

National  
Library of  
Medicine

Programs  
and  
Services

Fiscal  
Year  
1986

U.S. DEPARTMENT OF HEALTH  
AND HUMAN SERVICES

Public Health Service  
National Institutes of Health  
Bethesda, Maryland

*A schematic illustration of the double helix. The two sugar-phosphate backbones twist about on the outside with the flat hydrogen-bonded base pairs forming the core. Seen this way, the structure resembles a spiral staircase with the base pairs forming the steps.*

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## Preface

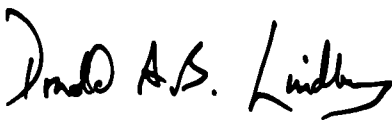
**T**his administrative report, although it contains statistics and descriptions of programs for fiscal year 1986 (October 1, 1985, through September 30, 1986), also reports on the Sesquicentennial activities conducted by the Library for the entire calendar year of 1986.

The Library's 150th year was a special one. A variety of events—from the staff picnic to the formal banquet sponsored by the Friends of the National Library of Medicine—was enjoyed by employees, families, Regents, and friends. As a byproduct, the institution gained an unprecedented opportunity to educate many health professionals and the general public about our important information services and products. My personal thanks to all those who helped plan and carry out our ambitious Sesquicentennial Year observance, and especially to Dr. Lois DeBakey, past Regent and good friend of the Library, for her extraordinary efforts on our behalf.

I believe that the program descriptions contained in this report will show that, within the budget and staffing constraints imposed on Federal agencies, we continue to make steady

progress. The Library's Long Range Plan, completed this year and approved by the Board of Regents, is a remarkable document that will help guide us in the coming years. The section of this report titled "1986 Special Initiatives" describes the Long Range Plan, including two issues of great importance—biotechnology information and the Unified Medical Language System.

The National Library of Medicine exists to serve all who seek health information. If it were not for the exceptional cooperation we receive from Regents, consultants, MEDLARS partners around the globe, health professionals and medical librarians everywhere, this would not be possible. On behalf of the Library's staff, I would like to express my appreciation to all those individuals and institutions who work closely with us to make the system function.



Donald A.B. Lindberg, M.D.  
Director

## A Historic Year

Programs and  
Services, FY 1986

**F**rom Bethesda to Bogota to Beijing, from Canberra to Cairo, from Toronto to Tokyo, from Region 1 to Region 7, from the depths of NLM's B-3 stacks to outer space, from 1836 to 2006, from the newest clerk-typist on the NLM staff to the President of the United States: All were involved in some way with the 150th anniversary celebration of the National Library of Medicine in 1986.

Thousands visited the Library during the year and, quite literally, millions more were reached through various media. What follows is a brief description of some of the events and products attendant on the celebration.

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### January

- President Reagan signed the Proclamation declaring 1986 the Sesquicentennial Year of the National Library of Medicine.
- A new, colorful Sesquicentennial brochure and poster were delivered from the printer, as was a Literature Search on the National Library of Medicine (LS 87-1).
- Articles about the Library appeared in IBM and TYMNET publications.

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### February

- Early in the month there was a special ceremony in the U.S. Capitol highlighting the Joint Resolution of the Congress honoring the NLM, passed late the previous year. Participating were Rep. Claude Pepper, Senator Strom Thurmond, Board members of the Friends of the National Library of Medicine, and NLM staff.
- A special all-day seminar for science journalists, "Online for Medicine and the Media," was attended by more than 100 science writers and journalists. A highlight of the program was the first public demonstration of GRATEFUL MED.

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### March

- "Extramural Programs Week" was the occasion of a number of events connected with the NLM grants activities, including an IAIMS Symposium.
- Among the special visitors this month were the new HHS Under Secretary, Mr. Donald M. Newman, the National Library Week Partners (sponsored by the American Library Association), the Consortium of Universities (D.C. area), and a research group of the American Association of Dental Schools.
- The Library's Toxicology Information Program received a special commendation for sustained high quality services from the Society of Toxicology on the occasion of the Sesquicentennial.

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#### April

- A major exhibit in honor of the Sesquicentennial was mounted in the Library's catalog area. Another NLM exhibit was put up in Ford's Theatre, where the Library was located for 20 years in the last century.
- An Open House, attended by 1,000 friends, neighbors in the community, and colleagues from NIH was held.
- "Medicine and the Arts," an all-day colloquium, was held in the Lister Hill Auditorium. The agenda is reproduced in Appendix 6.

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#### May

- Lecture by Dr. Albert Sabin in the Lister Hill Center auditorium.
- Tribute to NLM at the World Health Assembly in Geneva, Switzerland, by HHS Secretary Otis Bowen.
- The CBS series "An American Portrait," featured John Shaw Billings.
- Major NLM exhibits at the Medical Library Association and the American Industrial Hygiene Association.

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#### June

- Dinner/ceremony at Ford's Theatre sponsored by the Friends of the NLM.
- Group photograph of entire Library staff.
- Visits to NLM by the Drug Information Association, Society of Biological Chemists, and Association of Biomedical Communications Directors.
- NLM exhibits at the annual meetings of the Public Health Service Association and the American Nurses Association.
- Region 7 hosts a special program in honor of the NLM's 150th.

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#### July

- Ceremony to open the Library's new Visitors Center.
- NLM staff picnic held at the Naval Medical Research Institute.
- Visits by the American Association of Law Librarians and the Institute of Federal Library Resources.

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#### August

- The new HHS Assistant Secretary for Health, Dr. Robert E. Windom, toured NLM with his staff.
- Item about the Library on Paul Harvey News—radio and television.
- A week of free interlibrary loans from NLM in honor of the 150th.
- NLM exhibited at the American Hospital Association annual meeting.

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#### September

- "National Library of Medicine: Past, Present, Future" held in conjunction with the Board of Regents meeting (see agenda, Appendix 6).
  - Barbecue on the Library grounds for staff and visitors—sponsored by the Friends of the NLM.
  - Public service announcements by Dr. Michael DeBakey on behalf of the Library sent to radio and television stations around the nation.
  - NLM exhibit sponsored jointly with the World Congress on Cardiology.
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### October

- MEDINFO 86—exhibit and tours of the Library.
- Foreign MEDLARS partners meet at NLM and observe the Sesquicentennial.
- Day of free MEDLINE searching for NLM's online users.
- Exhibit about NLM at the Karolinska Institute in Stockholm.
- Region 2 features NLM at a special "Technology Fair."
- Special section on the Library in the *Bulletin of the Medical Library Association*.

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### November

- One-day symposium on space medicine sponsored jointly by NLM and NASA (see agenda, Appendix 6).
- Exhibit at the American Heart Association meeting in collaboration with Region 5.
- Regions 1, 3, 4, 6 hold symposia and special observances on the Library's Sesquicentennial.

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### December

- Week-long medical film festival held at NLM in observance of the Sesquicentennial.
- An exhibit honoring both NLM on its 150th anniversary and NIH on its centennial was installed outside HHS Secretary Bowen's office.

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### Selected Bibliography

Over the year, there were a number of articles about the Library in the professional and public press. A selection of these articles, listed chronologically, follows:

Austrian, Geoffrey D. Nothing abstract about their abstracts. *Think*. No. 1, 1986, 14-18.

National Library of Medicine. *THUGS Quarterly*. January 1986. 8-12.

Swick, Thomas. The National Library of Medicine after 150 years. *American College of Physicians Observer*. February 1986. pp. 12-13.

The National Library of Medicine celebrates its sesquicentennial. *Library News*. Dolph. B. Briscoe Library—University of Texas Health Science Center at San Antonio. February 1986. p.1.

Rooney, Andy. Good news about government. *The Frederick Post*. February 15, 1986. [Syndicated column in 400 newspapers]

Mitric, Joan McQueeney. Spreading the medical word. *The Washington Post*, Health Section. April 9, 1986. 10-11.

Colburn, Don. Medicine and its muses. *The Washington Post*, Health Section. May 7, 1986. 10-11.

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Lawrence, Susan V. Medicine and the arts: An ancient and persisting relationship. *American College of Physicians Observer*. July/August, 1986. p. 28.

Watson, Linda. National Library of Medicine celebrates its sesquicentennial year. Houston Academy of Medicine—Texas Medical Center Library. *New Titles & News*. Number 158. July/August 1986. pp. 4-5.

Schoolman, Harold M. The physician and the medical librarian. *Archives of Dermatology*. Vol. 122, No. 8. August 1986. pp. 875-6.

Harvey, Paul. How your doctor keeps in touch. [Syndicated newspaper, radio, and television presentation about NLM] August 16, 1986.

National Library of Medicine celebrates sesquicentennial. *Journal of the American Veterinary Medical Association*. Vol. 189, No. 5. September 1, 1986. p. 503.

Cuniberti, Betty. Electronic library puts a world of information at doctors' fingertips. *The Los Angeles Times*. Part V. October 14, 1986. [Syndicated: L.A. Times/Washington Post News Service].

150th birthday gala for NLM. *American Libraries*. October 1986. p. 659.

Spotlight on the National Library of Medicine. *Levy Library News*. The Mount Sinai Medical Center. October 1986. pp. 1-3.

Sesquicentennial of the National Library of Medicine. *Bulletin of the Medical Library Association*. Vol. 74, No. 4. October 1986. pp. 316-352. [Series of 5 articles with introduction].

Gamarekian, Barbara. A library of medicine turns 150. *The New York Times*. November 14, 1986.

Baker, Peter. National medical library celebrates 150th anniversary. *The Washington Times*. November 19, 1986. p. 6B.

National library of medicine marks 150 years of service. *American Medical News*. November 14, 1986. p. 46.

Mehnert, Robert B. A world of knowledge for the nation's health: The U.S. National Library of Medicine. *American Journal of Hospital Pharmacy*. Vol. 43. December 1986. pp. 2991-97.

Culliton, Barbara J. "Friends" dance for library of medicine. *Science*. 19 December 1986. p. 1493.

Jones, Jenkin Lloyd. Elimination of error: Guesses being replaced by instant recall. *The Tulsa Tribune*. December 27, 1986.

Lindberg, Donald A. B. National Library of Medicine: The view at 150 years. *Journal of the American Society for Information Science*. Vol. 38, No. 1. January 1987. pp. 34-39.

Cassedy, James H. National Library of Medicine aids historians. *The Federalist*. Vol. 8, No. 1. Spring 1987. p. 3.

## 1986 Special Initiatives

*Programs and  
Services, FY 1986*

Last year's report described three "special initiatives": planning, Unified Medical Language System, and preservation. This section updates the Library's activities in planning and the UMLS and adds a section on biotechnology. The chapter on Library Operations contains a section on the Library's continuing preservation activities.

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### Planning

The Board of Regents is charged with advising the Secretary of Health and Human Services on important matters of policy affecting the Library. Mindful of this duty, the Board two years ago began to consider the Library's future in light of the increasingly important role of information in American medicine and science. The Regents took note of the accelerated growth of the medical literature, the special challenges and opportunities presented by the scientific revolution in molecular biology, and the remarkable advances in electronic systems technology for storing and communicating information. Such trends, they concluded, present NLM with an opportunity to play an even greater role in improving the Nation's health by improving biomedical communications. Accordingly, the Regents requested that a long range strategy for the Library's future be devised, and they sought out the assistance of experts to develop it.

Physicians, nurses, dentists, veterinarians, librarians, editors, publishers, educators, and participants from industry, biomedical professional associations, information services, and health insurance companies enthusiastically responded to the call. This broad diversity of occupations and expertise reflects the constituencies of the Library and the variety of needs and interests it

serves. More than one hundred outstanding individuals willingly gave their attention to the process by participating in or providing expert advice to one of five planning panels.

Each panel addressed the future in one of the five domains that encompass NLM's current programs and activities. The domains, which provided the panels a framework for thinking about the future, are:

- I Building and organizing the Library's collection
- II Locating and gaining access to medical and scientific literature
- III Obtaining factual information from data bases
- IV Medical informatics
- V Assisting health professions education through information technology

The panels worked from September 1985 through May 1986. At the end of the planning process, each panel formulated recommendations and priorities for future NLM programs and activities in the domain under its purview. The five panel reports were reviewed by the Board of Regents in June 1986. They prepared a synthesized Plan reflecting their high priority initiatives and an Executive Summary which together, represents the official Long-Range Plan of the Board of Regents of the National Library of Medicine. The Plan will be published in seven volumes in FY 1987 and made available to a wide audience including Congress and the Executive Branch, relevant professional communities, and the lay public.

The vision of the planners is both dazzling and simple. They posit nothing less than a nationwide system that will provide immediate, authoritative answers to questions posed by health professionals. Often these answers may

come from systems based on the medical literature—either bibliographic or full text—but they may also come from knowledge bases, expert systems, or other computer-based and network-accessible collections of information.

The Board of Regents acknowledges that, although the Library's mandate clearly covers such a system, it would be wise for NLM to involve others in building it. The Library can provide the vision and leadership, but it will require broad collaboration among academic institutions, national and international organizations, professional societies, libraries, publishers, and computer hardware and software developers if such a goal is to be achieved.

The Plan embodies a central challenge to the National Library of Medicine to strive to be certain that health care in America and the advancement of biomedical research toward this end will benefit from the technological discoveries that are available to us now from computer and information science, telecommunications engineering, physics and chemistry. In the past, the Library has established a distinguished record of scholarly leadership in medicine. This Plan emphasizes the present urgent need for improved access by health-care professionals and scientists to the fast growing scientific literature of newly discovered biomedical concepts, treatments, and preventatives—across a wide range of practical and theoretical problems. The most encouraging aspect of the Plan is the recommendation that the Library move as quickly as possible to translate the existing "raw" technology of computers, information, and engineering science into products and services that through its insight and understanding of the special biomedical practices and needs can improve health care in America.

The Plan clearly recognizes certain outstanding considerations. NLM's fundamental priority certainly is to sustain the collections of the Library and to provide better access; or, stated another way, to provide high quality library and information services to the biomedical community. Actions toward this goal include continued refinement of collections and preservation programs, improvements to the electronic system for end-user access, and modernization of our information support services.

The top priority for NLM's discretionary efforts is to prepare the Library and the Nation's health professionals for the optimal utilization of the burgeoning electronic technologies for knowledge management. Of the numerous initiatives the Plan proposes as components of this preparation, one in particular stands out. This is the "window of opportunity" presented to the Library in the field of molecular biology and biotechnology. Attention to this opportunity—through the provision of advanced information handling services—will permit NLM to contribute significantly to discovery of new principles and treatments by health-care professionals and scientists.

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#### **Unified Medical Language System**

The substantial and growing body of medically-related information available in machine-readable form can be divided into at least four broad categories: (1) the published literature; (2) clinical records; (3) medically relevant databanks, such as NLM's Hazardous Substances Databank; and (4) knowledge bases, such as those in medical expert systems. The availability of these machine-readable data provides the potential for rapid automated retrieval and integration of a variety of

information pertinent to a particular clinical or research question.

The NLM-sponsored IAIMS program is an effort to foster integration of the various sources of information critical to the operations of academic medical centers. The potential that exists for such integrated medical information systems is unlikely to be realized, however, without the development of a mechanism for intelligent switching and linking among the many disparate vocabularies and classifications currently employed in automated systems. Today the practitioner who wishes to examine literature related to clinical findings retrieved from a medical record system or to a diagnosis suggested by an expert system has no alternative but to turn to a different automated system, rephrase the question in one or more ways, and start again.

Although the variety of hardware and software in use presents real problems, the inability to cross back and forth among the types of information is not due primarily to technological barriers. The principal impediment is the lack of any precise intellectual links among related information of the four different types. There is no automated way to translate information retrieved in one area into a query that can be interpreted intelligently by existing systems in another area. There is no automated way to take the user's original question and frame it in the variety of different codes needed to access all the different types of relevant information.

To solve these fundamental medical information problems, NLM has begun the development of a Unified Medical Language System or UMLS, in the form of an integrated series of automated tools that can be invoked by a variety of applications to interpret questions, classify new medical

information, and provide the intelligent links necessary to retrieve or process the whole range of information relevant to a particular inquiry. The goal is not to impose a single vocabulary on all systems and users, but to make the myriad of classifications of medical knowledge invisible to the user and to provide one logical path to the whole range of automated biomedical information.

Moving from the current fragmented situation will require research, development, and creative implementation strategies in many different areas. While the achievement of the ultimate goal is far in the future, the early steps in the process can have immediate payoffs in better information service to health care practitioners, administrators, researchers, and educators.

In FY 1986 a multi-disciplinary team of NLM staff and a wide variety of experts and consultants worked to identify the general parameters of the problem; assemble basic information about some of the key sources of medical information and some of the medical classifications currently in use; define the objectives for the initial years of the project; and develop a mechanism for involving qualified researchers from throughout the country in the UMLS development.

The second phase of the project began with the award of UMLS support contracts in August 1986. In this two-year phase, the intent is to (1) develop tools that will assist in the long-term research effort; (2) perform background studies to obtain key information needed in the design of a functioning UMLS; and (3) as a by-product of these activities, create interim products which will have an immediate beneficial effect on the ability of health professionals and researchers to retrieve relevant information. The following

institutions have received two-year UMLS support contracts:

- Massachusetts General Hospital  
(with Brigham & Women's Hospital as a subcontractor)  
Principal Investigator: G. Octo Barnett, M.D.  
Principal Investigator for subcontractor: Robert Greenes, M.D., Ph.D.
- MPC Corporation (for University of Pittsburgh and Carnegie-Mellon University)  
Principal Investigators: David Evans, Ph.D., and Randolph Miller, M.D.  
Consultant: Homer Warner, M.D., University of Utah
- University of California, San Francisco  
Principal Investigator: Marsden S. Blois, M.D., Ph.D.  
Associated Senior Investigator: John Starkweather, Ph.D.
- Yale University School of Medicine  
Principal Investigator: Perry Miller, M.D., Ph.D.

The principal investigators and other key contract personnel met with NLM staff at the Library on September 11-12, 1986 to discuss previous related work and the research approaches proposed by each of the contractors and by NLM itself. Initial tasks were identified for each research group and work is now underway on a variety of projects.

Massachusetts General Hospital will expand MicroMeSH, its current microcomputer based graphical tool for searching, traversing, and displaying the MeSH vocabulary. New features to be added will include the means to accommodate mapping between MeSH® and other vocabularies. In a related project, Brigham and Women's Hospital will use a semantic network

approach and expert software to explore the optimum structure for storing mapped thesauri and for displaying them graphically to users.

Massachusetts General Hospital will also examine terminology used for procedures, signs, and symptoms in existing medical thesauri and classifications and develop a prototype nomenclature to record the results of a defined section of the physical examination. This prototype nomenclature will be built using the MicroMeSH system.

The University of Pittsburgh, Carnegie-Mellon University, and the University of Utah will collaborate on a task to develop and refine a frame-based "standardized representation scheme" for the clinical manifestations of disease and will use this scheme to map the terminology for signs and symptoms of diseases found in the INTERNIST-1 knowledge base, the HELP hospital information system, and MeSH. The initial focus will be on pulmonary diseases.

The University of California at San Francisco will create a structured file of disease descriptions using standard terms derived from MeSH as much as possible. These descriptions will include: disease names and synonyms; ICD and other applicable disease codes; names of related diseases; predominant sex, age, and race of those affected; etiology, symptoms, signs; laboratory procedures; tests; complications; treatment, prevention, etc. The goal is not to create an expert knowledge base about the diseases, but to provide a matrix or structure with consistent terminology that a user can easily understand and which also will be machine processable. UCSF will begin with selected diseases in the INTERNIST-1 knowledge base. UCSF will also compare the terminology from questions in standard test instruments used in medical education with the terminology in MeSH and the medical literature.

The Yale University School of Medicine will use a specific subject area, liver cancers, to explore how words and phrases in a thesaurus like MeSH can be augmented with "semantic features" indicating certain of their properties and how a set of attributes and relationships among terms can be defined using these semantic features. If a limited set of attributes and relationships is identified as useful in focusing bibliographic retrieval, these features could be incorporated in NLM's vocabulary system and possibly in the indexing process.

