

Regardless of the absolute number of scientific and technical journals published today, it is an acknowledged fact that the number is too great for each library to acquire and index the total scientific literature. The latter has become the function of the secondary publication profession—the abstracting and indexing (A&I) services. Although the relationship between the library and the A&I service varies from situation to situation, the association is actually much closer than either most librarians or A&I service producers realize. When the basic purpose of the library—to provide users with information or documents—is viewed alongside the basic purpose of the A&I service—to make users aware of the available literature—it becomes apparent that abstracting and indexing are merely extensions of the over-all library function.

Rarely do data contained in secondary publications serve as substitutes for the originals. Abstracts, index entries, title listings, and other forms of document representations are merely highly organized and detailed guides to lead the user back to the originals that the libraries are expected to furnish. In addition to acting as guides, document representations also provide the user with a means of appraising the value of the available literature, its relevance to his area of interest, and his need for the original. Shipman⁴ has stated (and others⁵⁻¹⁰ have substantiated his findings) that over 93 percent of all new chemical information is contained in serials. It is the A&I service that provides the library and its users with content analysis of the serial, technical report, dissertation, and patent literature.

A&I services perform an exceedingly important library function, and they, in return, receive considerable support from the libraries they serve. Through their subscriptions, libraries provide a substantial portion of the A&I services' operating revenues. As subscribers, the libraries also serve as bibliographic retailers of the information contained in the printed A&I publications.

In addition, not all libraries have abandoned their A&I programs. Several continue to function as abstracting and indexing services in addition to their traditional library work. All three of the national libraries, for example, are deeply involved in the production of indexes or abstracts designed to disseminate content-analysis information of a significant portion of the literature they acquire. The National Library of Medicine (NLM), the world's largest biomedical library, devotes substantial portions of its resources to its *Medical Literature Analysis and Retrieval System* (MEDLARS). MEDLARS, a computer-based

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information system, is designed to cope with the tremendous growth of biomedical literature and the corresponding information requirements of health scientists, practitioners, and educators. One product of MEDLARS is *Index Medicus*, a comprehensive monthly, subject/author index to articles from approximately 2,400 of the world's biomedical journals. MEDLARS also produces recurring bibliographies or periodical lists of citations in specialized medical-subject areas. These are compiled at regular intervals from data in the MEDLARS store and are printed for distribution to organizations working in the specialty fields. The MEDLARS data base can also be rapidly searched to provide answers to complex reference questions which cannot be effectively handled by the existing printed indexes and catalogs.

The National Agricultural Library (NAL) is also one of the major A&I services in this country. Its *Bibliography of Agriculture*, issued monthly since 1942, provides indexes by subject and author to all important books and articles acquired by the library in agriculture and related sciences. Over 110,000 items are indexed annually and widely disseminated to agricultural workers in every part of the world. NAL also publishes the *Pesticides Documentation Bulletin*. This bi-weekly index to the multi-disciplinary pest-control literature is disseminated not only to personnel in the Department of Agriculture, but also to other Federal, state, private, and industrial organizations. It is a computer-produced permuted title index issued in three parts: a keyword index, a bibliography, and an author index.

The Library of Congress, in addition to issuing catalog cards that can be considered "skeleton" abstracts (bibliographic data plus subject headings), issues the *Monthly Index of Russian Accessions* and *Arms Control and Disarmament*, to name but two of this library's secondary publications.

In addition to these national libraries, many others, including those of an academic, governmental, public, and industrial nature, disseminate information on the the contents of various segments of their collections. For example, the Research Information Service of the John Crerar Library in Chicago prepares and publishes *Leukemia Abstracts*, a monthly publication that since 1953 has been distributed gratis to organizations and individuals actively engaged in leukemia research.

