an experiment is underway to develop systems for rapid processing of the data in large files to provide a computer-based data bank for retrieval and assembly of facts for automatic answering of the questions.

The INTREX program also plans to develop the network concept of information retrieval and for that purpose is working on an experimental design using the MEDLARS and NASA computer-aided literature search services.

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