NLM staff will work on mapping MeSH to the PDQ® (Physician's Data Query) Thesaurus and to the keywords in GenBank. Developed by the National Cancer Institute, PDQ provides access to information about types of cancer, cancer treatment protocols, and individuals involved in related clinical research or practice. GenBank is a databank of information about gene sequences. Mapping MeSH to the vocabularies used in these files will serve as a test-bed for exploring problems associated with keeping evolving thesauri synchronized and in mapping extensive subject-specific thesauri to a general medical thesaurus. These mapping projects will eventually make it easier for PDQ and GenBank users to retrieve related MEDLINE® citations and for MEDLINE users to access pertinent information in PDQ and GenBank. NLM staff will also continue to experiment with automated or semi-automated methods for mapping and merging thesauri, will develop a group of sample search questions to be used in testing and evaluation of research results, and will apply knowledge gained in the UMLS development effort to the improvement of the Library's retrieval interfaces, such as GRATEFUL MED™.

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## Biotechnology

As mentioned in the previous section, the planners described biotechnology as a "window of opportunity" for the Library. It appears that this subject will be of great importance to the health science community for some time to come, and that the Library should be prepared to assume a leadership role in the crucial area of biotechnology information handling.

Late in the 99th Congress, Representative Claude Pepper introduced a bill—H.R. 5271—that called for the creation of a center on biotechnology information at the National Library of Medicine. The center would store biotechnology information, build links among existing data banks, and create new computerized systems that would allow scientists around the United States to share the molecular genetic information coming from the nation's laboratories.

Biotechnology is the research and development involving the all important molecules that control life processes—how our bodies grow, how we age, whether we suffer a host of mental and physical diseases. Its central focus is DNA, the long, twisted threads in the nucleus of each of our ten trillion cells. Genes are essentially pieces, or chemical subunits, of DNA carrying the messages of heredity in the strands of the famous double helix. If researchers can read and understand the language of heredity—if they can learn the sequence of nucleic acid bases in a gene and amino acid sequences in the gene products—they can clone these genetic elements outside the body. Or find out why certain genes are switched on, or off during a lifetime. Or which ones are defective or even missing.

It is the complexity and amount of biotechnology information that give rise to the

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need for a center devoted to handling it. The Library, with its experience in building computerized databases and communication networks, is being looked to as a locus for such an activity. The center would work with research laboratories where the data originate to coordinate its handling—to store, process, and make it available to the research community nationwide. New information systems would allow data retrieved from one source to be linked to other related findings and to other research databases. So an investigator might ask one computer a question and that computer would automatically search for the answer not only in its own knowledge base but in other research bases as well.

Such a center would not only help fit together the pieces of the genetic puzzle, it could help prevent unnecessary duplication of research. The number and variety of genetic diseases that will benefit from improved biotechnology information services range from diseases which we know are inherited, like sickle cell anemia, to such common and serious diseases as cancer and arthritis, which may well be influenced in complicated ways by the working of the human gene.

The chapter in this report on the Lister Hill Center has a brief report on the Biotechnology Information Program already under way within the Center.

*Special Initiatives, 1986*



## Library Operations

Lois Ann Colaiani

Associate Director, Library Operations

*Programs and  
Services, FY 1986*

**T**he Library Operations Division of NLM:

- Acquires and preserves the world's biomedical literature;
- Organizes this literature by cataloging and indexing;
- Disseminates indexing and cataloging data in publications, online files, and other machine readable forms;
- Lends or copies documents in the NLM collection as a backup to document delivery service provided by other U.S. biomedical libraries; and
- Provides reference and research assistance to health professionals.

A staff of more than 250 librarians, technical information specialists, subject matter experts, health sciences professionals, library technicians, and administrative support personnel carries out Library Operations' programs and services. These people are organized into four main divisions: Bibliographic Services, Public Services, Technical Services, and History of Medicine; two special units: the Medical Subject Headings Section and the Regional Medical Library Program Office; and a small administrative group in the Office of the Associate Director.

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### Planning and Management

During FY 1986, Library Operations (LO) continued to make progress toward the broad objectives in its strategic plan for FY 1984-1988. The four objectives are: (1) to improve internal technical and bibliographic processing; (2) to develop and implement programs that make it easier to identify, locate, obtain and use biomedical information and literature; (3) to

develop and implement a program for the preservation of the biomedical literature; and (4) to ascertain the information needs and information-seeking behavior of health science professionals and the history of medicine community, as a step toward improving Library Operations' products and services. Accomplishments related to the plan are described throughout the Library Operations report. In FY 1987, LO will reorient its activities as needed to respond to the recommendations of the new NLM Long Range Plan.

Several LO components were reorganized in FY 1986 to reflect current program emphases and to handle workloads more effectively. The Reference Services Division became the Public Services Division. Public Services now contains three sections: Reference, Collection Access (formerly Circulation and Control), and Preservation. Most collection maintenance functions, previously handled in Circulation and Control, were transferred to the new Preservation Section. The Audiovisual Resources Section was disbanded and its functions divided among the Reference, Collection Access, and Preservation Sections. This action was taken to provide a more integrated approach to service from all parts of the NLM collection and represents an improvement on NLM's existing commitment to excellent audiovisual services.

LO substantially completed the first three in a series of seven management studies of LO functions mandated by the governmentwide productivity improvement program, which is governed by the Office of Management and Budget's A76 Circular. As a result of the study of the document delivery function, LO has increased the number of first-line supervisors in the Collection Access Section, plans to create a new unit to handle referral of requests NLM cannot fill, and

will contract out the reshelving of books and journals in FY 1987. Recommendations from the A76 studies of the serials control and indexing operations will be reviewed by LO management in early FY 1987.

The Cataloging Section has been reorganized to reduce the number of staff members reporting directly to the Head of the Section and to integrate all catalog maintenance functions. Dorothy Gregor, University Librarian, University of California at San Diego, served as a consultant on the reorganization which is designed to improve the Section's ability to catalog incoming materials expeditiously and reduce the cataloging backlog.

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### Collection Development

Collection development includes maintaining literature selection policies, identifying and acquiring biomedical literature in all formats and languages, and processing materials as they are received. NLM's collection currently contains more than 1,791,000 printed books, journal volumes, theses, and pamphlets and 1,918,000 other items, including audiovisuals, computer software, microforms, prints, photographs, and manuscripts.

*Selection.* Materials are selected for the NLM collection according to the guidelines described in the *Collection Development Manual of the National Library of Medicine*, published in 1985. This year, NLM's profile as a selective depository of Government Printing Office publications was revised based on the provisions of the new manual. NLM provided a test floppy disc version of the *Collection Development Manual* to a few selected health sciences libraries to assess the value of a

machine-readable version of NLM's manual in the development of selection guidelines for their own collections.

The Library continued to coordinate its selection policies with those of other U.S. national libraries and to support and participate in cooperative collection development efforts among other research libraries. NLM and the National Agricultural Library (NAL) developed a joint statement clarifying their collection development policies in the field of human nutrition. A similar statement covering veterinary science was published by the two national libraries last year. NLM contributed additional data about its existing collection strengths and current collecting policies to the automated compilation of data on U.S. research library collections maintained by the Research Libraries Group (RLG). The Library also produced listings of random samples of its cataloging records for monographs in the fields of neurology and nursing to be used by RLG institutions in verifying staff estimates of their collection strengths in those subjects.

As part of NLM's program of collection evaluation and indexing coverage studies in specific subject areas, staff completed a report on NLM's coverage of the literature in medical informatics, defined as the application of computer and information science to medicine and health services. In general, NLM's coverage of the field appears to be good. The results of the inhouse study will be compared with opinions solicited from a broad cross-section of experts in the field of medical informatics in FY 1987. A group of consultants was convened to discuss information needs in the field of health services research and advise on a planned study of NLM's coverage of literature in that field. Also in FY 1986, NLM

**Table 1**  
**Growth of Collections**

<i>Collection</i>	<i>Previous Total (Sept. 1985)</i>	<i>FY 1986</i>	<i>New Total</i>
<i>Book Materials</i>			
<i>Monographs:</i>			
Before 1500 .....	568	0	568
1501-1600 .....	5,680	22	5,702
1601-1700 .....	9,949	41	9,990
1701-1800 .....	24,042	128	24,170
1801-1870 .....	39,664	74	39,738
Americana .....	2,331	1	2,332
1871-Present .....	468,980	11,482	480,462
Theses HMD .....	281,780	8	281,788
Pamphlets .....	172,021*	0	172,021
Bound serial volumes .....	772,889*	31,547	804,436
Volumes withdrawn .....	(30,066)	(12)	(30,078)
Total volumes .....	1,747,838*	43,291	1,791,129
<i>Nonbook Materials</i>			
<i>Microforms:</i>			
Reels of microfilm .....	35,179	110	35,289
Number of microfiche .....	169,104	16,312	185,416
Total microforms .....	204,283	16,422	220,705
Audiovisuals .....	43,001	1,294	44,295
Pictures .....	75,422	190	75,612
Manuscripts .....	1,433,384	144,105	1,577,489

\*Adjusted figure

identified the need to improve its collection of early works in psychology and began systematic efforts to acquire additional historical items in this field.

*Acquisitions.* The NLM collection grew by 43,291 volumes and 162,011 other items, includ-

ing microforms, pictures, audiovisual programs, manuscripts, and a limited number of computer software programs. The staff received and processed about 153,000 modern books, individual serial issues, and audiovisual programs. The Library's historical collections were enriched by many significant acquisitions including: *Ein neu*

**Table 2**  
**Acquisition Statistics**

<i>Acquisitions</i>	<i>FY 1984</i>	<i>FY 1985</i>	<i>FY 1986</i>
Current serial titles received . . . . .	22,294	23,087	22,621
Publications processed:			
Serial pieces . . . . .	126,167	125,243	125,584
Other . . . . .	27,456	27,212	27,264
Total . . . . .	153,623	152,455	152,848
Obligations for:			
Publications . . . . .	\$2,390,426	\$2,128,787	\$2,318,192
Included for Rare Books . . . . .	(\$88,088)	(\$116,154)	(\$90,000)

*Wund-Artzney* by Johannes von Beris, Strassburg, ca. 1540, an early and rare book on wound surgery; Martin Pansa's *Consilium peripneumoniacum*, 1614, which describes the lung diseases of miners and smelters; Jacques Gohory's *Instruction sur l'herbe petum ditte en France l'herbe de la royne ou medicee*, Paris, 1572, thought to be the earliest published work on tobacco; the *Luminare Maius* of Joannes Jacobus de Manlius in a 1522 edition published in Venice, an influential pharmaceutical work during most of the sixteenth century; a large collection of material documenting in detail the operation of a Civil War hospital, Sloan General in Montpelier, Vermont; the early records of the American Society for Clinical Investigation, founded in 1907; and materials from the film archive of the American Dental Association.

**Collection Preservation and Maintenance.** This includes ensuring appropriate storage conditions for the NLM collection, promoting safe handling of materials, providing physical or chemical protection to items, and making copies of items in archival formats. The development of a more

comprehensive preservation program for the biomedical literature is one of LO's strategic objectives for FY 1984-1988. In FY 1985, NLM completed a preservation plan based on a thorough study of the condition of the NLM collection and available preservation options. In FY 1986, LO implemented several key recommendations of the plan.

The NLM Board of Regents approved a revised Preservation Policy which links NLM's preservation program to its collection development guidelines, clarifies the Library's responsibility for the preservation of the *content* as opposed to the format of the literature, defines NLM's role in assisting to preserve significant biomedical literature held by other U.S. libraries, and assigns NLM a responsibility to work with publishers to encourage the publication of the biomedical literature on more permanent media. A new Preservation Section was established and a preservation librarian recruited to head it. At the end of the fiscal year, the Library awarded a four-year contract for preservation microfilming of up to 37,000,000 pages of brittle books and serial volumes. Staff in the Technical Services and

Public Services Division developed a plan for obtaining or borrowing missing issues to complete back volumes of serials being preserved on microfilm.

NLM also began a campaign to persuade biomedical publishers to use more permanent paper in printed publications. The campaign is directed by Charles Kalina, Special Projects Officer, Office of the Director, with support from other NLM components. The NLM Board of Regents will sponsor a hearing on permanent paper in early FY 1987. An LO staff member is chairing the National Information Standards Organization (NISO) Committee charged with revising the *American National Standard for Information Science: Permanence of Paper for Library Materials* to cover coated as well as uncoated papers. Coated papers are heavily used in biomedical publishing because they are essential for high quality illustrations. NLM also continued its research on the preservation characteristics of optical-digital disks. This activity is discussed in the section of this report describing the programs of the Lister Hill National Center for Biomedical Communications.

Staff from the Conservation Center for Art and Historical Artifacts in Philadelphia surveyed NLM's collection of fine art prints. The Center's report indicated that the Library's fine art prints are generally in good condition, but recommended several ways to improve storage conditions and treat specific items. During FY 1986, final plans were completed for the insulation of NLM's film vault and improved humidification of sections of the Library building used to store historical collections. The actual building modifications will take place in 1987. To provide better control over the use of fragile older items and more integrated service for materials of

historical interest, LO transferred the responsibility for materials published between 1871 and 1913 from the Public Services Division to the History of Medicine Division. Some of these materials are being moved as a result of this realignment.

Regular preservation and maintenance activities also continued during FY 1986. A total of 27,533 modern volumes were bound; the bindings for 345 rare books were oiled and 2,714 pages were mended; 245 rare books were restored and/or rebound; and 286 bound manuscript volumes were repaired and rebound. Five hundred sixty historical films were copied on new film stock; and 317 were produced by Research Publications, Inc. as part of NLM's agreement with the firm allowing them to film nineteenth-century American medical periodicals in NLM's collection in exchange for archival and service copies of the microfilm.

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### Bibliographic Control

Bibliographic control includes the development of intellectual schemes for organizing the biomedical literature by subject; the cataloging of all types of library materials in the field of medicine and health; and indexing journal articles on biomedical subjects. Providing intellectual access to the content of the world's biomedical literature is one of NLM's primary services.

*Thesaurus.* The *Medical Subject Headings* (MeSH), NLM's hierarchical thesaurus used in both cataloging and indexing, now contains 14,647 subject headings and 42,816 chemical terms. Since its first use by NLM in 1960, MeSH has provided the foundation for the Library's

efforts to create uniform subject access to the biomedical literature. Each year staff review developments in medicine and health and modify MeSH in an effort to keep current with changes in biomedical terminology. In FY 1986, 311 individual suggestions for MeSH changes were reviewed. These led to the introduction of 334 new MeSH headings, 1,000 new entry terms or cross-references to MeSH headings, and 164 other changes, such as modified hierarchical relationships among existing terms. Of these changes, 139 were the result of a special project to review and improve MeSH terminology in the field of medical informatics and to develop a special-purpose thesaurus for use in creating standard subject indices to the proceedings of the MEDINFO and SCAMC conference on medical informatics.

MeSH inevitably plays an important role in the Library's long-term effort to develop the Unified Medical Language System or UMLS (described in the earlier section on Special Initiatives) to allow integrated access to different kinds of biomedical information classified according to a variety of subject schemes. As the UMLS develops, MeSH terms will be mapped to a variety of other vocabularies; more "user friendly" access to existing MeSH terminology will be provided; and the "intelligence" of MeSH will be exploited more fully in online retrieval systems.

In FY 1986, the bulk of the intellectual work of mapping MeSH terms to biomedical terminology in the Library of Congress Subject Headings (LCSH) was completed. The mapping will make it possible to improve subject searching capabilities in catalog files containing some records with MeSH and some records with LCSH terms. NLM staff are now deciding on an appropriate approach to machine storage and distribution of the mapping.

Additional entry terms were added to the MeSH file to improve retrieval by users unfamiliar with the MeSH vocabulary. Singular forms of terms now map directly to plural forms and vice versa. Direct order versions of multiple word terms (e.g., infectious arthritis) are now available as cross-references to all inverted headings (e.g., arthritis, infectious). Only some inverted headings previously had such direct entry terms. Better access to MeSH terminology will also be incorporated into Version 2 of GRATEFUL MED, NLM's microcomputer-based search package for access to MEDLINE and other selected MEDLARS files.

*Cataloging.* At NLM, cataloging includes: (1) the creation of a standard bibliographic description of each new work added to the NLM collection, containing author's name, title, publisher, date of publication, etc., (2) the assignment of MeSH headings to describe its subject content; (3) the assignment of a classification code or shelving number which identifies the item's principal subject focus; and (4) the maintenance of automated files of cataloging records and of the authoritative forms of names used in those records.

The Library cataloged 20,285 books, serials, audiovisual programs, and Cataloging in Publication (CIP) galley in FY 1986, a 20.5 percent increase over FY 1985 cataloging output. The increase was due to a combination of improved inhouse production and expanded contracts and interagency agreements for cataloging. NLM continues to obtain assistance from the Library of Congress for limited cataloging of books in certain languages for which NLM does not have sufficient expertise. In FY 1986, NLM began cataloging computer software on an experimental basis. Based on data obtained in this experiment, the Library will establish a policy for acquiring

**Table 3**  
**Cataloging Statistics**

<i>Item</i>	<i>FY 1984</i>	<i>FY 1985</i>	<i>FY 1986</i>
Completed Cataloging			
Full .....	11,243	11,174*	11,716
Limited .....	6,267	5,676*	8,569
Total .....	17,510	16,850*	20,285

\*Adjusted figure

**Table 4**  
**Bibliographic Services**

<i>Services</i>	<i>FY 1984</i>	<i>FY 1985</i>	<i>FY 1986</i>
Total citations published*	306,263	307,333	316,585
For <i>Index Medicus</i> .....	278,905	280,379	297,772
Recurring bibliographies .....	24	23	27
Journals indexed for <i>Index Medicus</i> .....	2,695	2,730	2,740
Abstracts entered .....	172,153	177,000	187,662

\*Includes special list articles, audiotapes, and Health Administration citations.

and cataloging this material in 1987. The first cataloging records for items in NLM's historical film collection were produced under contract and added to the AVLINE® file this year.

To provide better access to lower priority serials awaiting cataloging, the Library began to assign call numbers to these titles and shelve the issues in the NLM general collection pending available staff time for cataloging them. In the meantime, these serials are more easily retrievable for use by onsite patrons and photocopying in response to interlibrary loan requests.

In preparing a five-year plan for the reduction of NLM's monograph cataloging backlog of 12,935 items to a working inventory of about 6,000 books, LO identified the need to modify any time-consuming cataloging processes which do not assist catalog users and to provide better automated assistance to catalogers. The entire cataloging workflow will be reviewed to see if it can be further streamlined and to achieve an optimum balance in the use of inhouse staff and outside cataloging resources. In FY 1986, NLM initiated a combined project with the other two national libraries to investigate the development

of an expert cataloger system. After attending two NLM-sponsored seminars on artificial intelligence techniques and their possible application to cataloging, representatives from LC, NAL, and NLM examined the amount of time required for various cataloging activities and identified aspects of the cataloging process most likely to benefit from improved automated assistance. Each of the three national libraries will mount projects to provide more sophisticated automated support to cataloging. LO and the Lister Hill Center will collaborate on the development of NLM's prototype expert cataloger system.

**Indexing.** At NLM, indexing is the creation of records describing the contents of specific articles in the journals the Library has selected for indexing. An indexing record includes descriptive information (authors' names, article title, pagination, journal title, date, etc.) essentially as it appears in the journal and a number of MeSH terms assigned to describe in detail the subject content of the article.

In FY 1986, the consultants who advise NLM on the selection of literature to be indexed in *Index Medicus*<sup>TM</sup> reviewed and rated 273 new journals. Of these, 65 were accepted for inclusion in *Index Medicus*. In addition, the consultants reviewed currently indexed journals in the fields of orthopedics, artificial organs, human engineering, medical technology, biomedical engineering, geriatrics, zoology, veterinary medicine, primates, laboratory animals, and comparative physiology. At the end of the year, there were 2,774 titles being indexed for *Index Medicus* and a total of 3,759 titles represented in MEDLINE. During FY 1986, staff began a review of the policies related to selection of titles for inclusion in MEDLINE and tested some modifica-

**Table 5**  
**Online Searches**

Databases	FY 1984	FY 1985	FY 1986
AVLINE	11,339	11,155	13,277
BIOETHICS	4,580	5,392	5,997
CANCERLIT*	48,664	51,582	54,876
CANCERPROJ*	1,797	1,875	2,337
CATLINE	156,914	138,818	135,546
CCDB			4
CCRIS			14,582
CHEMLINE*	32,614	28,459	27,056
CLINPROT*	2,405	3,378	3,394
DIRECTORY	840	50	
DIRLINE	2,446	2,758	3,534
EXPRESS	1,761	1,173	
HEALTH	90,140	99,666	108,719
HISTLINE*	4,173	3,766	4,842
HSDB*		4,999	32,375
INFORM	47	117	176
INTOX		292	282
INTROMED*	719	4,906	10,087
MEDLINE	1,199,482	1,282,755	1,442,598
MED83			269,614
MED80	247,046	353,978	313,112
MED77	189,077	153,886	133,060
MED75	90,644	86,758	83,168
MED71	62,799	57,985	56,845
MED66	45,500	45,598	46,223
MESH VOCABULARY	12,141	10,083	13,186
NAME AUTHORITY	5,322	4,499	3,473
PDQ-ELHILL	4,724	1,426	
PDQ-UFS	1,949	19,742	25,994
POPLINE	19,486	25,588	20,058
REF			13
RTECS*	8,512	10,535	10,658
SDILINE*	25,979	28,856	33,010
SERLINE*	29,887	30,307	36,982
STORED SEARCH	89	88	95
TDB*ELHILL*	7,470	8,849	
TBD-TOXNET		372	5,325
TOXLINE*	75,190	71,959	68,869
TOXBACK76	2,889	20,216	18,681
TOXBACK74	11,518		
TOXBACK65	8,246	14,158	13,395
	2,406,389	2,586,024	3,011,443

\* Reg. U.S. Pat. Off.



tions to existing procedures. NLM will institute a revised approach to journal selection in 1987.