A unique way in which libraries support abstracting and indexing efforts is the very generous contribution made by major libraries in the United States and abroad to the *List of Periodicals Abstracted by Chemical Abstracts*. Every five years since 1922, these libraries have

provided the "Key to Library Files" data for these lists. Presently, some four hundred of the world's major resource libraries are together contributing over one million dollars in effort to the Chemical Abstracts Service's (CAS) *Comprehensive List of Periodicals for Chemistry and Chemical Engineering* by furnishing information on their holdings of scientific and technical journals, conference and symposia-type publications, and patent specification collections.

As has been stated before, the basic functions of an A&I service are two: to provide organized access to the available literature and to provide a means to appraise this literature. However, over the years, an ancillary function has developed—that of aiding libraries gain access to original documents. In most libraries, a serious gap exists between a document reference and the document itself. For example, in 1961, CAS conducted a survey to obtain source guide information for the 1961 *List of Periodicals With Key to Library Files*. Data accumulated during this survey indicated that of 334 U.S. and foreign libraries serving chemistry, only eleven U.S. and two foreign libraries maintained subscriptions to over 30 percent of the over 9,000 serials that were then being abstracted by *Chemical Abstracts*. Of the eleven U.S. libraries, only three subscribed to over 50 percent of the serials, the largest subscribing to only 5,256. Of the institutions polled in the survey, 65.5 percent of the U.S. and 71.1 percent of the foreign libraries subscribed to fewer than 1,000 of the serials that contained substantive chemical articles. Kruzas substantiates these results, for in his statistical analysis of the libraries listed in *Special Libraries and Information Centers*, he notes that 76 percent of the libraries reporting maintained fewer than 300 serial subscriptions.¹¹

The comparatively small number of periodicals held by any one library is the cause of one of the most frequently heard complaints from the users of A&I services. Both scientists and the librarians serving them complain that cited originals are either unobtainable from local resources or that the time required to obtain them is excessive. In order to circumvent this dilemma, libraries rely heavily upon interlibrary lending to acquire original documents or facsimiles thereof from other libraries, or in some cases, from the A&I services themselves.

Different A&I services approach the document-access problem in different ways. Some have arranged with major source libraries to provide users with copies of originals. For example, the John Crerar Library in Chicago furnishes photocopies of abstracted articles to the users of *Biological Abstracts*, while the Linda Hall Library in Kansas

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City, Missouri, performs a similar service for the users of *Applied Mechanics Reviews*. Other A&I services perform this function themselves. The American Institute of Aeronautics and Astronautics (AIAA) publishes *International Aerospace Abstracts*, an A&I journal, under contract to NASA. AIAA members and U.S. and Canadian NASA centers may borrow publications from the Technical Information Service of the AIAA without charge. Libraries of government agencies and of academic and non-profit institutions of both countries may borrow abstracted documents for a period of two weeks by paying the return postage and insurance. Microfiche and/or photocopies are supplied for a fee to all others who request them.

Complementing *International Aerospace Abstracts* is NASA's *Scientific and Technical Aerospace Reports (STAR)*, a comprehensive A&I journal for the report literature on space and aeronautics science and technology. Van A. Wentz described this program in this manner:

Accessibility is the final key to the information system designed for NASA. The acquisition of documents from all parts of the globe as well as from U.S. sources large and small, often yields documents in single copies that would be difficult if not impossible for many users to obtain by normal means. Before such material is announced, the central facility prepares and distributes microform copies [To] achieve maximum decentralization, the microfiche permits carrying this accessibility even farther than the 100 or so locations initially receiving it. Because it is a high quality transparency in a unitized form, microfiche may serve as a reproducible master at each location.¹²

In keeping with this philosophy, NASA automatically makes available copies of the reports it abstracts in *STAR* to its offices, centers, contractors, grantees, consultants, other U.S. Government agencies and their contractors, and U.S. libraries that maintain a collection of NASA documents for public reference. A similar approach is used by Derwent Publications of London, England, the publisher of *Plasdoc*, a plastics-patent documentation and retrieval system. Among several options available to the subscribers of *Plasdoc* is one that automatically provides copies of abstracted or indexed specifications, in addition to detailed abstracts and punched cards for manual and machine retrieval of information.