The number of indexed citations to articles added to MEDLINE in FY 1986 was 316,585, about 6 percent higher than each of the two previous years. The increase was due primarily to an effort to reduce the number of articles in the working backlog. Abstracts were added to MEDLINE for 187,662 or 59 percent of the citations added to that database. Of the articles indexed for *Index Medicus*, 22 percent were indexed by NLM staff; 9 percent directly by foreign centers or through arrangements made by them with U.S. commercial firms; and 69 percent by NLM contractors. Indexing throughput, or the elapsed time between receipt of journals issues at NLM and the completion of the indexing of those issues, continued to improve; 60 percent of all articles processed were indexed within 30 days.

The Library developed a policy and procedures for entering information about errata in articles indexed by NLM into the appropriate MEDLINE citations. When a published erratum notice appears in the literature, staff will modify the citation to the original article to indicate where the erratum has been published. For certain types of errors (e.g., in the title, author's name, or dosage levels in the abstract), corrected information will be inserted in the citation following the incorrect portion. NLM will also annotate citations to articles with substantive errors before a published erratum appears, if the editor or publisher intends to publish such a notice.

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#### Network Services

NLM's services to remote users throughout the country include: (1) disseminating its

authoritative cataloging and indexing data in publications, machine-readable formats, and an online retrieval service; (2) providing reference assistance in response to telephone and written requests; (3) sending documents or copies of documents not available in other U.S. health sciences library collections to health professionals and researchers who need them; and (4) directing the Regional Medical Library Network, which links U.S. biomedical libraries in an effort to make quality information service available to all health professionals irrespective of their geographic location.

*Publications.* Publications, NLM's original method for distributing its cataloging and indexing data, remain an important vehicle for worldwide dissemination of the Library's authoritative information about the biomedical literature. In FY 1986, NLM produced issues of over 30 recurring indexes and catalogs on paper or microfiche. These included *Index Medicus*, the *National Library of Medicine Current Catalog*, *Health Sciences Serials*, *Health Sciences Audiovisuals*, and the *NLM Catalog*, among many other publications. The 1981-85 cumulation of the *Bibliography of the History of Medicine* was published. Four new publications, *ONCHO Update*, *Schisto Update*, *Selected Medical Library on Microfiche*, and *Bibliography on Multiple Sclerosis*, joined the list of recurring bibliographies which NLM produces in collaboration with other organizations.

In addition to its catalogs and indexes, NLM also published several literature searches on specific topics of current interest, such as the integrated approach to the management of pain, use of computer models in biomedical research, and diet and exercise in the treatment of non-insulin dependent diabetes mellitus. The Library

produces and distributes a quarterly literature search on acquired immunodeficiency syndrome (AIDS) to make the latest research results readily available to investigators in this field. Approximately 56,000 copies of various Literature Searches were distributed by NLM during FY 1986. Health professionals may request Literature Searches through AMANET and WORLDLINK, as well as by mail and telephone.

*Machine Readable Databases.* In order to provide the broadest possible access to its authoritative data, NLM leases complete databases and subsets to other organizations in machine-readable form. These organizations include commercial database vendors, international MEDLARS centers, medical schools, and a variety of other nonprofit and commercial organizations. In 1986, NLM distributed more than 2,000 tapes of various databases to 70 foreign and domestic licensees. The Chinese Academy of Medical Sciences (Beijing) and the Academy of Scientific Research and Technology (Cairo, Egypt) became international MEDLARS Centers and tape licensees in FY 1986. Mead Data Central became the fifth U.S. database vendor to offer MEDLINE to its users. By the end of the fiscal year, there were 25 licensees providing access to subsets of MEDLINE on their local systems. Data from some of the institutions indicate that the subset program has achieved its goal of making MEDLINE available to a broader spectrum of health professionals, including students. In another effort to broaden the availability of MEDLINE data, NLM has made agreements with 10 commercial firms to allow them to produce compact disk copies of MEDLINE data on an experimental basis. NLM will participate in the evaluation of the products resulting from these experiments.

FY 1986 also saw a great increase in the online availability of NLM's catalog records. The Research Libraries Information Network (RLIN) and the Online Computer Library Center (OCLC) decided to mount NLM's retrospective cataloging records, joining the University of Toronto Library Automation System (UTLAS) and MARCIVE, a commercial service which produces catalog cards and machine-readable catalogs for individual libraries and consortia, which made the records available in FY 1985. UTLAS and MARCIVE also obtained NLM's audiovisual cataloging records in MARC format.

As the number of organizations providing access to MEDLARS data increases and the ways in which the data are made available proliferate, assuring the quality of the data on these many systems becomes more important and increasingly difficult. This year, the Library worked to develop acceptable methods to exert reasonable control over how licensees of MEDLARS data update and provide access to NLM records and how they represent the source, content, and uses of these records. NLM has drafted a revision of its License Agreement to require that quality assurance issues be addressed by all institutions leasing the databases.

*Online Services.* NLM provides online access to 28 MEDLARS databases. During FY 1986, the number of online domestic and foreign users of NLM's system increased 64 percent to a total of 6,975. Most of the new recipients of codes are individual health professionals and researchers, who now make up about one third of all domestic online users. To keep pace with the increase in applications for online codes, the Library streamlined its procedures and reduced the time required to assign new codes to less than 7 days.



*Online Services Reference Manual.* MEDLEARN<sup>®</sup>, the computer-assisted instruction program for MEDLINE, became available 24 hours a day. In conjunction with the NLM Sesquicentennial celebration, LO staff demonstrated the MEDLARS databases and GRATEFUL MED at a variety of professional meetings, symposia, and information fairs.

With the availability of GRATEFUL MED and other "user friendly" means of access to NLM's system, the Library eliminated the requirement that all new users have some level of training in online searching prior to obtaining an access code. Many new users, particularly library and information professionals who will provide search services to others, continue to attend NLM-sponsored online training classes. Approximately 1,000 people attended classes in searching NLM databases in FY 1986. LO staff conducted 17 classes at NLM and 6 in other locations in the United States. Three Regional Medical Libraries also provide MEDLARS online training. Together the New York Academy of Medicine, the University of California at Los Angeles, and the University of Nebraska conducted 30 classes at several different sites. Health sciences librarians around the United States also taught many special online searching classes for thousands of health professionals.

*Reference Assistance.* In FY 1986, NLM responded to 25,397 telephone requests for reference assistance and 686 reference requests received in the mail. An analysis of the telephone request traffic conducted by an NLM Associate revealed that about 20 percent of the calls come from outside the Washington, D.C. metropolitan area. Requestors called from every region of the United States and several foreign countries. Many

people who write to NLM are unaware of biomedical information resources available locally or of the various federal information clearinghouses for health information for the lay public. In addition to providing some information to answer the requestor's immediate question, the NLM staff also directs people to other agencies that can help. The staff also provides rapid responses, usually on the same day, to a variety of special information requests from members of Congress, the Supreme Court, the Office of the President, the Office of the Secretary of the Department of Health and Human Services, and other federal agencies.

*Document Delivery.* In FY 1986, NLM filled 119,591 requests for interlibrary loans or photocopies of books, journals, and audiovisual programs; 85 percent were filled within four days of receipt. The number of interlibrary loan requests received by NLM increased 11 percent in FY 1986, the first significant increase in eight years.

Four hundred seventy-three libraries began using DOCLINE,<sup>®</sup> NLM's automated document request system, during the year, bringing the total number of DOCLINE users to 588 as of September 30, 1986. Thirty-five percent of all interlibrary loan requests received by NLM during the year came through DOCLINE. An additional 700-800 libraries are expected to become DOCLINE users in FY 1987. The Regional Medical Libraries are assisting NLM in implementing the system throughout the U.S. DOCLINE is linked to MEDLINE, CATLINE,<sup>®</sup> and AVLINE to facilitate the generation of requests and uses data in SERHOLD,<sup>®</sup> NLM's computerized serials holdings database, to route requests automatically to libraries which report holding the requested

titles. SERHOLD now contains over 960,000 holdings statements for 2,276 U.S. biomedical libraries. SERHOLD is updated by merging data from a variety of machine-readable databases to which health sciences libraries contribute. In FY 1986, NLM successfully tested the incorporation in SERHOLD of a tape of holdings data originally entered in OCLC. In 1987, any SERHOLD participant which is also an OCLC member institution will have the option of contributing holdings data in this fashion.

NLM conducted a test of telefacsimile delivery of documents by eight health sciences libraries in FY 1986 to determine the costs of providing such a service and the procedures and policies necessary to support it. A total of 751 documents were delivered by telefacsimile during the year; 50 were needed for patient care emergencies. Based on the experience gained in this test, LO staff members are preparing a plan for regular telefacsimile service, probably in 1987.

*Regional Medical Library Program.* From its inception twenty-one years ago, a major goal of the Regional Medical Library Program has been to improve document delivery service by making optimum use of local library collections and then referring requests for items not available locally to more distant libraries. This year LO staff completed a study comparing interlibrary loan requests received by NLM in 1984 with those received in 1959. This comparison showed a tremendous change in the materials requested from NLM and the number of institutions requesting these materials. In 1959, the journal titles most heavily requested from NLM were English language titles now commonly held by many U.S. health sciences libraries; twenty-five years later the most heavily requested journal

titles were primarily foreign publications not readily available elsewhere in the United States. The number of different libraries requesting materials from NLM doubled between 1959 and 1984. These results indicate the Regional Medical Library Network is handling the bulk of document requests for readily available materials and is serving as an effective conduit for transferring unfilled requests from all over the country to the backup collection at NLM. An estimated 2,000,000 requests for journal articles, books, and audiovisual programs are filled for health professionals each year by libraries in the Regional Medical Library Network. In FY 1986, the Regional Medical Libraries themselves filled 123,527 requests; NLM, as national backup, filled 119,591 requests.

In FY 1986, the Library awarded new five-year contracts to the seven Regional Medical Libraries.

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#### Regional Medical Libraries

1. Greater Northeastern Regional  
Medical Library Program  
The New York Academy of Medicine  
2 East 103rd Street  
New York, New York 10029  
States served: CT, DE, MA, ME, NH, NJ, NY,  
PA, RI, VT, and Puerto Rico
2. Southeastern/Atlantic Regional  
Medical Library Services  
University of Maryland  
Health Sciences Library  
111 South Greene Street  
Baltimore, Maryland 21201  
States served: AL, FL, GA, MD, MS, NC, SC,  
TN, VA, WV, the District of Columbia and the  
Virgin Islands

3. Greater Midwest Regional Medical Library Network  
University of Illinois at Chicago  
Library of the Health Sciences  
P.O. Box 7509  
Chicago, Illinois 60680  
States served: IA, IL, IN, KY, MI, MN, ND, OH, SD, WI
4. Midcontinental Regional Medical Library Program  
University of Nebraska  
Medical Center Library  
42nd and Dewey Avenue  
Omaha, Nebraska 68105-1065  
States served: CO, KS, MO, NE, UT, WY  
ONLINE CENTER for Regions 3, 4, and 5
5. South Central Regional Medical Library Program  
University of Texas  
Health Science Center at Dallas  
5323 Harry Hines Blvd.  
Dallas, Texas 75235  
States served: AR, LA, NM, OK, TX
6. Pacific Northwest Regional Health Sciences Library Service  
Health Sciences Library and Information Center  
University of Washington  
Seattle, Washington 98195  
States served: AK, ID, MT, OR, WA
7. Pacific Southwest Regional Medical Library Service  
UCLA Biomedical Library  
Center for the Health Sciences  
Los Angeles, California 90024  
States served: AZ, CA, HI, NV, and U.S. Territories in the Pacific Basin

The new RML contracts continue to stress document delivery and information access programs, but also place greater emphasis on cooperative collection development, preservation activities, and cooperation with NLM in the testing of new products and services, such as GRATEFUL MED. A new feature of the current contracts is the series of enhancement projects which will be awarded at intervals throughout the life of the contracts. These projects will include investigations of the information needs and information-seeking behavior of health professionals, pilot development of new information services, tests of new technologies or procedures to improve health information processing, and other similar activities. In FY 1986, three enhancement projects were awarded: the University of California at Los Angeles is studying what use health professionals make of the documents delivered to them via the RML Network; the New York Academy of Medicine is enhancing NLM's serials database by adding titles held in the Regions but not at NLM; and the University of Washington is developing a regional microcomputer directory of information resources based on DIRLINE<sup>®</sup>, but enhanced with additional information of specific regional interest.

During the past year, NLM, the RML Network and the Land Grant College Network sponsored by the National Agricultural Library developed and publicized a cooperative agreement designed to provide better information service in the field of veterinary science. Users requiring veterinary science documents or information may contact either a local health sciences library in the RML network or a land grant college library. Requests will be referred to NLM or NAL as appropriate

**Table 7**  
**Circulation Statistics**

<i>Activity</i>	<i>FY 1984</i>	<i>FY 1985</i>	<i>FY 1986</i>
Requests Received: . . . . .	358,654	390,058	438,678
Interlibrary Loan . . . . .	147,017	144,346	153,797
Readers . . . . .	211,637	245,712	284,881
Requests Filled: . . . . .	299,681	327,125	364,661
Interlibrary Loan . . . . .	113,440	110,849	119,591
Photocopy . . . . .	102,723	102,698	110,379
Original . . . . .	6,534	6,606	7,595
Audiovisual . . . . .	4,183*	1,545	1,617
Readers . . . . .	186,241	216,276	245,070
Requests Unfilled: . . . . .	54,737	57,347	74,017
Interlibrary Loan . . . . .	33,577	27,911	34,206
Referred . . . . .	1,975	1,504	1,169
Returned . . . . .	31,602	26,407	33,037
Reader Service			
Returned as unavailable . . . . .	25,160	29,436	39,811

\*Includes videocassettes loaned by the Audiovisual Resources Section and motion pictures circulated from an off-site contract facility directly to individuals for educational use. Beginning in FY 1985, all audiovisual programs in the NLM collection became available for loan; and the contract for motion picture distribution was discontinued

regardless of which network was originally entered by the user. The RML Network also developed an interim directory of health sciences libraries with telefacsimile equipment to facilitate telefacsimile transfer of documents in response to emergency requests and gathered data for a more extensive directory of services available from resource libraries for users not affiliated with institutions with libraries. Plans were made for regular teleconferences among the staffs of the

seven Regional Medical Libraries and NLM to facilitate exchange of information and the development of network policies and programs. To ensure a permanent record of the development and accomplishments of the RML Network, NLM has issued a contract to the Medical Library Association to prepare a written history of the RML Program. Alison Bunting, Director, Pacific Southwest Regional Medical Library System (Region 7), is the principal investigator on this

project, which also includes the preparation of a brochure about the current RML program.

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### Onsite Services

NLM offers a variety of services for people who come to the Library in Bethesda. These services include reference and research assistance, access to materials in the collection, guided tours and briefings on NLM's services and operations, and special programs in the history of medicine. The Library also conducts a one-year onsite training program for library school graduates with potential for useful careers in health sciences information.

*Reference and Research Assistance.* An increasing number of people come to NLM to use its two reading rooms and Learning Resource Center each year. In FY 1986, these visitors requested 248,881 modern books, journals, and audiovisual programs from NLM's closed stacks, 16 percent more than in FY 1985. Since FY 1983 onsite document request traffic has increased 59 percent. Onsite users also asked 44,444 reference questions and received the results of 1014 online searches. Use of NLM's audiovisual and historical collections continued to grow.

In an effort to gain a better understanding of onsite use of the NLM collection, in FY 1986 Library Operations used sampling techniques to identify the different user groups and the materials they were requesting. The percentages of different types of onsite users are as follows: 19 percent health care practitioners; 17 percent researchers; 7 percent librarians and commercial information professionals; 37 percent students; and 20 percent various other categories. Eighty-

five percent come from the Washington metropolitan area; 13 percent from elsewhere in the United States; and 2 percent from foreign countries. Eighty-five percent of the materials requested by onsite users were serials. The most heavily used titles were English language journals that are readily available at many other health sciences libraries. NLM staff will consider these data when reassessing the Library's onsite service policies in FY 1987.

The facilities available to onsite users underwent dramatic changes. The main card catalog was removed from the public service area; all access to catalog records for modern materials is now through the online catalog or the backup microfiche catalog. The main Reading Room and the area vacated by the card catalog were then redesigned, recarpeted, and refurnished. A Sesquicentennial exhibit highlighting NLM's history and its current activities was installed in part of the space formerly occupied by the main card catalog. Although users of the historical collections continue to rely on card and early book catalogs for access to some items, they can now also use the online catalog in the History of Medicine Reading Room. A new system of signs and directories was installed in the Library Building and the Lister Hill Center Building to help onsite visitors navigate through the NLM facilities.

*Public Tours.* The Sesquicentennial celebration drew large numbers of visitors to both the regularly scheduled daily tours of NLM and to the special tours held in conjunction with the many Sesquicentennial events. In FY 1986, LO staff conducted 135 regular tours for a total of 469 visitors. More than 1,200 people (140 groups)



**Table 8**  
**Reference Services**

<i>Activity</i>	<i>FY 1984*</i>	<i>FY 1985*</i>	<i>FY 1986</i>
<b>Reference Section:</b>			
Requests by telephone .....	22,542	24,218	25,744
Requests by mail .....	2,106	2,100	1,104
Readers assisted .....	39,638	42,561	44,444
Total .....	64,286	68,879	71,292

\*All figures revised

received special orientation programs and tours arranged by the Office of Inquiries and Publications Management (Office of the Director). This does not include the estimated 1,000 visitors during the April 11 Open House. NLM staff also arranged special briefings on library programs and services for many individual visitors.

*Special Historical Programs.* The FY 1986 Visiting Historical Scholar was James Harvey Young, Charles Howard Candler Professor of American Social History Emeritus at Emory University. Under the Visiting Scholar program, each year a recognized scholar is competitively selected to spend 6 to 12 months at the Library to engage in research that will use NLM's collections, to give one or more public presentations, to assess segments of NLM's historical collection, and to consult with staff in his or her areas of expertise. Dr. Young used NLM's collection in his work on a history of food and drug regulation in America and delivered a public lecture at NLM on "American Health Quackery: Past and Present" on June 4. Dr. Thomas Bonner, Distinguished Professor of History, Wayne State

University, has been selected as the 1987 visiting Historical Scholar. He will come to NLM in January 1987 to pursue his research on 19th and 20th century medical education in England, Germany, and the United States.

Another distinguished historian, Dr. Albert Cowdry, was detailed to NLM from the U.S. Army Center for Military History to carry out research in the Library's Collection of Stanhope Bayne-Jones papers in preparation for a biography of Dr. Bayne-Jones. In FY 1986, NLM's History of Medicine Division staff members assisted in the preparation of many special exhibits, presentations, brochures, and other materials associated with the NLM Sesquicentennial. A major lobby exhibit on "Historical Treasures of the National Library of Medicine" displayed a selection of unique and significant printed works, manuscripts, and fine art prints in the historical collections. A symposium on "History of Chemistry Resources at the National Library of Medicine" was conducted at the American Chemical Society Meeting in New York on April 14.

Individual staff members continued their research using NLM's historical collections. Staff

**Table 9**  
**History of Medicine Activities**

<i>Activity</i>	<i>FY 1984</i>	<i>FY 1985</i>	<i>FY 1986</i>
<b>Acquisitions:</b>			
Books .....	271	438	296
Modern Manuscripts .....	33,024	193,101	146,105
Prints and Photographs .....	459	298	190
<b>Processing:</b>			
Book cataloged .....	349	326	313
Modern manuscripts cataloged .....	36,209	91,304	62,650
Pictures cataloged .....	1,436	163	995
Citations indexed .....	6,000	4,954	5,880
Pages microfilmed .....	80,817	94,594	134,546
<b>Public Service:</b>			
Reference questions answered .....	2,659	3,093	4,560
ILL and pay orders filled .....	2,118	2,042	1,936
Reader requests filled .....	5,061	4,981	6,228
Pictures supplied .....	2,627	3,252	5,262

research was published in several publications and presented at invited lectures throughout the year (see Appendix 1, Staff Bibliography).

*NLM Associate Program.* The NLM Associate Program is a one-year competitive program which provides three to six library school graduates an opportunity to learn about NLM's operations and those of other health sciences libraries, to use new information technologies, and to develop their skills through the conduct of special projects. Associates have an opportunity to visit the other national libraries and various types of health sciences libraries or information centers and to attend professional meetings. NLM offers an international traineeship for one librarian from outside the United States

to participate in the NLM Associate Program. In this arrangement, NLM provides the training, but does not assume the cost for the trainee's travel or stay in the United States.

Three Associates completed the program in August 1986; four new Associates began the program in September 1986. Beginning in FY 1986, NLM staff members may apply to attend selected portions of the Associates' formal curriculum. In September 1986, faculty from three southern library schools were invited to attend the initial orientation for the new Associates. The purpose was to increase their understanding of the program so they could promote interest in it among qualified library school students, particularly minority students.

## Specialized Information Services

Henry M. Kissman, Ph.D.  
Associate Director

*Programs and  
Services, FY 1986*

**C**hristmas Week 1986: Shoppers on Manhattan's Fifth Avenue search for last minute gifts while, several miles north, a threatening package is about to be unwrapped. A warehouse with massive quantities of hazardous chemicals is discovered in a densely populated section of the Bronx. Over 100 chemicals are identified, many of which are explosive, flammable, corrosive, poisonous, and highly reactive. They are contained in drums and boxes, most in poor condition. The building is roped off and guarded by a police sentry. One falling container or one leaking drum of the wrong chemical could result in a fire or explosion. The health and safety of the neighborhood is at risk. Officials need guidance on the safe handling and disposal of these chemicals, but where can they get it?

Quick-thinking federal emergency response officials contact the National Library of Medicine. The Toxicology Information Program in the Library's Division of Specialized Information Services (SIS) is widely recognized as a resource which maintains data that can assist in chemical emergency situations. The chemical names are transmitted by facsimile to SIS. One of its many computer files, the Hazardous Substances Data Bank, is searched. This data bank can answer questions about the safety and handling, health effects, and environmental fate of these chemicals. Multiple printouts with detailed information are promptly generated and sent both to the federal emergency response teams handling this case and, as a further precautionary measure, to six local hospitals. The chemicals are ultimately removed without incident and the neighborhood around the warehouse is spared an unwelcome Christmas surprise.

The above real-life situation is just one example of a critical SIS activity not traditionally

associated with library services. Although SIS does issue publications and answer inquiries, its primary function is to build and make available online, computer files related to toxicology and hazardous chemicals. From TOXLINE, the earliest online service covering toxicology literature, to TOXNET<sup>®</sup>, an advanced integrated system of toxicologically oriented data banks, SIS has been at the forefront of utilizing sophisticated computer technologies to answer pressing scientific questions. Very recently, SIS has also begun investigating the adequacy of information handling in the burgeoning field of biotechnology.

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### Online Services

The Toxicology Information Program of NLM, established in 1967 in Specialized Information Services (SIS), is a direct outgrowth of the recommendations made by a panel of the President's Science Advisory Committee in 1966 which found that "there exists an urgent need for a much more coordinated and more complete computer-based file of toxicology information than any currently available and further, that access to this file be more generally available to all those legitimately needing such information." SIS is responsible for several of NLM's online services that relate to the provision of chemical and toxicological information. These services include the CHEMLINE, TOXLINE, RTECS and DIRLINE files on the ELHILL system and the CCRIS and HSDB files on the TOXNET system.

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### Databases under ELHILL

CHEMLINE (Chemical Dictionary Online) is an online chemical dictionary and directory file which allows users to verify chemical

nomenclature and structure and to formulate optimum search strategies for other NLM files. Each chemical record also has pointers to these other files which contain information about that chemical substance. CHEMLINE is built and maintained in collaboration with Chemical Abstracts Service (CAS). It is updated bimonthly and regenerated annually, and now contains over 700,000 records.

During FY 1986, several changes were made to increase CHEMLINE's effectiveness in retrieving records. The content of the Synonym field was enhanced with the identifier (NLM) which indicates the synonym was provided by NLM. Citations in TOXLINE appearing during a 12-month period in 1985-86 were checked for new chemical names not appearing in CHEMLINE, and many such names were added to CHEMLINE after a quality review. Work is scheduled to obtain Hazardous Waste/Regulatory identifiers (synonyms), and to investigate the availability of commercial mixture names and the names of foreign drugs.

A new Classification Code (CC) field was added to CHEMLINE. The first data put into this field was Pharmacologic and/or Therapeutic Category data obtained from the publication *USAN and the USP Dictionary of Drug Names*. For example, major "antiviral" drugs are labelled as such, and are now searchable as a class. These data were added to over 2,700 drug records. To enhance the ability to use the directory function of CHEMLINE, certain filenames were added for the first time to the Locator field; these were MED83, CANCERLIT, and CANCERPROJ on the ELHILL system, and HSDB and CCRIS on the TOXNET system. This allows users to bridge the gap between the two systems for chemical retrieval questions. Ring structure data for over

21,000 records were coded for addition to CHEMLINE

*TOXLINE (Toxicology Information Online)* is an online bibliographic retrieval service, produced by merging "toxicology" subsets from some thirteen secondary sources, including *Biological Abstracts*, *Chemical Abstracts*, *Government Reports Announcement and Index* (report literature), *International Pharmaceutical Abstracts*, and *Index Medicus*. TOXLINE and its two backfiles TOXBACK76 and TOXBACK65 now contain some 2,018,000 records.

A new subfile from the Environmental Mutagen Information Center, the Aneuploidy File, was added to TOXLINE in 1986. It provides citations to literature about various aspects of chromosomal abnormalities. In another change, the contribution of *Biological Abstracts* to TOXLINE has tripled to 37,000 references per year. Increased coverage is being provided in the areas of occupational exposure to chemicals, disposal methods, and environmental effects of chemical waste dumps.

An evaluation of TOXLINE's coverage, and how well this coverage adapts to changes in toxicology and related sciences, is being conducted in FY 1987. A contract has been awarded to the Institute for Scientific Information to undertake this evaluation using bibliometric analyses.

*RTECS (Registry of Toxic Effects of Chemical Substances)*, another online data retrieval service, is based upon a National Institute for Occupational Safety and Health file which NLM restructures for online searching. In 1986, the file was enriched by adding Chemical Abstracts Service (CAS) Registry Numbers to RTECS records lacking them. These identification numbers are crucial

for unequivocal data retrieval and for matching RTECS records with those in other files. Some 12,000 records were enhanced in this way; a few thousand more remain to be processed. The work was done by CAS under contract. Funding support came from Superfund (see below). RTECS now contains over 80,000 records. Plans are underway to move this database to the TOXNET system.

*DIRLINE (Directory of Information Resources Online)*, is an online directory which assists MEDLARS users by providing an alternative resource for information needs not met by bibliographic or factual databases, by locating service facilities and educational materials, by identifying organizations capable of providing support services, and by serving as a general information tool in locating "helping" organizations. DIRLINE has been available as one of NLM's online services since August 1984. At present, this directory uses data from (1) the Library of Congress's National Referral Center (NRC) database (14,405 multi-disciplinary records); (2) DHHS's Office of Disease Prevention and Health Promotion Health Information Center database (984 records on health-related organizations); (3) poison control center directories (PCC) compiled and maintained by the publication, *Emergency Medicine*, and the American Association of Poison Control Centers (119 records indicating certified and/or state-designated centers); and (4) the DHHS Alcohol, Drug Abuse and Mental Health Administration's Drug Abuse Communications Network (DRACON) (49 records which link the users to over 10,000 local drug abuse and alcoholism resources).

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### TOXNET and Its Files

SIS's major file building and enrichment efforts this year continue to be partially funded by Superfund. The Superfund Amendments and Reauthorization Act of 1986 (SARA), which amends the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, charges the Department of Health and Human Services with certain health-related responsibilities associated with the cleanup of chemical dump sites and responses to accidents involving hazardous chemicals. The lead agency in the Department for Superfund-related activities is the Agency for Toxic Substances and Disease Registry (ATSDR). Relevant information activities such as file building and creation of improved access methods to information resources in the areas of hazardous wastes and emergency responses are carried out by NLM under an agreement with ATSDR. The predominant SIS activities supported by Superfund have been enhancement of its online, factual data bank, HSDB, and the development of TOXNET, an integrated, file building and online search system.

TOXNET became available to the NLM online community for searching and retrieval on July 1, 1985. TOXNET is an umbrella system that currently contains two data banks, the Hazardous Substances Data Bank (HSDB) and the Chemical Carcinogenesis Research Information System (CCRIS). The addition of other files is planned for FY 1987. One will be the RTECS file presently available on NLM's ELHILL system and scheduled for transfer to TOXNET in early 1987.

TOXNET's major online data bank is HSDB, a direct outgrowth of the former TDB (Toxicology Data Bank). TDB® service was discontinued on September 30, 1986, since its file content had

been subsumed by the larger, more comprehensive HSDB. HSDB contains records for 4200 chemical substances described in 144 data fields organized into 11 subject categories. The scope of HSDB includes and expands upon that of its predecessor, the TDB, by providing more comprehensive information primarily in the areas of environmental fate and exposure, standards and regulations, and safety and handling. Data are extracted from monographic sources, government reports and from the primary scientific literature. Data statements in the file are referenced.

A major accomplishment of the past year was the chartering of the new Scientific Review Panel, appointed by NLM but operated by a contractor, to peer review the information contained in the HSDB file. The panel is co-funded by the Defense Logistics Agency (DLA) and reviews HSDB content as well as materials for the DLA-supported Hazardous Materials Technical Center. Refinements to the HSDB file include the creation of five new data fields and the ability to display complete source bibliographic citations.

Also mounted on TOXNET is CCRIS, a file of the National Cancer Institute (NCI), which became publicly available on February 25, 1986. CCRIS is a scientifically evaluated and fully referenced data bank, developed and maintained by NCI, containing carcinogenicity, mutagenicity and tumor promotion test results. Data are derived from the scanning of primary journals, current awareness tools, and a special core set of sources, including a wide range of NCI reports. CCRIS is organized by chemical substance and now contains 1200 chemical records

*User Support* for all online files is an ongoing SIS function. User Guides for the CHEMLINE,

TOXLINE, RTECS and DIRLINE files were updated. A TOXNET User Guide and a brief guide for searching TOXNET were developed. A self-instructional guide for searching DIRLINE became available. Fact Sheets for the TOXNET system and each of the files on TOXNET were updated. SIS continued to provide training for its online files both as a part of the MEDLARS Training Program and for end-users at professional meetings and elsewhere.

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#### Information Services to Other Agencies

The SIS continues to provide data and information to Federal and State agencies, as well as to users in the private sector. SIS has also been involved in joint ventures with several Federal organizations in developing new or enhancing existing data and information services. The Division continues to be involved with the restructured Committee to Coordinate Environmental Health and Related Programs (CCEHRP), and chairs the Subcommittee on Information Coordination.

Collaboration has continued with the Agency for Toxic Substances and Disease Registry, which is the organization coordinating Superfund-supported activities across DHHS. These activities include the HSDB and TOXNET Projects described above and the development of a microcomputer workstation for chemical emergency response.

Enhancement of the microcomputer workstation continued as new features were implemented. The workstation uses software developed by NLM in conjunction with the Environmental Protection Agency (EPA) and the Council on Environmental Quality (CEQ) to retrieve and manipulate data and information

needed in responding to emergencies involving hazardous materials. Primary emphasis during the period has been the development of a generalized bibliographic "script." This script, known as BIBLIO, can search over 250 separate databases, located in eight vendor systems, for 18 subject areas. The bibliographic script uses stored strategies to search on authors' names, keywords, languages, publication dates, and chemical names. In addition to the bibliographic databases, access to six new factual/numeric databases was also completed. These are: EPA's AQUIRE, DERMAL, ENVIROFATE, and GENETOX databases and NLM's HSDB and CCRIS on the TOXNET System. The microcomputer workstation was field-tested by NLM and ATSDR at the end of FY 1985 and the first quarter of FY 1986. Later in FY 1986 a formal beta-test was conducted at 20 organizations in government, private industry, and academia. Results of these tests were compiled and a report was prepared.

NLM and ATSDR plan to enhance the workstation further for emergency response use by adding relevant subsets of chemical/toxicological files. This will allow response staff to search either the resident subsets or to go outside the workstation by accessing remote online databases. Workstations of this type would facilitate access to important sources of data and information for workers at chemical waste dumps or emergency response teams at chemical accident sites. Other enhancements include adding factual/numeric databases and increasing access speed to them through another "script," called TOXCHEM. A related activity is the start-up of the development of a prototype expert system, capable of running in a microcomputer, which supports information gathering for personnel responding to chemical emergencies.

SIS continues to produce TOX-TIPS™ (Toxicology Testing-in Progress) as a monthly publication identifying toxicology testing that is ongoing or planned in public or private sector laboratories. It also identifies from the scientific literature new toxicological test methods as well as articles dealing with "alternatives to animal testing."

On the horizon is increased SIS involvement in biotechnology. An NLM-sponsored National Academy of Sciences Workshop, convened in May 1986, explored the organization of biotechnology nomenclature and information. The workshop found great need for a standardized biotechnology vocabulary, linkages among data banks, and improved methods of tracking, capturing and making accessible, the literature of the field.

As information continues to be a highly valued commodity, libraries will be increasingly called upon to provide the answers to complex questions. SIS's staff uses advanced computer technologies mixed with human know-how to answer the questions. The Division anticipates the needs of a diverse scientific community and continues to seek better ways to fulfill these needs through technology and personal understanding.

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# Lister Hill National Center for Biomedical Communications

Daniel Masys, M.D.  
Director

The Lister Hill National Center for Biomedical Communications (LHNCBC) was established in 1968 by a joint resolution of Congress. The Center serves as the intramural research and development arm of the National Library of Medicine. LHNCBC research programs explore the use of state-of-the-art computer and communications technologies to disseminate biomedical knowledge. This knowledge takes the form of electronic representations of text, images and sound, as well as the procedural knowledge encoded in rule-based expert systems. LHNCBC programs develop innovative methods for acquiring, storing, retrieving, analyzing, and presenting information to biomedical researchers and health care professionals.

During its first decade, the Center devised prototype systems for computer-assisted instructional networks, two-way audio and video communications via satellite, and system designs for online information retrieval which were later incorporated into the NLM's precedent-setting MEDLINE system. The Center has gradually turned to research projects with long-term potential for improving patterns of information processing, analysis and retrieval on a national scale. Document image processing, videodisc-based computer assisted instruction and simulation, artificial intelligence for medical decision assistance, and natural language processing research are among important areas currently under investigation by Lister Hill Center staff.

The Long Range Planning exercise undertaken by the NLM in FY 1985-86 portrayed a future of biomedical communications rich with opportunity for national leadership in advanced information systems development. It was an appropriate legacy of the planning effort that Dr. Daniel Masys, a member of the panel on "Obtaining

Information from Factual Databases," was appointed as Director of the Lister Hill Center in June 1986. Dr. Masys had previously served as the Chief of the National Cancer Institute's International Cancer Research Data Bank Branch, where he had managed the development of both publication and computer-based technical information services, including components of NCI's "Physician Data Query" (PDQ) cancer information system.

*Lister Hill Center*

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## Organizational Structure

Leadership for the Lister Hill Center programs is provided by a Director and Deputy Director, overseeing the activities of six branches:

- Computer Science Branch
- Information Technology Branch
- Communications Engineering Branch
- Audiovisual Program Development Branch
- Health Professions Applications Branch\*
- Training and Consultation Branch\*

A Board of Scientific Counselors (BoSC) meets to review the quality and content of the intramural research programs within NLM, with particular attention directed to the Lister Hill Center. It is composed of scientific and technical experts who are prominent leaders in the fields of medicine, computer science, and health professions education. The BoSC meets twice yearly to review and make recommendations on the LHNCBC programs to the NLM Director and the Lister Hill Center Director.

\*Effective February 1987, the Health Professions Applications and Training and Consultation Branches were merged into a new Educational Technology Branch responsible for development and testing of educational applications for the health professions.



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### Research Program Overview

The research and development programs of the LHCBC fall into three major categories:

1. Computer and Information Science as applied to the problems of the Library, of biomedical research, and health care delivery.
2. Biomedical image engineering, including image acquisition, processing, storage, retrieval, and communications.
3. Use of new technologies for health professions education.

Within each of these major program areas, there are a number of diverse projects.

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### Computer and Information Science

*Biotechnology Information Program.* The long range planning panels identified molecular biology and biotechnology information as an area of special importance for future development by NLM. In response to this, LHCBC and NLM staff have been analyzing the impact of the accumulation of massive amounts of information on human gene sequences and other macromolecules which is resulting from the rapidly accelerating pace of biological research. In FY 1986, LHCBC began the process of identifying needs for organizing, and accessing the enormous amounts of data expected to result from molecular biology research over the next several years. Collaborating with efforts by other NIH Institutes, other government agencies and private organizations such as the Howard Hughes Medical Institute, the Center initiated a program to develop advanced, multi-database information retrieval and analysis prototypes for biologists.

This Biotechnology Information Program encompasses a series of short and long range goals in which existing systems, such as the Information Retrieval Experiment (described within the Online Reference Works Project below), could be applied for enhancing information retrieval and analysis from molecular biology databases. By the close of the fiscal year, GenBank (nucleic acid sequences), Protein Sequence Database, and a subset of MEDLINE on molecular genetics had been mounted as databases under LHCBC prototype retrieval systems as the first step to developing an advanced multi-database retrieval system for molecular biologists. The requirements for this system are being developed through interviews with molecular biologists on the NIH campus who will also serve as test users of the experimental system. Key issues will be providing ease of access to the sequence databases, downloading of sequence information to analytic programs, and linked retrieval from MEDLINE (which already extensively covers the field of molecular biology). Longer-range issues now being addressed include data management for large-scale sequence databases, common terminology, networked databases, and expert systems for retrieval and analysis.

*Artificial Intelligence/Expert Systems Program.* A research program in artificial intelligence concentrating on expert systems was established at LHCBC in FY 1985. Expert systems are computer programs which combine knowledge of a particular subject area with inferencing mechanisms enabling them to use this knowledge in problem-solving situations. Such systems can amplify the accessibility of specialist-level

expertise by making it available when the human experts are not. The Expert Systems Program explores research topics in artificial intelligence appropriate to the development of knowledge-based expert consultant systems in biomedicine.

Of particular interest to the Expert Systems Program investigators are problems in knowledge representation and knowledge base structure, in human factors design for expert systems, in the uses of high-resolution graphics to illustrate system reasoning, in interactive videodisc capability to extend system utility and educational potential, in the linking of expert systems to visual databanks, in the linking of expert systems to large-scale mainframe databanks, and in high-performance microcomputers and workstations as delivery vehicles for these complex programs.

The efforts of the researchers are directed both to the extension of an in-house artificial intelligence systems development capability and to the extramural aspects of technology transfer, research community-building, and information dissemination appropriate to the mission of the National Library of Medicine. The in-house capability has been enhanced by the development of an Artificial Intelligence Laboratory area to provide hardware and software environments which facilitate this research and the demonstration of its results.

During FY 1986 Expert Systems Program staff addressed software environment and technology transfer issues by significantly augmenting the capabilities of EXPERT, a major expert systems software development tool, and porting it to the IBM PC-AT microcomputer. The mainframe version of the EXPERT was produced by the Department of Computer Science at Rutgers University. The capabilities added to the IBM

PC-AT version included a new user interface with a mouse pointing device, color and context-sensitive help frames, a videodisc interface and video image bank utilities, a dial-out interface for access to mainframe databanks, and a criteria table translator to assist in knowledge acquisition. The resulting software system offers an excellent test-bed for the development of expert consultant systems in widely varied subject areas.