The American Society for Metals makes available to users of the *Review of Metal Literature* copies of abstracted articles. The exceptions to this service are government-issued and classified reports, com-

mercial translators' work, articles from copyright-restricted journals, and those articles originally abstracted in the *Referativnyi Zhurnal*, *Metallurgia*. The Chemical Abstracts Service, on the other hand, will supply photocopies of the Soviet literature abstracted in *Chemical Abstracts*. The CAS service is limited to Soviet literature because it is not copyrighted. At this time, CAS has no similar service for copyrighted literature.

The Institute for Scientific Information in Philadelphia and the Engineering Society in New York also provide copies of abstracted articles. The former furnishes articles torn from the source periodical, while the latter supplies photoprint or microfilm copies of articles abstracted in its *Engineering Index*.

Abstracts of U.S. patents published in the weekly *Official Gazette of the U.S. Patent Office* are backed up with microfilm copies of the full patent specifications and drawings. These are available by subscription from the Clearinghouse for Federal Scientific and Technical Information (CFSTI). Full-size copies of individual patents are available directly from the U.S. Patent Office.

The National Library of Medicine functions as a library's library. Over 80 percent of the requests filed by NLM are for copies of articles that had been indexed in *Index Medicus*.¹³ These are supplied as photocopies, although occasionally the originals are loaned. The National Agricultural Library will similarly provide copies of any article indexed in its *Bibliography of Agriculture* and the *Pesticide Documentation Bulletin*.

Several A&I services maintain regional depositories of the documents they cover and provide copies of these documents to users on demand. Many of the world's patent offices deposit copies of granted patents in both domestic and foreign libraries. The patents announced in the patent offices' gazettes or journals are available not only to those who visit the depository libraries, but also from other libraries in the form of loans or reproductions from the depositories. The U.S. Atomic Energy Commission backs up *Nuclear Science Abstracts* with a similar service.

Dissertation Abstracts, the publication of University Microfilms, is an A&I service for doctoral dissertations from some three hundred U.S. colleges and universities. Copies of the dissertations are deposited with University Microfilms who then make available both microfilm and Xerox copies.

The Clearinghouse for Federal Scientific and Technical Information

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sells copies of reports announced in *U.S. Government Research and Development Reports* and the *Government-wide Index to Federal Research and Development Reports*. The latter is an index to the unclassified reports announced in *Nuclear Science Abstracts*, *Scientific and Technical Aerospace Reports*, *Technical Abstract Bulletin*, and in their own *U.S. Government Research and Development Reports*. Reports can be ordered directly from CFSTI by accession number and title. The Defense Documentation Center provides Department of Defense contractors and other qualified users with copies of the report literature abstracted in their *Technical Abstract Bulletin*.

One unique way in which an A&I service assists libraries is demonstrated by the H. W. Wilson Company's policy of having the librarians select the lists of periodicals to be covered by the various Wilson indexing services. *Applied Science & Technology Index*, for example, is a subject index to approximately 158 periodicals chosen by the subscribers to the *Index*. In this manner, the subscribers determine coverage and adjust their serial-acquisition policies in order to maintain the indexed originals. This interplay between the user librarian and the A&I service benefits both parties. The service does not have to arbitrarily establish a list of monitored journals, and the libraries obtain coverage for the serials that they believe the most useful. The drawback to this method is that any A&I service that limits its coverage to a fixed number of periodicals does so at the expense of comprehensive coverage.