One focus of the Expert Systems Program is the continuing development of the AI/RHEUM consultant system in rheumatology, one of the world's largest medical artificial intelligence systems. AI/RHEUM was built at the University of Missouri in Columbia by a project team which included Dr. Lindberg and Dr. Kingsland. With their move to NLM, AI/RHEUM became a Lister Hill Center project in FY 1985. AI/RHEUM runs under EXPERT and takes full advantage of the new NLM-developed user interface and new functional capabilities. AI/RHEUM is unusual among expert systems in offering the user direct access to information from four knowledge sources: text definitions, videodisc images, the disease criteria tables which are the foundation of its medical knowledge base, and direct dial-out to NLM's MEDLARS family of databases from within the running consultant system.

At the close of FY 1986, the AI/RHEUM diagnostic system contained in its knowledge base information on 26 rheumatologic diseases. It was able to reason from 877 patient findings (basic information such as signs, symptoms, laboratory tests and radiographic observations) through 547 intermediate hypotheses to these 26 disease conclusions. It had 181 text definitions available online for those patient findings which might not be familiar to its intended users, physicians not having specialty training in

rheumatology. In addition, the system offered direct access to an "image bank" of 1,500 videodisc images illustrating specific rheumatologic findings. The scope and complexity of the program continue to grow.

AI/RHEUM has been tested with more than 500 clinical cases. Its overall level of agreement with the consensus diagnosis of Board-certified rheumatologist clinicians is above 90%. A total of 500 additional test cases are currently being acquired from five widely separated institutions in a further validation of the system's knowledge base. The knowledge base itself has been extended with draft criteria for six new diseases, bringing the total to 32 diseases when the validation is complete.

The evaluation of medical expert systems such as AI/RHEUM is a difficult problem which has not yet been well addressed. One of the Expert Systems Program initiatives in FY 1986 was a proposal for the development of a general methodology for the evaluation of medical expert systems. An NLM-sponsored process for the development of this methodology began in FY 1986. From FY 1987 through 1989, AI/RHEUM will be used as the specific vehicle for the testing of this methodology at multiple clinical sites in an NIH-funded evaluation trial.

In addition to the diagnostic component detailed above, AI/RHEUM has a patient management component. The AI/RHEUM patient management system provides therapy recommendations for patients having rheumatoid arthritis, one of the more complex rheumatologic diseases. It assesses patient condition on the basis of specific information requested and makes treatment suggestions at several levels, from basic measures through cytotoxic drug therapies. This system has "Tell Me More"

information available in many categories for users who would like detailed explanations of its recommendations.

The Expert Systems Program also works with knowledge-based consultant systems in other areas of medicine. An example is AI/COAG, which like AI/RHEUM was originally developed at Missouri and brought to NLM by Dr. Lindberg and Dr. Kingsland. AI/COAG offers diagnostic assistance for problems in human hemostasis. This system also is designed in several modules. The first module performs a differential interpretation of six coagulation laboratory screening tests, and offers "Tell Me More" and "Tell Me Reference" information to support its conclusions. The second module acquires and stores a detailed hemostasis history. It prints a summary record for the user and analyzes the history to help the user decide whether a full workup is desirable. During FY 1986 a clinician expert in hemostasis and blood banking joined the Expert Systems Program team to assist in the building of a third module, for advising emergency room physicians on blood component replacement therapy in cases of major trauma.

Expert Systems Program staff are currently involved in the start-up phases of a system to advise emergency response teams during hazardous substances emergencies and of a "cataloger's assistant" system to assist in the NLM cataloging process for new acquisitions. In addition, staff members are actively involved in the artificial intelligence initiatives of NLM's Unified Medical Language System project.

The extramural aspects appropriate to artificial intelligence research at the National Library of Medicine have been addressed in several ways. The issues of technology transfer have been explored by focusing on methods of delivering

these large-scale artificial intelligence programs on powerful microcomputers which are more widely available than the mainframe systems previously used. The porting of the development system called EXPERT to the IBM PC AT is an example of such an effort.

The dissemination of information on artificial intelligence in medicine has been addressed by working with LHCNBC's Audiovisual Program Development Branch in the production of a series of brief (10-15 minutes) videotape segments on medical expert systems. These taped productions help to explain artificial intelligence programs in presentations by the system developers themselves. When appropriate, they use electronic graphics to illustrate the reasoning process of the system being presented. The tapes are available through the standard library loan process for audiovisual materials.

In FY 1986, Dr. Kingsland of the Expert Systems Program worked with members of LHCNBC's Audiovisual Program Development Branch to develop an NLM-sponsored museum exhibit on "Artificial Intelligence in Medicine." This exhibit is a portion of a larger exhibition called "Robots and Beyond: The Age of Intelligent Machines" which opens at the Museum of Science in Boston in January of 1987. It will be in Boston for three months, then will appear in a total of eight major museums of science nationwide over the course of three years. The NLM-sponsored exhibit on artificial intelligence in medicine is a fully interactive computer-controlled videodisc system with touch-screen command input by the museum visitor, the overlaying of videodisc sequences with computer-generated graphics frames, and synthetic voice response to user choices. The Museum of Science estimates that three million

visitors will have seen this exhibit by the end of 1989.

Manuscripts describing research results of the Expert Systems Program Staff have appeared in journals and conference proceedings during the year. The AI/RHEUM system was presented to a standing-room-only group of attendees in a formal theater-style demonstration at MEDINFO 86, a triennial international conference in medical information. During 1986, AI/RHEUM was also the subject of a cover article in *MD Computing* magazine.

*Online Reference Works.* The Online Reference Works program, directed by Charles Goldstein, addresses the issues of how to use most effectively the extensive, published body of medical reference works in an online, interactive manner and how to aid in the scholarly process of text creation and maintenance. One objective of the program is to define and build a prototype of a "scholar's workstation" that would serve as an integrated information resource for both the creation and the retrieval of reference works.

Current work in the ORW program has evolved from earlier projects within the Information Technology Branch which addressed issues related to the effective management and dissemination of information from factual databases, i.e., collections of data and information other than bibliographic records. One of the earlier projects was the design of a system for online management and delivery of full-text data from the Toxicology Data Bank file, a collection of information on over 4000 toxic substances. A second project, and one in which there is continuing development, is the Network Access Workstation which aims at providing a

user-friendly, personal computer front-end to different online information systems. With the collaboration of the NLM's Specialized Information Services, the project has resulted in the Micro-CSIN™ (Chemical Substances Information Network) workstation, a PC-based system that can automatically logon to online databases, create a search that can be sent to over 200 different databases, and transform the retrieved data into a standard format. Work is under way to combine features of the NLM's GRATEFUL MED front-end program to MEDLINE with the multi-database facilities of Micro-CSIN.

Since retrieval from factual or full-text databases has been a common element in ITB's projects, a testbed system for evaluating retrieval strategies was developed in 1985 and has served not only as a test system but also as the foundation for an interactive retrieval system for end users. Designated IRX (Information Retrieval Experiment), the system has been used to conduct experiments in document ranking, word stemming algorithms, and the use of thesauruses. The testbed has been constructed as a series of extensible modules that permits independent evaluation of the different components of document retrieval such as query processing, document access methods, and the user interface. Since AI principles or rule-based systems could be used in modules of IRX, IRX can be considered a bridge between traditional access methods and fully developed AI systems. Implemented on a DEC VAX-11/780 in the C language, IRX has been transported to IBM PCs and, most recently, to Sun workstations in order to evaluate a high-resolution display device and a window environment.

These earlier projects have formed a foundation for ongoing work in collaboration with The

Johns Hopkins School of Medicine whereby concepts and prototypes developed at Lister Hill are being tested and evaluated in the operational environment of Johns Hopkins and the Welch Medical Library. The authoring and retrieval concepts have been implemented in a system based on the text, *Mendelian Inheritance in Man (MIM)*, Dr. Victor A. McKusick. The text, currently in its seventh published edition, is over 12 million characters in length and is considered the authoritative work in cataloging human inherited disorders. All text creation and revision is performed online and versions of the text are immediately available for retrieval. The efficiency of the text management system was demonstrated in preparing the seventh edition for publication: less than three weeks lapsed between the final updates to the text and the delivery of the phototypesetting tape to the printer. Users access the text online with IRX by entering a natural language query and obtaining a list of documents ranked in order of expected relevance. Other related data, such as a human chromosome map and a list of fundamental enzyme defects, have been linked to the MIM database and appear to the user as a single virtual database. Another linkage is being developed for a visual database of several thousand photographs and radiographs that will be stored on a videodisc and accessed simultaneously with the text description of a particular disorder. Besides being in daily operation at Johns Hopkins for the past year, the system has also been demonstrated at several medical genetics meetings.

#### *Automated Classification & Retrieval Program.*

The objectives of this program are to conduct basic and applied research which will lead to the

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development of automated systems for identifying, representing, and retrieving relevant information from biomedical documents. Current work includes the development of an interactive indexing aid and the development of a natural language understanding system.

The specific objectives of the indexing aid project are to develop and test interactive knowledge based systems for computer assisted indexing. A pilot system has been developed. The system represents medical concepts and relationships as frames in a knowledge base. This representation forms the basis for the interactive creation of document-specific indexing frames, and the generation of indexing terms from NLM's Medical Subject Headings (MeSH). Work continues both in expanding the knowledge base and in enhancing the interface to the system.

The specific objective of the natural language understanding project is to develop a system that will intelligently process biomedical text, with the result that access to biomedical information is improved. Current work is concerned with the development of a syntactic parser. A lexicon of biomedical terms and general English terms is being constructed, using data provided by text in NLM's MEDLINE system, by MeSH, and by medical dictionaries. Work continues in the enhancement of the parsing engine and in the development of morphological, lexical, and syntactic rules.

Work to construct a medical thesaurus is under way through a contract with Carnegie Mellon University. The purpose of the contract is to construct a thesaurus which will contain entries in the domains of the management and treatment of rheumatoid arthritis, diseases and findings in general medicine and in neurology, and links to the MeSH vocabulary.

*Biomedical Image Engineering.* The focus of this research area is electronic imaging technology in the capture, storage, processing, online retrieval, transmission and display of biomedical documents and medical imagery. Research areas include image compression, image enhancement, image understanding, pseudo-grayscale rendition, image transmission and networks, omnifont text recognition, and man-machine interface design. Research into imaging techniques that support medical educational packages employing digitized radiographic and other imagery are also included.

*Electronic Document Storage and Retrieval Program.* The NLM mandate to serve as an archive for preserving biomedical information is challenged by the deterioration occurring in a portion of its collection. In large part this deterioration is due to the use of acid-containing paper as a print medium, which may result in spontaneous destruction of printed works in as little as thirty years. The standard means for archiving such endangered materials is photographic. LHNCBC is investigating new electronic technologies as an alternative means of preservation which promises improved access and communications possibilities. Additionally, the principles governing the acquisition, storage, and retrieval of document page images are potentially applicable to a wide range of biomedical images.

A laboratory facility has been developed for investigating the role of electronic document storage and retrieval information processing activities. The facility is implemented as an integrated prototype system that includes document capture devices for both loose-leaf pages as

well as bound volumes, magnetic buffer storage, digital optical disk drives, high resolution softcopy displays rendering a legible bit-mapped image of a full page of a book or journal, modules for dynamic thresholding and pseudo-half-toning, high speed digital image transmission subsystems, and modules for image enhancement and manipulation. A system controller has been designed and implemented to control the basic functions of capturing the document images, transferring them to magnetic and optical disk storage, retrieving them in conjunction with bibliographic databases such as MEDLINE and CATLINE, and displaying them at remote workstations.

In the process of implementing archival storage capability in the prototype system by means of digital optical disk technology, research was conducted on hardware and software interface design techniques, image data transfer error performance, design factors limiting transfer rate, and modification of optical disk drives to interchangeably handle optical media having different characteristics. These studies have been reported in the technical journal literature.

To implement access to and retrieval of document images at a remote workstation, research was conducted in image transmission techniques. Three high speed (10 Mbps) digital transmission interfaces were developed using various signal modulation techniques, design factors affecting speed and reliability were identified, application protocols and software modules to support high speed image transmission were developed, and remote distance transmission was demonstrated. The demonstrations took the form of online document delivery of journal articles on normal pressure hydrocephalus in the Lister Hill Center auditorium (for the February 1986 Science Writers' seminar), in the Center lobby (as a part

of NLM's Sesquicentennial observance), and in the NLM Board Room (to a meeting of the Board of Scientific Counselors).

Document capture by means of the book scanner (for bound volumes and brittle material that would be damaged by rapid transport through the loose leaf scanner) results in page images that have borders and that are off-center. Software and hardware interfaces were developed to remove the borders electronically and to center the images. Apart from the aesthetic value of this processing, studies showed that it substantially improved image compression performance. Custom interface hardware was also developed to allow pseudo-gray (halftone) rendition of multiple gray level imagery.

In March 1986 an Experiment Plan for investigating document preservation by electronic imaging was presented for review by the NLM Board of Scientific Counselors. This followed a recommendation by NLM's Preservation Committee that while the Library should begin the preservation of its store of biomedical literature by microfilming and the mass deacidification of paper, research should proceed in the use of electronic imaging techniques and digital optical disk media for document preservation. The Plan identified several preservation objectives and the corresponding research questions. It also described experiments designed to address these questions by using the laboratory prototype system as a testbed. The issues of interest included throughput and conversion costs, document classification strategies, errors encountered in the conversion process, quality control strategies, and image enhancement techniques, among others.

To summarize this experiment in the period since April 1986: the NLM collection has been

randomly sampled, the items in the assembled sample have undergone conversion (from bound volumes to bitmapped images on optical media), tools to support data collection, reduction and analysis were developed, data on document characteristics and system performance were collected, and data analysis is currently proceeding. The Experiment Plan divided the overall effort into five parts:

1. Throughput and Conversion Costs
2. Document Classification
3. Error Evaluation and Quality Control Strategy
4. Optimal Scheduling
5. Man-Machine Interface Evaluation

By the close of FY 1986, progress included the following: In conducting the experiment investigating document throughput, a random sample of about 6000 pages from nearly 400 volumes was assembled in line with established statistical procedures and underwent conversion using the baseline system and procedures. Detailed timing data (mean time distributions) was collected for each stage of conversion. Preliminary analysis of this data led to a deeper understanding of the process and helped in the development of detailed workflow diagrams for the different stages. The data has also helped clarify the role of the system design factors (both hardware and software) that introduce delays in image data flow and thereby reduce throughput. The collected data therefore is a sound basis for further analysis leading to design specifications for an operational system.

A cost model was developed on the basis of certain assumptions. The conversion process is dominated by the two most time-consuming stages, document scanning and quality check

(QC). The model is undergoing further refinement (e.g., to include the remaining stages and introduce cost dependencies in systems parameters) to allow its use as a tool for tradeoff analyses.

For document classification, over a dozen optical and mechanical characteristics of the approximately 400 volumes were recorded. Cluster analysis resulted in creating six document classes and a formula that allows a document picked arbitrarily from the NLM collection to be placed in one of the six classes. The identification of these classes is a basis for estimating improvements in throughput and cost over the baseline system and procedures by batching document by class.

In the experiment investigating error performance and a quality control strategy, the baseline procedure developed for quality control involved: a quick check of the image after initial scan, a check of the quality and retrievability of the image on magnetic disk followed by a rescanning if necessary, and a final check of the image on optical disk. The contribution of quality control to throughput was determined. The types and frequency of errors were also determined. As a result of error rate tests it was found that the magnetic disk to optical disk transfer was error-free. Consequently the quality control procedure was modified to eliminate the final check on the optical disk.

This research into the applicability of electronic imaging to the problem of preserving the biomedical literature is continuing. An interim report on this work was presented to the Board of Scientific Counselors in November 1986.

*Digital Biomedical Image Processing.* This R&D area involves the development and evaluation of



improved techniques to capture, store and display medical images for computer-based education systems. Techniques presently being implemented and evaluated include digital capture and encoding of radiographs to improve the signal-to-noise ratio, and window techniques to provide high resolution images in video format on standard television video (also called NTSC) systems. Compared to analog systems, these techniques provide improved image quality on low cost personal computer workstations.

Image processing techniques are also being explored to isolate and display localized regions of interest on digitized radiographic images. As part of this research, a prototype x-ray imaging system (XRIS) has been developed using an IBM AT controlling a "frame grabber" subsystem and a CD-ROM storage unit capable of online access to half a gigabyte of image data and displaying a  $512 \times 512$  pixel image.

The Center for Devices and Radiological Health supported the project with images from its library of digital x-ray images. Fifty-eight cases, a total of 121 images, were selected from the library for the XRIS visual database. Cases selected included examples of different body areas, with images for both male and female, and patient case impressions for different age groups.

Each image in the database is provided with a patient history text file and two bit map files, one consisting of a low resolution image and the other a high resolution image. The low resolution image files are structured as eight bit binary files with a spatial resolution of  $512 \times 512$  pixels with gray levels. High resolution files use the same data structure and contain  $2048 \times 2048$  pixels of spatial resolution. A menu driven user interface to a relational database was developed to retrieve and display image files. The database

is structured using a record management system allowing relational access to the files by case number, medical impression, and body area. This retrieval schema was developed to support the prototype system; any future retrieval system will be integrated into the host computer-based educational system it supports.

Because the bandwidth and spatial resolution of NTSC (TV-like video) systems limit the display capability of the monitor to the size of low resolution images, a windowing technique is used to display segments of the high resolution image. Each low resolution image contains one-sixteenth the area of a high resolution image; this is equivalent to an image one-fourth the height and width of the full high resolution image. Therefore a moveable fixed size window is superimposed onto the low resolution image which correlates to a mapped segment of the high resolution image file. By locating this window over a selected area using a "mouse" pointing device, the system can effectively increase the resolution of that area by a factor of sixteen, that is, equivalent to the resolution yielded by a  $2048 \times 2048$  pixel display.

In addition to the XRIS prototype a laboratory system involving a high resolution ( $2048 \times 2048$  pixel, 8 bit/pixel) gray scale image capture system, and a Gould IP8500 Image Processing System hosted by a DEC PDP 11/44 has been developed for the capture and processing of high resolution digitized biomedical imagery. Software developed inhouse allows zoom, scroll and roam through a  $2048 \times 2048$  pixel bit image with a  $1024 \times 1024$  pixel display.

*Audiovisual Program Support.* The Audiovisual Program Development Branch (APDB) applies current and emerging video communications

technologies and audiovisual techniques to Lister Hill Center research, development, and demonstration projects and to the information needs of the health sciences community.

In order to achieve its program goals, APDB maintains a major videodisc mastering facility, improving and enlarging its capabilities through a constant upgrading effort. A sophisticated electronic videographics system, activated in 1986, and the installation of improved one-inch videotape recording equipment have allowed the facility to incorporate state-of-the-art visual techniques in the development of project materials. A flexible, computer-controlled still video transfer system ("The Rig"), to be installed in December, 1986, will enable the Branch to integrate slides, transparencies and hard-copy visuals into videotaped project materials with higher quality and with greater effectiveness than was possible in the past.

In support of the NLM Sesquicentennial Year activities, the Branch videotaped the U.S. Congress Joint Resolution Announcement Ceremonies at the Capitol on February 5. Also on that date, a Library-sponsored Science Writers Seminar was videotaped in the Lister Hill Center Auditorium, as were program demonstrations during an April 11 NLM Open House, a Medicine and the Arts Colloquium on April 22, a lecture by Dr. Albert Sabin on May 28, a symposium on the NLM: Past, Present and Future on September 16 and a Space Medicine Colloquium on November 13. Numerous additional Sesquicentennial-related events, including the production and installation in Ford's Theatre of a special Interactive Videodisc Sampler, highlighting a number of NLM and Lister Hill Center programs and projects, were completed.

APDB continued working with the TIME project during 1986 (described in the Educational Technology section, following). Materials from the first TIME project, "The Case of Frank Hall," were re-edited as a pre-master videotape for the production of a standalone Level II (programmed) videodisc, which was installed in the NLM Visitor's Center in June. This and most other interactive videodisc projects, continue to make use of DRAW (Direct Read After Write) videodiscs as programming and editing tools, prior to the manufacture of final optical videodiscs—an approach developed during FY 1985. A wide variety of location videotaping and considerable computerized editing went into the pre-mastering of three videodisc "sides" of a second TIME project on the subject of obesity, "The Case of Patricia Fletcher."

A collaborative effort with the National Institute of Mental Health was completed this year, with the production of an interactive videodisc on "Adolescent Depression and Suicide." Another collaborative project—this one with the NIH Office for Protection from Research Risks—resulted in the production of three videotape programs explaining the history, problems and procedures necessary to assure protection of human rights and health in the conduct of medical research.

To expand its usefulness to foreign visitors and health sciences personnel abroad, Japanese and Chinese versions of the NLM program "Communicating for Health" were produced. Sixty-three radiographs and fourteen photographic prints were video recorded, using both physical and electronically produced masking for technical quality comparison, and an eight-inch videodisc of "Mendelian Inheritance in Man/

Prototype Visuals" was pre-mastered, in cooperation with an Information Technology Branch human genetics information project. An optical videodisc was pre-mastered on the subject of orthopedics, with "Arthroscopy: the Chronic Unstable Knee" on one side and with "Segmental Micro-Cryoanatomy" slides and "CT and MR Imaging" sequences on the other side.

Project work, including the integration of BOSCH-generated electronic videographic sequences, continued on five videomicroscopy programs: "Necrosis," "Acute Inflammation," "Chronic Inflammation," and "Circulatory Disturbances- Part I and II." A German version of the "Necrosis" program was also produced for evaluation.

The Branch continued development of NLM education program materials with the production of three videotape programs on the Library's information storage and retrieval systems: "MEDLARS/An Overview," "MEDLARS/Indexing" and "MEDLARS/DOCLINE."

In collaboration with Dr. Gordon Sharpe and the AI/RHEUM project at the University of Missouri, 1,700 stills and additional graphics were pre-mastered for conversion to an "AI/LEARN" optical videodisc.

Working with Dr. Frank Allan, GWU School of Medicine, the Branch finished video recording some 3,000 histology slides which, enhanced with graphic descriptors and other visual aids, will be indexed and pre-mastered for interactive videodisc conversion for use in microanatomy teaching units.

APDB's Graphics and Still Photography Labs continue to provide visual materials to Lister Hill Center research and demonstration projects and to other elements of the Library. The Graphics Lab contributes to the upgrading of the Branch's

premastering facility through the generation of numerous and creative electronic videographic animation sequences. The Still Photo Lab will have similar responsibility for the effective operation of a new computer-controlled still video transfer system to be installed in early FY 1987. The Branch also provides projection, audio recording and other audiovisual support to meetings scheduled in the Lister Hill Center Auditorium and the NLM Board of Regents Conference Room.

The Branch provided extensive coordination, consultation and technical support to a number of specialized programs making use of the LHC Auditorium. Among these were two Texas Instruments-sponsored teleconferences on Artificial Intelligence (November 13, 1985 and June 25, 1986); a USIA/Worldnet MEDCOM '85 two-way satellite teleconference, linking American cardiovascular experts in the Auditorium with Russian counterparts in Moscow (December 16, 1985); and the live origination of a four-site, two hour teleconference, aired on national television, of a Public Broadcasting Service "Frontline" program on Acquired Immune Deficiency Syndrome (AIDS). This complex event entailed several weeks of detailed planning with PBS and its sub-contractors. APDB's coordinating role included working with the microwave transmit unit, two satellite receive units, telephone communications group, audio and lighting contractors, staging contractors, security personnel and program producers.

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#### Educational Technology

*TIME PROJECT.* The TIME project has created an innovative form of patient simulation which embodies the powerful capabilities of interactive

videodisc, voice recognition and microprocessor technology. This educational model shows promise of providing faculty with the ability to conduct patient-centered, problem-oriented classroom sessions for medical students at virtually any level of their training.

Specifically, the TIME Project is asking the following research questions: 1) Can the new technology support the systematic inclusion of patient-centered, problem-oriented, experimental learning strategies in the existing medical school curriculum? 2) Is the model useful and effective as a resource to aid faculty teaching of medical facts concepts and clinical decision-making? 3) Is the model a useful and effective strategy for teaching medical students the non-cognitive characteristics (e.g., attitudes, values and psychosocial concerns) which are essential to the medical practitioner? 4) Does the model provide an effective educational strategy for medical students to learn medical concepts and their relationship to illness and the patient condition? 6) What is the actual cost of creating and implementing these interactive case studies?

A prototype demonstration videodisc of the TIME interactive case study model was produced in 1985. The videodisc-based simulated patient, "Frank Hall," is an alcoholic with a bleeding duodenal ulcer and a variety of life problems. The purpose of the demonstration disc was to show educators what is possible in terms of innovative teaching approaches using the capability of the new technology. In October 1985, the TIME Project received, on behalf of the National Library of Medicine, the Best Educational Achievement Award for the Case of Frank Hall. The award was presented by the Nebraska Videodisc Design/Production Group at the annual symposium in Lincoln, Nebraska.

Fourteen major presentations were made during the remainder of 1986 to a variety of professional groups. In addition, five papers concerning the work of the project were written, submitted and accepted for publication during FY 1986.

During the first six months of 1986, the demonstration disc was expanded into a fully operational program. In May, the Case of Frank Hall was presented to second-year medical students at Georgetown University in a preliminary field trial. The case was included in the Introduction to Clinical Medicine gastroenterology seminar by a Georgetown instructor with the assistance of Dr. Harless, Project Director.

Analysis of the data gathered from pre- and post-tests and a questionnaire showed that students mastered the content objective of the curriculum with this approach while feeling positive about the interactive case study method compared to the paper case study method employed by the school. In July, the TIME Project was awarded NIH set-aside evaluation funds to conduct an expanded field test of the TIME model at selected medical schools in 1987.

The TIME project staff designed the Case of Patricia Fletcher during 1986 and, with the cooperation of Dr. William Ayers, Undergraduate Dean of Georgetown Medical School, and staff members from Georgetown University accomplished the video production of that case. The Patricia Fletcher case involves a 48-year-old female college professor with a history of obesity from childhood. The case study was developed around contemporary patient management options including the Garren-Gastric Bubble, gastroplasty and outpatient monitoring. The design also includes multiple crisis probabilities and performance feedback. This case was

developed with the intention of including it in the expanded field test.

Plans for 1987 revolve around extensive field testing, evaluating and documenting the classroom use of the interactive case studies developed by the TIME Project staff. To this end, an educational committee of senior medical educators (Dr. George M. Miller, Dr. Donald W. King, Dr. Edward N. Brandt and Dr. Edmund Pellegrino) was convened at the Lister Hill Center to advise the Center. Dr. Robert Duncan of the University of Miami Medical School was engaged to consult with the project staff concerning the experimental design for the field tests.

*Dermatology.* Activities of the Dermatology project included continuation of the consulting relationship with Dr. Antoniette Hood, Johns Hopkins University, which contributed to development of a dermatologic image videodisc; presentation/demonstration of the disc at the American Association of Dermatologists' annual meeting; and two investigations of videodisc-based dermatologic images, both conducted at The Johns Hopkins University with local staff cooperation. In other collaborations, the project obtained 800 photographs of febrile eruptions from Dr. W.V. Stoecher of Rolla, MO, and participated in the experimental recording of dermatologic images, using flying spot scanner facilities of the U.S. Video Corp., Vienna, VA.

*Computer Based Curriculum Delivery System.* The Computer-based Curriculum Delivery System (CCDS) project expanded its field testing network from 38 to 50 schools of the health professions and recruited five new authors for the pathology series, thus assuring completion of that project in FY 1987. Four of the network schools have produced their own videodiscs, an indication that CCDS is achieving some success

in its goal of facilitating adoption of new technologies by medical educators. Two CCDS projects, Teenage Suicide and Orthopaedic Surgery, were completed during the year. Together, they represented the planning and development of five videodisc sides and three related computer programs. Dr. Woods presented program plans and demonstrated by invitation at the annual meetings of the American Academy of Orthopaedic Surgeons, American Psychiatric Association, American Psychological Association, and American Suicidology Association. Dr. Woods also assisted European colleagues in organizing an international meeting (DOCMED EUROPE87) to be held in May 1987, in Amsterdam.

*National Learning Demonstration Center.* The National Learning Demonstration Center (NLDC) opened in March 1985 as a central location where various computer-video information and educational technologies are demonstrated, reviewed, and evaluated. The NLDC also serves as a laboratory where visiting scholars can spend extended periods of time exploring comparative applications and developing evaluation methods for assessing the impact of specific technologies.

The NLDC staff assist visitors in a variety of ways. Individual or small group tutorials are provided depending on the interests, needs and time commitment of visitors. Tutorials range from a general overview of computer-based and video education/information systems in the health professions to self-tutorials and hands-on experience with individual systems. Demonstrations are also provided to illustrate the diversity among system attributes and the alternatives available for courseware design and delivery.

Exhibits available in the NLDC represent examples of education and information technologies developed by staff of the LHCNBC, by individuals at other institutions, and by

private companies. Exhibits are organized in five categories:

- Health Science Education and Information Networks
- Stand-alone Microcomputer Courseware
- Interactive Videodiscs
- Courseware Authoring Tools
- Knowledge-based Information Systems

More than seven hundred health professionals visited the NLDC in FY 1986. In response to their needs and interests the NLDC staff conducted three hundred demonstrations. In addition, two national medical organizations included visits to the NLDC as part of their formal meeting agenda: the American College of Cardiology Conference on Cardiovascular Teaching Techniques and the 63rd annual session of the American Congress of Rehabilitation Medicine.

NLDC staff, in collaboration with the Audiovisual Program Development Branch, designed and developed a National Learning Demonstration Center exhibit to celebrate the National Library of Medicine's Sesquicentennial. The exhibit highlighted information and education technology programs of the Lister Hill National Center for Biomedical Communications and was presented at the Library's "Open House" and at the Biomedical Information Technology Fair held at the University of Maryland, Health Sciences Library.

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#### Research in Support of NLM Operational Goals

*PH Testing of NLM Holdings.* The NLM's commitment to preservation of the world's biomedical literature is complicated by the fact that many biomedical publishers do not know if

the paper which they use to publish their journals is acid free. The large number of paper producers makes it difficult to find readily available data about the acid/alkaline nature of the papers in use by biomedical publishers. In order to assist the Library Operations Division survey the chemical characteristics of the paper in serials acquired by the Library, the LHCBC began a pilot project to test selected samples of book and periodical papers for pH (and alkaline reserve, if applicable) over a period of seven months beginning in the early fall of 1986.

*Library Growth.* The Library Growth project completed the data analyses for a major study/report on recent research library trends and prepared major portions of the report, which is scheduled for completion early in FY 87. (Evidence indicates that, for 35 years, research library expenditures have increased at an annual compounding rate of 9%; if continued, this rate will result in growth from a 1985 level of \$10.8 million expenditures per research library to \$16 million in 1990 and \$20.7 million in 1993). Project staff also collected and organized data required for related studies of other research and medical libraries, including NLM. Status reports on the work were presented to Council on Library Resources staff, ARL Statistics Committee, ARL membership, and the NLM Library Operations staff. The project continued its collaborations with Dr. Paul Games, Penn State U.; Maxine Sitts, ARL headquarters staff; and Kendon Stubbs, Alderman Library of the University of Virginia, and it sponsored an informal "first annual" meeting that included these collaborators, plus five additional colleagues with interest in library statistical studies.

## Extramural Grants and Contracts

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*Programs and  
Services, FY 1986*

The National Library of Medicine's Extramural Programs provide assistance opportunities in a variety of areas consistent with the NLM mission, using a number of competitive award mechanisms which best facilitate specific program objectives. Authorities for NLM grants and contracts come from two Public Laws, the Medical Library Assistance Act (MLAA) of 1965 and extensions, and Section 301 of the Public Health Service Act as amended. Together these comprehensive laws provide the basis and conditions for financial support for any appropriate area of NLM interest or concern and to any qualified institution or organization which has the capability of carrying out the purpose of meritorious projects. Scientific merit of individual applications is determined using a system of peer review which is identical to other grant funding units of the National Institutes of Health. The current set of priority grant programs, funding mechanisms and examples of recent awards are described later in this chapter. Regional Medical Library contract activities, as authorized by the MLAA, are described in the section on Library Operations.

In the 150-year-old family of the National Library of Medicine, the Extramural Programs Division is a relatively young member. However, NLM's sesquicentennial year of 1986 also marks the twentieth anniversary of an annual grants appropriation for extramural assistance activities. The NLM grants program, an innovative experiment in the mid-1960's, has matured in tandem with the relevant, rapidly advancing technology. Architects of the 1965 MLAA, while recognizing the potential change in the management of information and knowledge, could not have foreseen the direction or the extent of this change. The charts (Figures 1 and 2) provide some indication

of the shifting emphasis in areas of grant support between the first and second decades of NLM's assistance programs.

If the NLM 1966 grant authorities have come of age in the opportunities they provide, they continue to lag fiscally when measured against the success of other health-related assistance. Twenty years before the MLAA, the "golden age" of NIH extramural activities began. In the succeeding twenty years, NIH extramural support increased more than 100 fold and, with every advancing year and virtually every recorded grant, widened the gap between the body of health knowledge and the effective means to make that knowledge available. If the tenets of the NLM 1986 planning effort are given their due, the next twenty years could eliminate that gap.

In the dual celebration of the NLM sesquicentennial and the Extramural Programs vicennial, it seemed appropriate to set aside an "Extramural Programs Week." The week of March 10-14 was so designated. On March 10-11, 1986, the Program Directors and the trainees from each of the five training sites convened at NLM. On the morning of the first day NLM staff from the Lister Hill Center, Specialized Information Services, and Library Operations presented and demonstrated some of their ongoing research. In the afternoon, while the Directors were meeting with senior NLM staff, three trainees demonstrated models and simulations which formed part of their research. The following day 25 of the trainees gave presentations of their research results or their research plans. The papers fell into four broad categories: Knowledge Management, Medical Decision Making, Knowledge Representation, and Expert Systems.

The next event of the special week of Extramural Programs activities for the Sesquicentennial

Year, held on March 12, was a second IAIMS Symposium. IAIMS—Integrated Academic Information Management Systems—is a relatively new NLM initiative. The Program's primary objectives are to support the planning and development of comprehensive, integrated information networks of computer-based systems and services in academic institutions, and to apply such systems to advancing health sciences education, research, patient care, and management. The theme for the second symposium was the support of health sciences education by IAIMS. More than 200 academic health center senior officials, deans, librarians and hospital directors, representing some 85 institutions, heard reports from institutions that are involved in IAIMS planning and development, and from individuals engaged in innovative educational programs. Proceedings for the symposium have been published.

Although a number of participants in those two special week events were also members of NLM's principal grants review group, it was more than logistical convenience that the third event, on March 13-14 of Extramural Programs (EP) Week, was a meeting of the Biomedical Library Review Committee (BLRC). To the contrary, it is this committee and the peer review system that it represents and executes, which are the foundation of all NLM and NIH grant programs. Members of the 1986 BLRC are found in Appendix 5.

In addition to the EP Week events, the Publication Grant Program and the Special Foreign Currency Program were the subject of a special sesquicentennial exhibit (prepared in collaboration with the History of Medicine Division) at the Annual Meeting of the American Association for the History of Medicine, held in Rochester, New York, April 29-May 3, 1986.

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### Research Grants

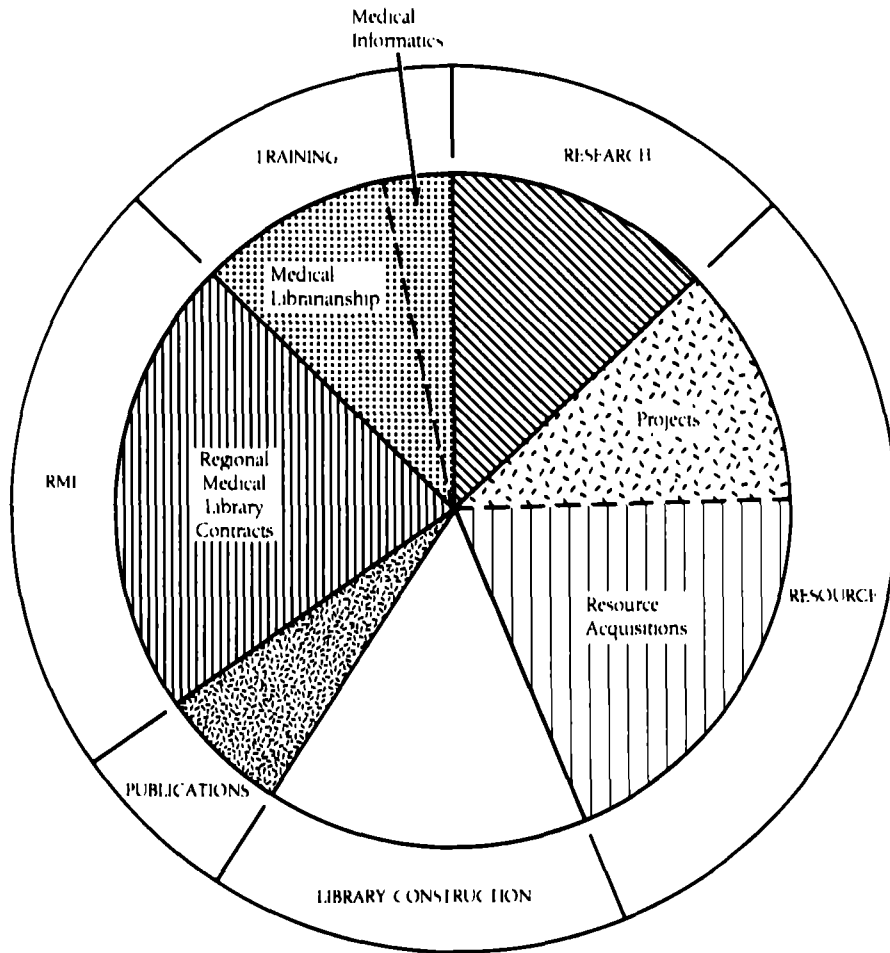
As in past years, the library continued to offer assistance to research investigators concerned with health knowledge issues. Following the usual highly selective review of grant applications, five new awards were issued. Although small in number, they cover the full range of theoretical through applied research endeavors in medical informatics. NLM also continued support for awards committed in earlier years. NLM's awardees are highly regarded members of several health information professional societies. They were also highly visible through presentations and other activities at MEDINFO 86, an international meeting of workers in health information disciplines which met in Washington in October.

Medical informatics is an interdisciplinary field which combines the medical sciences with other sciences in the information, computer, linguistic, and behavioral domains. The field therefore represents a coalescence of more traditional disciplines, due in large part to the emergence of advanced computing and telecommunications capabilities. Attempting to harness these technologies to the constantly enlarging body of biomedical knowledge has by itself given rise to many fundamental problems about knowledge representation, human cognitive processes, and adaptation of new information behaviors to practitioners' daily routines. NLM's research grant program is the only Federal program specifically concerned with knowledge issues and health. As such, it is not constrained by specific categorical disease.