Nearly all of the A&I services, however, could benefit by more user participation in the selection of material to be abstracted and indexed. There are, undoubtedly, many serials in the "underlap" area (those not covered) that would warrant coverage by one or more of the A&I services. These would be added if the services were aware of both the existence of the serial and of the desire of librarians to have it covered. Several other A&I services have taken an approach similar to the H. W. Wilson Company. Recently, the National Library of Medicine established an advisory panel to direct the selection of biomedical serials to be covered by MEDLARS.¹⁴ Both the abstractors and section editors for *Chemical Abstracts* suggest journals for coverage.¹⁵ The National Agricultural Library solicits advice from users throughout the country to guide in up-dating and improving the *Bibliography of Agriculture*. The intercourse between user and publisher tends to satisfy the objectives of both.

The preceding remarks should not be interpreted as meaning that

only the A&I services have directed themselves to the problem of document acquisition. The library community has long recognized that in the information transfer cycle, its most important contribution is to provide the cited documents, both current and historical, to users of A&I services. To fulfill this duty, local libraries obtain documents they do not hold via interlibrary loan borrowing and photocopy procurement. Were it not for the fact that through his local library the user of the A&I service can gain access to the full range of primary source publications cited by the A&I services, the entire structure of the information transfer process, from author to reader, would be greatly endangered, if not totally ineffective. As only a single example of interlibrary cooperation: in 1956, with National Science Foundation assistance, the Midwest Interlibrary Center (now the Research Center for Libraries) and its member libraries began a program to acquire among them every serial abstracted in *Chemical Abstracts* and *Biological Abstracts*.¹⁶ Emanating from this project was a list entitled *Rarely Held Scientific Serials in the Center for Research Libraries* (1963). This list, which has been updated several times, has been widely distributed so that the availability of these hard-to-obtain serials is generally known.

The user's link between the secondary services and the library's resources is the bibliographic citation, a reference intended uniquely and unambiguously to identify a specific document. Most A&I services cite publications by abbreviated titles to save space. However, different A&I services use different abbreviations and often entirely different forms of the title. The linkage is weakened further by the fact that most libraries maintain their serial files according to corporate entry. Thus, the abbreviated title used in abstract journals or indexes must often be translated into the full title and then retranslated to a corporate entry before the user is even able to determine if his library has the document he desires.

A&I service editors are frequently asked by librarians to adopt the American Library Association cataloging rules, or more recently, the Anglo-American cataloging rules. These are said to be "standard." However, most major resource libraries modify the ALA cataloging rules to fit their own cataloging situations. In some instances, they are even tailored to fit the cataloging practices of individual divisions and departments within the same library. Because of the various cataloging rules followed, Library of Congress printed records will often show as many as three entry forms for the same publication,

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depending upon the catalog or list being searched. For example, a given Russian title may be cited in the *Monthly Index of Russian Accessions* one way, in *New Serial Titles* another way, and in the printed LC catalog a third way.

The difference between one library's cataloging practices and those of another is not basically the result of inconsistency. Cataloging is done by analogy with the rules and examples found in the various editions of the cataloging codes. As a result, a body of ad hoc decisions develops in each library. If the A&I service tried to follow the ALA or Anglo-American cataloging rules, whose adaptation would they follow? This lack of compatibility between these two major systems is time-consuming and therefore costly. It may even obstruct access to the document. When document procurement involves an interlibrary loan request, the faulty linkage between the citation and the document becomes even more of a deterrent to efficient and effective retrieval. The link further weakens when the preciseness required by computer systems is considered.

Efforts are being made to assist the A&I services and libraries in their attempt to standardize bibliographic citations. The 1963 *American Standard for Periodical Title Abbreviations*¹⁷ culminated nearly two decades of effort on the part of librarians and A&I service producers to develop a common language for periodical title abbreviations. By 1968, most major A&I services in the United States as well as primary journals will be using this Standard. The subsequent establishment of the National Clearinghouse for Periodical Title Word Abbreviations (NCPTWA) by the United States of America Standards Institute's (USASI, formerly American Standards Association) Sectional Committee Z39 on Library Work, Documentation, and Related Publishing Practices has furthered standardization in this area. In December 1966, the NCPTWA issued a "Revised and Enlarged Word-Abbreviation List" for the Z39.5 Standard.¹⁸ This list contained nearly six thousand title words or word roots and their abbreviations. It is being kept up to date by the NCPTWA through quarterly supplements. The first two such supplements appeared in April and August of 1967 and contained 126 title words or word roots and their abbreviations that had been requested from the NCPTWA during the first quarter of 1967.