Among the new work supported, Dr. Marsden Blois at the University of California, San Francisco, will probe the origin of structure in

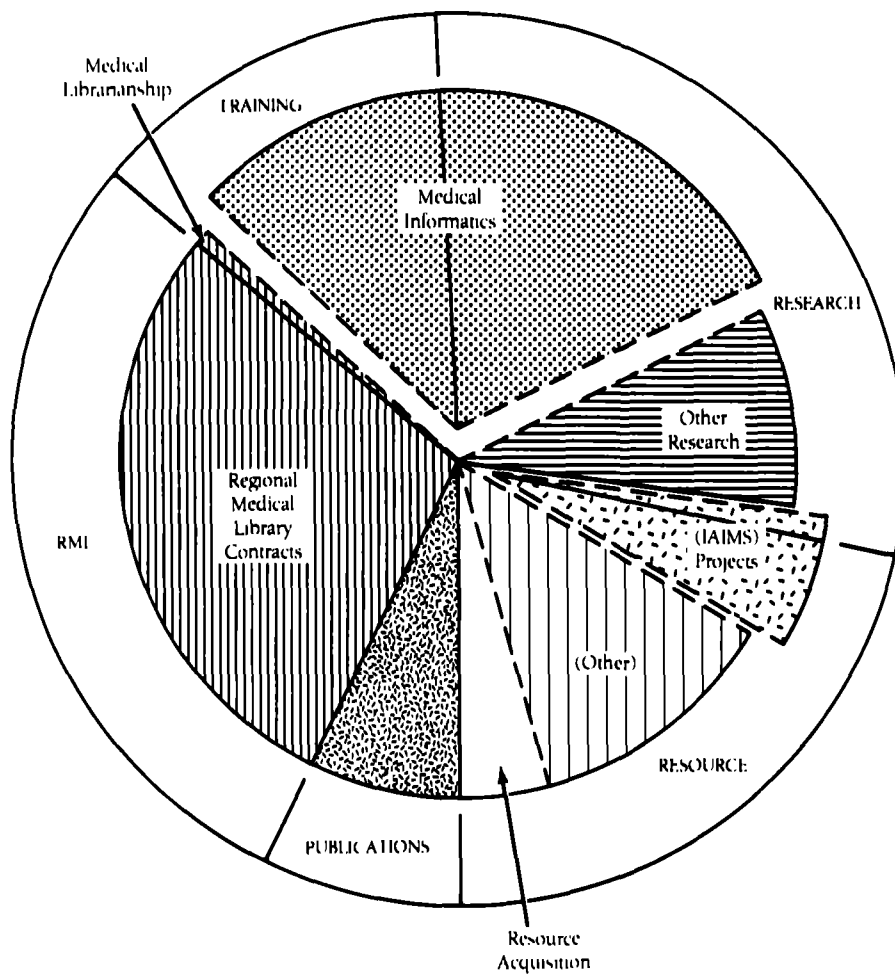


Figure 1



Extramural Awards  
FY 1966-1975 (\$75 million)

Figure 2



**Extramural Awards  
FY 1976-1986 (\$100 million)  
Emphasis to New and Expanded Program Priorities**

medical databases. Dr. Blois is the author of the definitive text, *Information and Medicine, The Nature of Medical Descriptions*, which was written in part with NLM support.

At the University of Southern California School of Medicine, Dr. Bharat Nathwani is investigating a system for computer-aided diagnosis of lymph node pathology. In doing so, he will draw upon a team of nationally known pathologists together with younger workers studying artificial intelligence methodologies in medicine.

Professor Arthur Elstein at the University of Illinois is investigating the similarities and differences of decision-making by experts and novices in intensive care situations.

At Cornell University, Dr. Roy Pollock is extending his concept of computer-based knowledge nets for medical information. The project involves knowledge in both human and veterinary medicine.

Dr. J. Robert Beck at Dartmouth College Medical School received a Research Career Development Award for his ongoing studies in theories of medical decision-making.

As one of its final awards for the year, NLM was able to renew support for Professor Harry Pople at the University of Pittsburgh. His highly advanced concepts of inferencing mechanisms for medical knowledge bases take the form of CADUCEUS, a computer-based diagnostic consultant for internal medicine.

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#### Training and Career Development

The National Library of Medicine continues its support of postdoctoral research training in the field of medical informatics. It is clear that this discipline goes beyond the use of the computer

as a computational tool and extends into the process of knowledge representation, storage, retrieval, and manipulation largely to support inferential reasoning and to rationalize decision-making in the health sciences. There remains a need for qualified talented investigators, well equipped to address fundamental issues in the use of computers and automated information systems in health care, health professions education, and biomedical research. These investigators will contribute to the growth of science by their studies of knowledge management and by advancing the frontiers of the computer sciences for organizing, retrieving, and utilizing health knowledge. It is also intended to foster medical informatics as a growing discipline with an appropriate place in academic medicine. It is expected that the trainees will become able, cross-disciplinary translators, taking the computer sciences to all of medicine.

Twenty-nine individuals are currently being supported at the five training sites:

- *University of California, San Francisco.* This postdoctoral training program is broadly based in the field of medical information science. Research areas include clinical database projects, decision support programs, and user software engineering.
- *University of Minnesota.* The focus of this interdisciplinary program is to provide training in cognitive, information, and computer sciences for academic researchers who will address fundamental issues in the management and clinical application of health knowledge.
- *Harvard Medical School.* Major emphases are computer-based decision support systems, modeling of physician decision-making, representation and structuring of medical

knowledge, applications of information technology to medical education, database and data analysis systems, computer graphics, and development and evaluation of digital imaging systems.

- *New England Medical Center.* This research training program emphasizes clinical decision-making, the use of microcomputers, artificial intelligence tools for structuring and using medical knowledge, clinical cognitions, and the use of medical informatics in medical education.
- *Stanford University.* All students, including postdoctoral trainees, are enrolled in a formal Master's or Ph.D. program and specialize in either medical computer science or medical decision science.

The National Library of Medicine also offers research grant programs in the fields of medical informatics and in health information science designed for individuals who have completed postdoctoral training and are now embarking on an independent research career. The First Independent Research Support and Transition (FIRST) Award is such a mechanism. It replaces the New Investigator Research Award and provides five years of support and a maximum total direct cost of \$300,000 for the five-year period.

To be eligible for this award the principal investigator must be a beginning investigator who is not in training status and who has not been designated previously as principal investigator on any peer-reviewed project supported by the PHS. Because the FIRST Award was initiated and announced this year, NLM was not able to make any awards. We continued to support the four New Investigator Research Awards already in existence.

The next career supporting mechanism utilized by NLM is the Research Career Development Award. These awards are given to institutions on behalf of candidates with promising research potential. The grants provide five years of salary support so that the individual can develop and advance as an independent investigator. The award is intended to make a significant difference to the individual's career growth. Research resources and support are not provided as a part of this award but must be available for use of the awardee.

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#### Resource Grants

Resource Grants are directed towards the nation's health science libraries and provide "seed money" to improve information resources and to enhance information services to the ultimate users whether they be faculty, students, researchers, or practitioners. Resource Grants are of two types—the Resource Improvement Grant and the Resource Project Grant—and offer assistance over a broad spectrum ranging from book and journal purchases in rural hospitals to installing computers in medical school libraries to automating internal technical operations. These grants require substantial cost sharing from the institutions to assure that the resources and services initiated with NLM funds will be continued.

The Medical Library Resource Improvement Grant is intended to develop book and journal resources in institutions which have not previously supported a library. These grants are available to single health science institutions, usually hospitals, as well as consortia of organizations which are involved in some aspect of the health sciences. The intent is to foster a

collaboration of a variety of organizations in order to maximize the information resources available to all. Such partnerships have joined hospital libraries with public libraries, community college libraries, county health agencies, to name a few. In 1986, Resource Improvement Grants were awarded to eight hospital libraries and to one consortium encompassing health-related institutions in the five northern counties of Idaho.

Medical Library Resource Project Grants are directed toward libraries which are already established and providing services. The purpose of the grant assistance is to initiate an information service or to expand an existing one. Support is available for up to three years depending upon the nature of the project, some requiring more or less time to become operational and to obtain alternative funding, since the NLM grant assists only in the large initial start-up costs. In 1986, three Medical Library Resource Project Grants were awarded. At the University of California the five medical school libraries are cooperating to add the MEDLINE periodical database to the previously computerized book catalog called MELVYL. Eventually the automated journal and book catalog will be extended to all University of California campuses. At the University of Texas at San Antonio the health sciences library, which is already equipped with a computerized system, is adding a drug information component in order to have drug data available within patient care areas. In the state of New Jersey a computerized library system is being established to connect the four campus sites of the University of Medicine and Dentistry of New Jersey.

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### **IAIMS Program**

Grants are awarded to assist medical centers and health science institutions in planning and development projects leading to the implementation of Integrated Academic Information Management Systems (IAIMS). IAIMS are institution-wide computer networks that link and relate library systems with individual and institutional databases and information files, within and external to the institution, for patient care, research, education, and administration. The goal is to create an organizational mechanism to manage more effectively the knowledge of medicine, and to provide for a system of comprehensive information access.

The IAIMS concept was originally described in a study sponsored by the NLM and developed by the Association of American Medical Colleges: "Academic Information in the Academic Health Sciences Center: Roles for the Library in Information Management." The report strongly recommended that the scholarly record and medical databases be brought together in an integrated network of computer-based systems and services. The primary objectives of the IAIMS Program are to assist in the development of such comprehensive networks, and to encourage the rapid integration of information technologies in health sciences education and practice.

NLM provides grant support for: 1) institution-wide IAIMS planning and policy analysis; 2) model development and testing of some segment or cross-section of the IAIMS plan; and 3) implementation of detailed, tested plans for a full-scale IAIMS. These phases of IAIMS activity are considered sequential, and successful completion of one stage is required before beginning

the next. Grant support is also provided for research projects related to IAIMS activities. IAIMS sites provide an expedient opportunity to exploit advances resulting from medical information science research, as well as a locus for a multitude of studies to improve information access and use in the health sciences.

During FY 1986, ten IAIMS planning and development projects were active; three were continuing, based on support received in FY 1985. IAIMS Phase I Planning was under way or nearing completion at the Baylor College of Medicine, Harvard University, Johns Hopkins University, and the University of Cincinnati. Having successfully completed institutional IAIMS planning, IAIMS Phase II Model Development and Testing was under way at Columbia University, Georgetown University, the University of Maryland, and the University of Utah. Reports of activities at each of these institutions were given at the second IAIMS Symposium cited previously in this Extramural Programs section.

Two new grants to begin strategic planning for IAIMS made during FY 1986 represented the first to a hospital and the first to a national medical specialty society. In approving the grant application from Rhode Island Hospital (Providence), the NLM reviewers stated that this institution provided an excellent example for demonstrating the relevance and effectiveness of IAIMS in a hospital setting. In their grant application, the American College of Obstetricians and Gynecologists (ACOG), Washington, D.C., cited numerous references to professional associations in the AAMC report that gave rise to the IAIMS program, and carefully delineated a series of activities and programs to develop and extend the IAIMS concept for a national community.

Two IAIMS research projects were active with continuation grant awards made during FY 1986. Investigators at the Baylor College of Medicine are studying the problem of integrating several local area networks (LANs), designing an advanced work station, and exploiting a specialized data management computer to advance IAIMS development, user interaction with IAIMS, and common access. At Georgetown University, the assessment of the information needs of health professionals in a Comprehensive Cancer Center will lead to the design and provision of an experimental library module. Evaluation of the module will give rise to guidelines for creating specialized information services, and thereby serve as a model for implementing the IAIMS concept broadly in an academic medical center.

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#### **Publication Grant Program**

Biomedical scientific publication grants expedite the availability of health information important to medical progress. The Publication Grant Program provides selective, short-term support for a variety of not-for-profit publications, including critical reviews and monographs in health fields; publications in library and information science and in biomedical communication; temporary support for periodical publications; studies in the history of medicine; translations of current foreign biomedical monographs; proceedings of symposia related to U.S. health needs; and secondary literature tools in the health sciences (such as annotated bibliographies, catalogs, and atlases). Together with its complementary activity, the Special Foreign Currency Program (described in the chapter on International Programs), the Publication Grant Program is administered by the

**Table 10**  
**Extramural Grant and Contract Program**  
(Dollars in Thousands)

Category	FY 1984		FY 1985		FY 1986	
	Number	Amount (\$)	Number	Amount (\$)	Number	Amount (\$)
Research . . . . .	129	\$2,399	39	\$5,431	35	\$5,609
Resource Projects . . . . .	16	1,114	25	2,507	19	2,604
Resource Improvement . . . . .	22	614	17	528	15	190
Training . . . . .	9	786	5	1091	5	1095
Regional Med. Libraries . . . . .	7	2,000	7	2054	7	2325
Publications . . . . .	20	587	15	403	16	426
(IAIMS Projects)* . . . . .	(2)	(134)	(11)	(1,717)	(9)	(2,205)
(Med. Info. Research) . . . . .	—	—	(31)	(4,489)	(27)	(4,029)
<b>Total . . . . .</b>	<b>103</b>	<b>\$7,500</b>	<b>108</b>	<b>\$12,014</b>	<b>97</b>	<b>\$12,249</b>

\*Includes both IAIMS Resource & Research Projects

**International Programs Branch of NLM's  
Extramural Programs Division.**

During FY 1986, NLM awarded 16 Publication Grants, totaling \$426,609. Of these, 10 were new awards, including one for the development of a handbook on clinical and legal issues for mental health practitioners, so that psychiatrists and others caring for mental patients may have the knowledge necessary to make clinical decisions confidently, while cognizant of legal requirements. The average amount of a Publication Grant in FY 1986—approximately \$27,000 in both direct and indirect costs—reflects the continuing emphasis in this program upon high quality, but low-cost, projects that are scheduled for early publication.

Among the studies published in FY 1986\* which the Publication Grant Program funded was a monograph on *Steroid-Protein Interactions II*, by Ulrich Westphal (New York: Springer-Verlag, 1985), which is a critical review of research carried out in many countries during the last fifteen years on interactions between steroids and proteins. The author is a world-recognized authority in this field and his review is expected to be a major source book for researchers for years to come. Another significant volume published this year is the first part of a new listing and description of all genetic and cytologic variations known in *Drosophila: The Genome of Drosophila melanogaster, Part 1: Genes A-K*, by Dan Lindsley and Georgiana

\*See Appendix 2 for a complete listing of publications received in FY 1986 resulting from NLM Extramural Program support

Zimm (*Drosophila Information Service*, No. 62, 1985). Since publication of the original volume in 1968, prolific research has led to an explosion of information, thus making updating of the catalog of this material crucial to continued rapid progress in *Drosophila* genetics. Also completed this year with grant support was a book on the origin and early years of the National Institutes of Health: *Inventing the NIH: Federal*

*Biomedical Research Policy, 1887-1937*, by Victoria A. Harden (Baltimore, Maryland: The Johns Hopkins University Press, 1986). Emphasis is placed upon the activities of the Public Health Service in the late 1920s and a critical analysis of the subsequent development of a national consensus on the need for broad Federal support for U.S. biomedical research.

*Extramural Programs*



## International Programs

Richard K. C. Hsieh, Dr. P.H.  
Director, International Programs

*Programs and  
Services, FY 1986*

The international programs of the National Library of Medicine (NLM) are integral to NLM's responsibilities in biomedical information. The U.S. health professional benefits from the international character of the NLM collection and from the powerful biomedical information retrieval service. The world health community shares benefits from NLM's advanced information systems.

During the past year NLM has continued its bilateral cooperative MEDLARS agreements with individual countries; its cooperation with international governmental organizations such as the World Health Organization (WHO) and the Pan American Health Organization (PAHO); and international nongovernmental organizations such as the International Council of Scientific and Technical Information (ICSTI). The Special Foreign Currency Program was active in the production of critical reviews and history of medicine projects. Other NLM international activities have included a jointly sponsored workshop entitled "International Collaboration on the Application of Medical Informatics," specialized training for colleagues from abroad, the NLM publications exchange program, as well as numerous professional visitors from abroad.

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### International MEDLARS Agreements

The National Library of Medicine currently has MEDLARS agreements with partners in 15 foreign countries and with the Pan American Health Organization. An International MEDLARS Policy Advisory Group (IMPAG) meeting was held on October 31, to November 1, 1986 at the Library. Major topics discussed were progress in CD-ROM development, MEDLARS III (the enhanced

automated system being developed by the Library), TOXNET and Hazardous Substance Data Bank (HSDB), NLM Long Range Plan, Current Issues in Library Operations, and Research and Development Projects of the Lister Hill National Center for Biomedical Communications. Each International Center also reported highlights of recent developments and plans for future years.

The Honorary Director of the Institute of Medical Information of the Chinese Academy of Medical Sciences (Beijing) represented China at the International MEDLARS Policy Advisory Group meeting. Technical assistance from NLM staff to install the ELHILL software and the training of system operators took place in Beijing in July and August of 1986. The MEDLINE system in China is operational on a limited service base, and the completion of testing is anticipated in six months.

The Director of the Center for Educational Technology and the Director of the Egyptian SDI Network represented Egypt at the International MEDLARS Policy Advisory Group meeting for the first time. The Director and two other staff from the Center completed their MEDLARS search and management training from NLM in July and August. Currently, the NLM provides Selective Dissemination of Information (SDI) tapes to this new Egyptian MEDLARS Center as well as access codes for their online search service on MEDLINE.

The following table lists the existing non-U.S. MEDLARS Center countries and how they access the MEDLARS system. Following the meeting of the International MEDLARS Policy Group, the International MEDLARS Centers continued to fulfill their mandate and functions to serve as national resources for the provision of biomedical research, education, and health information.

**Table 11**  
**Non-U.S. MEDLARS Centers**

<i>Tapes</i>	<i>Tapes/Software</i>	Online NLM
Egypt	Australia	Canada
Germany	China	Colombia
Japan	BIREME (PAHO)	Italy
Switzerland	France	Kuwait
	Sweden	Mexico
		South Africa
		United Kingdom

India has shown an interest in sharing advances in science and technology with NLM. At the meeting with a delegation from India for Science and Technology as well as the visit of the Minister of Health, their desire to set up a MEDLARS Center in New Delhi was discussed. The Indian government has made progress on deciding the appropriate organizational entity to serve as a MEDLARS center and how the center should be administered.

#### **Collaboration with the World Health Organization**

The National Library of Medicine has enjoyed collaborative activities with the World Health Organization (WHO) and its affiliated Pan American Health Organization (PAHO).

With WHO, the Library collaborates on the *Quarterly Bibliography of Acute Diarrhoeal Diseases*. NLM is responsible for carrying out the literature searches, classifies the articles retrieved and prepares camera-ready copy, which WHO prints and distributes to thousands of institutions in developing countries. The Library also

supports the *Quarterly Bibliography of Major Tropical Diseases*, printed in India and collaboratively distributed internationally by WHO.

NLM provides bibliographies from the contents of the MEDLINE system to PAHO in camera-ready copy, and PAHO prints and distributes these in the *Bibliography of Respiratory Infections in Children* publication.

NLM and WHO also continue a collaborative arrangement to provide photocopies of journal articles for the use of health professionals in developing countries in Africa, the Eastern Mediterranean and South East Asia. Library resources in developing countries are usually insufficient and their need for biomedical and health information can be met only by drawing on the collections of the developed world. Even though NLM provides more than 5,000 photocopies a year to developing countries (more than 80 are eligible for interlibrary loans), this number can only partially meet their demand. Unless new resources or contributions from other developed countries can be found, the gap for free interlibrary loans to developing countries will be widened continuously.

#### **NLM Special Foreign Currency Program**

Authorized under Public Law 83-480, the Library's Special Foreign Currency Program utilizes appropriations of U.S.-owned, local foreign currencies to fund biomedical scientific publication and translation projects in cooperating countries. The NLM P.L. 480 Program, administered in the Extramural Program Division's International Programs Branch, is the oldest of the Library's extramural support activities and constitutes an important supplement to the domestic Publication Grant Program.

During FY 1986, the P.L. 480 Program sponsored 73 projects totaling \$945,288 in U.S. equivalent dollars. Approximately 70 percent of the program is carried out in India, 20 percent in Poland, and the remaining projects are active in Egypt, Israel and Pakistan.

About half of NLM's current P.L. 480 funding supports the preparation of scholarly research monographs and translations of classics in the history of medicine. Another fourth of the program funds the preparation and publication of state-of-the-art critical reviews and monographs which analyze research and practice in biomedicine. Approximately 20 percent of the program supports secondary literature tools (bibliographies, handbooks, biomedical guides, etc.). Among these is the *Quarterly Bibliography of Major Tropical Diseases*, printed in India and collaboratively distributed internationally by the World Health Organization.

Among the studies resulting this year from support in the P.L. 480 program was a comprehensive review of the natural history of a unique zoonotic viral infection, Omsk hemorrhagic fever (OHF):

*Kharitonova, and Leonov, Yu. A.*  
*Omsk Hemorrhagic Fever: Ecology*  
*of the Agent and Epizootiology.*  
New Delhi, India: Amerind  
Publishing Co. Pvt. Ltd., 1985, 230  
pp. Distributed through the National  
Technical Information Service

Originally published in Russian, this English translation was edited by the late Dr. Harry Hoogstraal, the well-known international authority on ticks, tickborne infections, and hemorrhagic fevers. The monograph raises important new issues of practical public health significance to international medicine.

The Library has sponsored a critical review program in Poland for the past 20 years which has produced a distinguished series of monographs written by Polish biomedical scientists. Despite the political tension in U.S.-Polish relationships since 1981, NLM P.L. 480-funded books continue to reach publication. In FY 1986 Dr. Franciszek Kokot's review of *Endocrine Abnormalities Associated with Acute Renal Failure*, published in collaboration with the Polish Academy of Sciences, was received. The author is an eminent clinical research scientist and Professor of Medicine at the Silesian School of Medicine in Katowice. The study explores why endocrine abnormalities may be expected in acute renal failure (ARF) and studies a range of abnormal hormone levels in blood plasma from patients with ARF.