At best, the *American Standard for Periodical Title Abbreviations* offers only a partial solution to the problems caused librarians by the A&I services' use of title abbreviations. Many secondary publications,

especially those published in Europe, follow the periodical title abbreviations published in the *World List of Scientific Periodicals, 1900-1960*. The philosophy behind *World List* abbreviations is very different from that behind the American Standard. In the *World List*, any given word may be abbreviated several different ways in different titles so as to make each title abbreviation unique. But in the American Standard, any given title word has only one abbreviation. In the latter, should two strings of title word abbreviations be identical, they are distinguished from one another by adding the publication site.

Another periodical title abbreviation gaining acceptance is The American Society for Testing and Materials (ASTM) Coden. These unique five-character representations for periodical titles are especially useful for the machine-readable data bases being developed by the A&I services. In 1961, with the publication of *Chemical Titles*, the first computer-based current alerting service, the Chemical Abstracts Service recognized the need for a very compact journal title representation. The Coden system developed by Charles Bishop¹⁹ and assigned to ASTM, was adopted to serve this end. As CAS developed additional computer-based services, it required a more refined, expanded, and reliable Coden system. As a result, CAS developed two independent checking features: the first, a machine-calculated check character, validates the Coden itself; the second assures that the proper Coden has been applied by correlating the Coden, the volume number, and the year of publication. Routine use of this type of error-detection procedure has guaranteed the reliability of the CAS Coden system, a fundamental requirement because the original journal reference is the keystone of the CAS information system.

The use and arrangement of volume number, issue number, year, and page data also require standardization. For printed A&I service publications, standardized arrangement of these data is not as important as is the certainty that sufficient data is included in the citation easily and unambiguously to identify the document being cited. If machine-readable records produced by different A&I services are to be compatible, however, both the format and content must be standardized. The USASI Sectional Committee Z39, Subcommittee SC-4 on Bibliographic References (chaired by Maurice F. Tauber of the Columbia University School of Library Service) is developing an American Standard for Bibliographic References. This forthcoming Standard should provide the needed guidelines for standardization of these data.

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In November, 1966, the USASI Committee Z39, Subcommittee SC-10 on the Arrangement of Periodicals, submitted the final draft of a proposed *American Standard for Periodicals: Format and Arrangement*.²⁰ A revision of *Reference Data and Arrangement of Periodicals*, Z39.1-1943 (1959),²¹ this Standard advocates printing a bibliographic strip across the foot of the cover page of each serial issue. The strip would contain the title of the periodical abbreviated according to the *American Standard for Periodical Title Abbreviations* and the ASTM Coden with complete volume, issue, and date data. The American Chemical Society has already begun publishing the ASTM Coden with the machine-calculated check character on the covers of many of its publications.

For all the need, it is not likely that either the A&I services or the libraries will change their citation and cataloging in the near future. Therefore, some correlation guides must be developed to allow the A&I service user to translate a periodical title abbreviation easily into the form of entry used in library files. One effort in this area is the the CAS *Comprehensive List of Periodicals for Chemistry and Chemical Engineering (CL)*. This list will contain these four forms of title representation: (1) the full title exactly as it appears on the journal, (2) the full title abbreviated according to the American Standard, (3) the ASTM Coden for the title with machine-calculated check character, and (4) the title cataloged according to the ALA cataloging rules. The *Comprehensive List* should serve as a useful correlation tool since it will cover not only some 14,000 currently published scientific and technical periodicals, but also an additional 15,000 entries of former titles, discontinued serials, and congress-proceedings volumes. The fact that the serials listed in the *CL* contain a significant portion of the world's scientific and technological literature presages its general value and use. The Serials Data Program of the Library of Congress²² will have similar correlation characteristics, also for the full range of serials.