A significant share of NLM's overall support program for research and publication in the history of medicine is carried out through the Special Foreign Currency Program. This year P.L. 480 support in Egypt resulted in the publication of a critical edition and translation of Averroes' commentaries on works of Galen, prepared collaboratively by the Director of the Dominican Institute of Oriental Studies of Cairo, Father G. C. Anawati, and the Professor Emeritus of Medicine at Ain Shams University, Dr. Paul Ghaloungui. These 12th century commentaries, originally written in Arabic, have never been previously published in Arabic or available in English.

Two additional studies in a new series entitled "Resources in Medical History," selected in collaboration with the American Association for the History of Medicine, were also published in FY 1986. Charles Turner Thackrah's *The Effects of Arts, Trades and Professions on Health and Longevity*, initially published in 1831, was the

first systematic publication in Great Britain on industrial disease and its prevention. Also reprinted, with a new historical introduction by Charles G. Roland, M.D., of McMaster University, was a rare volume by Dr. John Douglas on the *Medical Topography of Upper Canada*—the first medical book ever to be published (1812) in Ontario, Canada.

is that as the advent of microcomputers reaches most households in the United States and other developed countries, the rate of utilization of computers in medicine in developing countries is not progressing at a same pace. Unless international collaboration and national resources for medical informatics are developed rapidly, the gap between the developed and developing countries will not be narrowed.

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#### International Conferences, Seminars, and Meetings

The National Library of Medicine is a member of the International Council for Scientific and Technical Information (ICSTI). This organization serves as a meeting ground for information and abstracting agencies, commercial and governmental, in a number of countries around the world including Canada, Federal Republic of Germany, France, Japan, the Netherlands, South Africa, United Kingdom, and U.S.S.R. Common interests include economics of primary and secondary publications, trans-border flow of information, electronic publication, standardization and the information needs of developing countries. At the general meeting of ICSTI held May 17-21, 1986 in York, United Kingdom, NLM was represented by the Assistant Director for International Programs.

On October 23 and 24 of 1986, NLM held an invitational workshop which was sponsored jointly with the Fogarty International Center, the Division of Computer Research and Technology, and the Division of Research Resources. Forty-five participants from 22 developing countries met for two days to exchange their viewpoints and experiences in international collaboration on the application of medical informatics. One consensus reported by participants of this workshop

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#### International Visitors

The National Library of Medicine continues to attract hundreds of foreign visitors each year, including doctors, medical librarians, public health specialists, and government officials. Many of these visitors have responsibilities for medical, scientific or technical information in their own countries. Their interest in NLM is more than cursory, and they are officially received and briefed on relevant aspects of NLM operations and research. The visitors came from the following countries:

Australia, Bulgaria, Canada, China, Colombia, Egypt, Federal Republic of Germany, Fiji Islands, France, India, Israel, Italy, Jamaica, Japan, Korea, Liberia, New Guinea, New Zealand, Poland, Singapore, South Africa, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, and Venezuela.

Many official delegations came to scrutinize one or more facets of NLM and to pursue technical issues in information and library science, usually with a view to identifying applications that might prove useful. In addition to foreign visitors, NLM received many trainees, students, and professionals in observer roles for short periods.

## Administration

Kenneth G. Carney  
Executive Officer

Programs and  
Services, FY 1986

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### Financial Resources

In FY 1986, the National Library of Medicine had a total budget authority of \$57,397,000. Table 12 displays the FY 1986 budget authority plus reimbursements from other agencies and the allocation of these resources by program activity.

**Table 12**  
**Financial Resources and Allocations FY 1986**  
(in thousands of dollars)

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Budget authority:	
Appropriation, NLM .....	\$57,808
Sequestration pursuant to P.L. 99-177 .....	- 2,486
Funds withheld pursuant to P.L. 99-190 .....	- 49
Subtotal .....	55,273
Plus: Reimbursements .....	2,124
Total .....	\$57,397
Budget allocation:	
Extramural Programs .....	\$12,254
Intramural Programs and Services ..	39,737
Library Operations .....	(26,858)
Lister Hill National Center for Biomedical Communications ...	(8,915)
Toxicology Information .....	(3,964)
Research Management and Support .	5,406
Total .....	\$57,397

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### Personnel

Richard K.C. Hsieh, Dr.P.H., was nominated for the position of Associate Director for International Programs in March 1986. Dr. Hsieh previously served as a Health Scientist Administrator in the extramural program of the National Cancer Institute.

Carol Spencer, formerly Deputy, Reference Services Division (RSD), and more recently Special Assistant in the Office of the Associate Director, LO, retired in April after almost 14 years of service at NLM.

Charles R. Kalina was appointed Special Expert in the Office of the Director, NLM in May 1986. Mr. Kalina was formerly Associate Director, Health Planning Council, Inc., of Providence, Rhode Island.

Cassandra Allen was appointed Head, Collection Access Section, Public Services Division (PSD) in May 1986. Ms. Allen had previously served as Assistant Head, Circulation Section, at the Library of Congress.

Daniel R. Masys, M.D., was appointed Director of the Lister Hill National Center for Biomedical Communications in June 1986. Dr. Masys had previously served as the Chief, International Cancer Research Data Bank Branch, National Cancer Institute.

Sally K. Sinn was appointed Deputy Chief, Technical Services Division (TSD), in July 1986. Ms. Sinn had previously served as Assistant Head, Cataloging Section in TSD.

Joseph Ganter, formerly Chief, Technical Services Division (TDS), and more recently Collection Development Officer, died in June 1986.

Margaret Byrnes was appointed Chief, Preservation Section, Public Services Division (PSD) in

August 1986. Ms. Byrnes was formerly the Preservation Officer at the University of Michigan.

Lloyd L. Wommack retired from his position as Head of the Index Section, Bibliographic Services Division (BSD) in August 1986. Mr. Wommack had devoted 25 of his 34 years of Federal service to the Index Section.

Bella L. Ceja was appointed Assistant to the Director, NLM, in August 1986. Mrs. Ceja previously served as Special Assistant to the Director of NIH.

Mamie O. Toler retired from her position in the Selection Acquisition Section of the Technical Services Division (TSD), after over 35 years of government service.

Arthur S. Pollitt, M.D., was appointed as a Special Expert in the Lister Hill National Center for Biomedical Communications in December 1986. Dr. Pollitt was formerly a senior lecturer in Computing and Information Systems in the Department of Computer Studies and Mathematics at the Polytechnic in Huddersfield, Great Britain.

Thomas N. Bonner, Ph.D., was appointed as a Special Expert in the History of Medicine Division, LO in January 1987. Dr. Bonner previously served as a Distinguished Professor of History and Higher Education at Wayne State University, Detroit, Michigan; and as Visiting Professor at the Institute of the History of Medicine, University of Freiburg, Germany.

Charlotte Kenton retired from her position in the Reference Section of the Public Services Division (PSD) in January 1987 after concluding over 37 years of government service.

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## Awards

NIH Merit Awards were presented to:

Becky Lyon-Hartman, Division of Library Operations, "for her outstanding leadership in administering the Regional Medical Library Program, which provides access to biomedical information resources to health professionals."

Frances E. Spina, Division of Library Operations, "for her initiative and industry in providing bibliographic input of the highest quality in the NLM MEDLARS databases."

Bruno M. Vasta, Division of Specialized Information Services, "for his initiative, resourcefulness, and leadership in providing a comprehensive, publicly accessible inventory of literature, research, and studies of health effects of toxic substances."

James W. Woods, Ph.D., Division of Lister Hill National Center for Biomedical Communications, "by anticipating trends and collaborating with prominent biomedical educators, his NLM projects advance the adoption of new instructional technologies."

Rose Marie Woodsmall, Office of Planning and Evaluation, "for her efforts in the development of specifications for GRATEFUL MED, which allows access to the most widely used biomedical database in the world, enhancing health practitioners' access to new and important knowledge."

The NLM Director's Award was presented to Mark J. Rotariu, Budget Officer, Office of Financial Management, "for his outstanding service to the library in the formulation and execution of the budget and for his conscientious preparation of the senior NLM management staff for congressional testimony."

The NLM Board of Regents Award was presented to William G. Harless, Ph.D., Special Assistant to the Director, Lister Hill National Center for Biomedical Communications, "for his creativity and leadership in the Technological Innovations in Medical Education (TIME) Project."

**Table 13**  
**Staff, FY 1986 Full-Time Equivalents (FTEs)**

<i>Program</i>	<i>Full-Time Permanent</i>	<i>Other</i>
Office of the Director . . . . .	17	1
Office of Inquiries and Publications Management . . . . .	5	1
Office of Administration . . . . .	42	4
Office of Computer and Communications Systems . . . . .	60	5
Extramural Programs . . . . .	19	2
Lister Hill National Center for Biomedical Communications . . . . .	66	7
Specialized Information Services . . . . .	28	4
Library Operations . . . . .	220	20
<b>Total . . . . .</b>	<b>457</b>	<b>44</b>
<b>Total FTE Usage . . . . .</b>	<b>501</b>	

### Equal Employment Opportunity

The focus of the 1986-87 NLM Equal Employment Opportunity Program was to revise the 1982 Affirmative Action Plan. One subcommittee of the EEO Advisory Committee evaluated the 1982 plan and recommended revisions; another subcommittee incorporated those recommendations into a revised plan.

During the year, several EEO Open Meetings were held by the operating Divisions to improve working conditions by management and employees informally addressing EEO issues. In April, Mike Causey, *Washington Post* journalist, addressed NLM employees discussing the EEO impact of the Gramm-Rudmann-Hollings Bill.

Also in April, a meeting was held at which 16 issues and problems concerning handicapped employees were identified and later discussed with management. Essie Lawrence, Chairman of the NIH Handicapped Employees Committee, received the Outstanding Handicapped Employee Award of the year from the Department of Health and Human Services.

Dr. Donald Buckner, NLM EEO Chairman, received the NLM EEO Special Achievement Award for providing outstanding leadership in encouraging discussion in open employee meetings and providing leadership in the development of the revised Affirmative Action Plan.

Another accomplishment was the establishment by the NLM EEO Officer of a quarterly minority statistics report. The most recent figures show that the NLM workforce comprises 30 percent members of minority groups, 65 percent females, and 6 percent handicapped employees.

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## Appendix 3: Board of Regents

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**T**he NLM Board of Regents meets three times a year to consider Library issues and policies and make recommendations to the Secretary of Health and Human Services on matters affecting the Library.

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### Appointed Members:

Albert E. Gunn, M.D. (Chairman)  
Medical Director  
M.D. Anderson Hospital and Tumor Institute

Edward N. Brandt, Jr., M.D., Ph.D.  
Chancellor  
University of Maryland at Baltimore

H. Robert Cathcart  
President  
Pennsylvania Hospital

Edward A. Feigenbaum, Ph.D.  
Professor of Computer Science  
Stanford University

Russell L. Fenwick  
Senior Vice President  
Bank of America

John K. Lopez  
Executive Vice President  
Medicalelectrographic Sciences

Nina W. Matheson  
Director, Welch Medical Library  
The Johns Hopkins University

Ann K. Randall, D.L.S.  
Chief Librarian  
City College of CUNY

Grant V. Rodkey, M.D.  
Associate Clinical Professor of Surgery  
Harvard Medical School

Eugene A. Stead, Jr., M.D.  
Professor Emeritus of Medicine  
Duke University

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### Ex Officio Members:

Librarian of Congress

Surgeon General  
Public Health Service

Surgeon General  
Department of the Air Force

Surgeon General  
Department of the Army

Surgeon General  
Department of the Navy

Chief Medical Director  
Veterans Administration

Assistant Director for Biological, Behavioral, and  
Social Sciences  
National Science Foundation

Director  
National Agricultural Library

Dean  
Uniformed Services University of the  
Health Sciences

## Appendix 4: Board of Scientific Counselors

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**T**he Board of Scientific Counselors meets periodically to review and make recommendations on the Library's intramural research and development programs.

*Members:*

Morris F. Collen, M.D. (Chairman)

Consultant

Permanente Medical Group

Arthur S. Elstein, Ph.D.

Professor of Health Professions Education

University of Illinois at Chicago

Susan J. Grobe, Ph.D.

Associate Professor of Nursing

University of Texas at Austin

Jerome P. Kassirer, M.D.

Associate Chairman, Dept. of Medicine

Tufts University School of Medicine

Casimir A. Kulikowski, Ph.D.

Professor of Computer Science

Rutgers University

Gwilym S. Lodwick, M.D.

Department of Radiology

Massachusetts General Hospital

M. Lucius Walker, Jr. Ph.D.

Dean, School of Engineering

Howard University

Bonnie L. Webber, Ph.D.

Associate Professor of Computer

and Information Science

University of Pennsylvania

## Appendix 5: Biomedical Library Review Committee

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**T**he Biomedical Library Review Committee meets three times a year to review applications for grants under the Medical Library Assistance Act.

*Members:*

Anthony R. Aguirre  
Director of Library  
College of Physicians  
Philadelphia College of Physicians

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Health Sciences Librarian  
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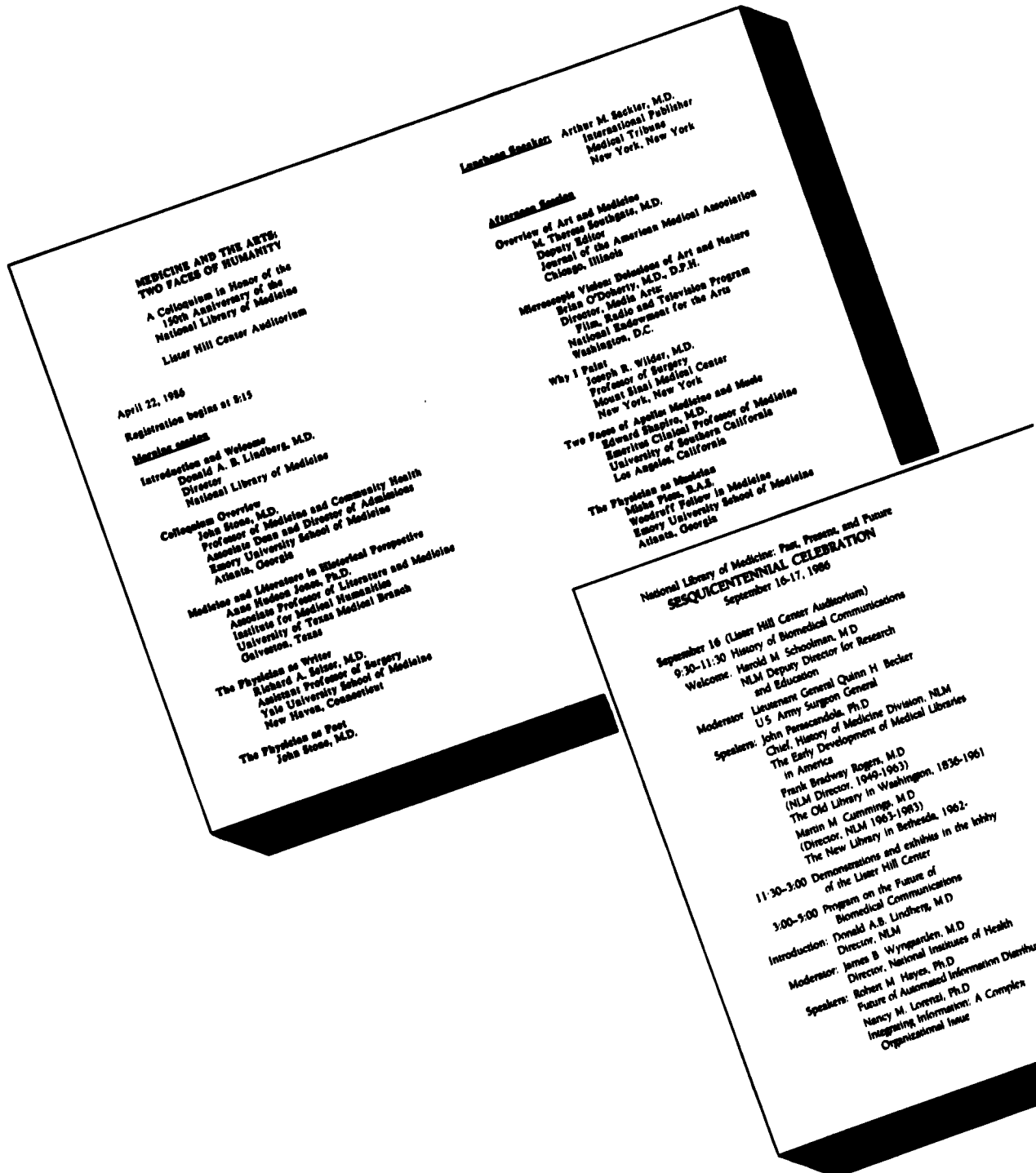
Thomas E. Piemme, M.D.  
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Graduate School of Library  
and Information Science  
University of Illinois

D. Dax Taylor, M.D.  
Evaluation Program  
National Board of Medical  
Examiners  
Philadelphia, Pennsylvania

## Appendix 6

[Reproductions of the agendas from "Medicine and the Arts," "NLM: Past Present and Future"; and "Space Medicine Colloquium."]



**Space Medicine**  
 Newest Frontier of the  
 Health Sciences  
 Lister Hill Center Auditorium  
 November 13, 1986

8:00-9:00 Morning Session	Registration
9:00-10:00 Welcome	David A. B. Lindberg, M.D. Director, National Library of Medicine
10:00-11:00 Overview	Arnold Neugarten, M.D. Director, NASA Life Sciences Division
11:00-12:00 Break	John B. West, M.D., Ph.D. Professor of Medicine and Physiology University of California at San Diego "The Spanish Bot"
12:00-1:00 Low Barb Orit	Michael J. Adelman, Ph.D. Head, Biomedical Engineering Branch, Naval Medical Research Institute "Information Processing and Communication in Low Barb Orit"
1:00-2:00 Lunch	Ann Peltz, M.D. Astronaut, Johnson Space Center
2:00-3:00 Afternoon Session	John Billingham, M.D. Huntsville, CA "Space Station: Biological Aspects"
3:00-4:00 Space Station	Big Betty, Ph.D. Director, Sciences Institute, Corvallis Medical University "Health Care Robotics in Space"

Break  
 Luncheon  
 Dr. Lindberg  
 Juan H. von Parlander  
 Program Manager for Long Range Planning  
 Office of Space Flight, NASA  
 "Advanced Medicine Planning"  
 Peter Kistner, Ph.D.  
 Assistant Professor of Biomedical  
 Engineering and Computer Science, MIT  
 "Artificial Intelligence and Computerized  
 Medicine in Space"

Closing

You are invited to view the model space station library, provided  
 through the courtesy of NASA. Tours guided by Astronaut Dr. S. P. S. Ryan  
 K. Lindberg take 20 minutes.

We hope you will enjoy the exhibit on emergency medicine on display  
 in the lobby. The exhibit was assembled by staff of the Library's  
 History of Medicine Division from materials in the collection.

Another stable feature GRATEFUL MED, the Library's new sub-  
 versive program that allows individual health professionals with personal  
 computers to access MEDLINE easily and quickly. MEDLINE contains  
 some 7 million references and abstracts in biomedical journal articles.

You are also invited to stay in at the Library's new Visitors Center in  
 the lobby just outside the auditorium.

Bill R. Mayhew, M.D.  
 Search Procedures of the Library: Molecules  
 and Megabases  
 Edward H. Shortell, M.D., Ph.D.  
 Medical Informatics: The Emergence  
 of a Discipline  
 G. Odo Barnes, M.D.  
 Application of Information Technology in  
 Medical Education: Present and Future

6:30 Friends of the National Library of Medicine  
 Reception  
 7:30 Subscription Banquet—NLM Dining Room  
 Speaker: FDA Commissioner Frank E. Young,  
 M.D., Ph.D.  
 Topic: "Quality Assurance of Medical Software"

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September 17  
 10:00 a.m.—4:00 p.m. Tours of the Library  
 Demonstrations/exhibits of NLM  
 information systems  
 5:00 p.m.—8:00 p.m. Barbeque with entertainment  
 Grounds of the National Library of Medicine

All those attending the September 16 program, NLM Past,  
 Present, and Future, are invited to return on Wednesday,  
 September 17

The evening activities of both days are being supported by  
 the new organization, the Friends of the National Library  
 of Medicine. We are grateful for their help.