Correlation guides are also needed between serial titles printed in non-Latin alphabets such as Cyrillic and oriental, and their Latin-alphabet equivalents. These would be especially helpful to those A&I services which cite large numbers of Russian and Japanese papers and to libraries which utilize such foreign-language A&I services as the *Referativnyi Zhurnal*. The ability to correlate rapidly different transliterated schemes is also required. This problem is especially apparent to those dealing with Chinese serial literature where entries are commonly found in both the P'in-Y'in and Wade-Giles transliteration schemes.

For bibliographic standardization efforts to be successful, the interests of all affected parties must be considered and the standards themselves must gain wide approval and use. Unfortunately, organizations concerned with standards usually have very limited resources to devote to the promotion of their work. Thus, the promotion of USASI Z39's standards has been left largely to those who developed and use the standards. The *American Standard for Periodical Title Abbreviations* (Z39.5) has been publicized by the R. R. Bowker Company by their reprinting it in part in Ulrich's *International Periodicals Directory*²³ and in the *1965 Bowker Annual of Library and Book Trade Information*.²⁴ It has also been reprinted by *Biological Abstracts*²⁵ and has been recommended by the Council of Biological Editors.²⁶

Once bibliographic standards are developed and used, they must be kept up to date. The ASTM has attacked this problem by operating a Coden clearinghouse for a number of years. It is possible for anyone desiring Coden to obtain them either by mail or by telephone or from *Coden for Periodical Titles*.²⁷ The NCPTWA, mentioned above, provides abbreviations for periodical title words not included in the *American Standard* or its *Revised and Enlarged Word-Abbreviation List*. Interestingly enough, over half of the requests received by the NCPTWA are not for periodical title word abbreviations, but for guidance on establishing the complete abbreviated titles for serials and monographic works that A&I services and primary journal editors want to cite. The Library of Congress' *New Serial Titles* and the National Library of Medicine's *Current Catalog* also function as standards clearinghouses. Many libraries depend on these two publications for serial-cataloging guidance just as they depend on the LC catalog cards.

Implied throughout this discussion, although never stated, is the crux of today's information-handling difficulties—the proliferation of the scientific and technological literature. Many of the difficulties faced by both libraries and the A&I services would be of a less critical nature if the information base which both must handle were smaller.

However, the literature *is* large and increasing every day. Therefore, means must be developed and used that will allow the libraries and the A&I services to perform their individual and combined functions in an efficient manner. The approach many A&I service publishers have taken in an effort to solve their problems has been the adoption of computer-based systems. This adoption and utilization of computers and other mechanized processing techniques by the A&I services will continue and will be intensified. The amount of literature to be proc-

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essed, i.e., abstracted, digested, indexed, or listed; the economics of processing and dissemination; and the ever-growing size of the data store that must be frequently searched dictate that new methods be found and implemented for coping with these problems. Recent advances in computer technology now make it possible to develop complete systems for handling the input, storage, and output of data bases. These can be expected to lead to the complete conversion of A&I services to information-handling centers.²⁸ Such changes in the A&I services will have far-reaching effects on the reference services libraries will be able to render to their clientele.

This shift is already having an effect on libraries. Computer-based information services provide more rapid dissemination of current-awareness information than do the manual systems. Users of these services subsequently turn to libraries to provide documents more rapidly. Mechanized A&I data bases offer libraries the potential to expand present services and to develop entirely new ones.

Mechanization of data-handling procedures is not the total approach taken by the A&I services in their effort to speed up the transfer of substantive information. Other techniques are being initiated to decrease the time between initial publication of an article in a primary journal and the time its abstract appears in a secondary document. For example, air mail is replacing the slower surface mail to speed primary publications from the generator to the processor. Many editors and publishers are providing the A&I services with advance copies of their journals. The American Institute of Physics, for example, currently sends page proofs to several different A&I services. Today, over 75 percent of the papers abstracted by the Chemical Abstracts Service are received at its Columbus offices in advance of publication and via express mail. Technical reports, for coverage in *STAR*, are ordered by NASA when the research contracts are first announced in the *Commerce Business Daily*. Abstracts for *Nuclear Science Abstracts* are now being prepared by the agencies responsible for the original research, thus enabling the publishers of *Nuclear Science Abstracts* to reduce their abstracting workload and speed up the dissemination of these abstracts.

Primary and secondary publishers are also cooperating to develop integrated data base techniques. The Chemical Abstracts Service is currently editing and enriching the author abstracts of papers to be published in American Chemical Society primary journals. These abstracts are entered into the CAS system prior to their publication and

held for immediate release upon assignment of the primary journal's volume, issue, and page numbers.

The System Development Corporation has estimated that, in 1966, the cost of preparing more than two and a half million document representations by A&I services was in excess of \$50 million.²⁹ This expense could be reduced if more informative author abstracts suitable for republication were available to the A&I services. This has long been recognized. In 1963, the Weinberg Report suggested "that every paper be accompanied by an author abstract that is acceptable to the editor of the journal, and that each editor insist (perhaps by detached reviewing) on abstracts the form and characteristics of which best serve the users in the particular field served by the journal."³⁰

However, before authors can prepare abstracts acceptable to the A&I services, standards for abstract preparation are needed. Numerous organizations and agencies have attempted to develop these guides and provide them to contributors and editors of primary journals. The International Council of Scientific Unions—Abstracting Board, for instance, has distributed over 100,000 copies of the UNESCO "Guide for the Preparation and Publication of Abstracts."³¹ The United States of America Standards Institute, Sectional Committee Z39, has been working on an American Standard for Abstracts for the past several years. Many editors and publishers, recognizing the importance of informative author abstracts, require that their authors prepare abstracts of their papers. These are then subjected to the same reviewing procedures as the papers themselves. As a result of these efforts, increasing numbers of good author-abstracts, suitable for use by the A&I services, are now appearing in the primary literature.

In some cases, especially in the engineering fields, indexing information is also published with the original contribution. This technique, called source indexing,³² is widely used in the report literature and is being implemented by the American Physics Institute, American Institute of Chemical Engineers, Society of Automotive Engineers, and the Society of Plastics Engineers. The technique requires close cooperation between the secondary and primary publishers in the development, application, and maintenance of vocabulary-control guides.

In the future, the A&I services should be able to utilize the computer tapes produced by primary-journal publishers for the composition of their journals via computer-driven photocomposition devices. This approach will provide direct input to the secondary systems without the re-keyboarding and reverification of data.

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The A&I services are also speeding up their own abstracting efforts. Author abstracts not sufficiently detailed for direct use are being used as the basis for developing more detailed abstracts, thus reducing abstracting time. There is also a trend away from decentralized volunteer abstractors to full-time professionals, thus enabling the services to schedule their work flow better, and to reduce further the time lag between the publication of the original work and the appearance of the abstracts and indexes. Further reductions in A&I processing time are being realized by the integration of the intellectual steps of abstracting and indexing and by minimizing redundant clerical operations.

Edited data, once entered into a computer-based system, can be manipulated and printed out in a variety of formats at incredibly high speeds. Computer-driven chain and bar printers are now capable of speeds ranging up to 1,100 lines-per-minute. The new photocomposition devices such as GRACE (Graphic Arts Composing Equipment), used by the National Library of Medicine; the Photon, used by the NASA facility; and the Linatron, used by the Government Printing Office, produce high quality, camera-ready copy at speeds ranging up to 1,000 characters per second. Chemical Abstracts Service, in cooperation with International Business Machine Corporation (IBM), has installed a modified IBM 2280 photocomposition device that can compose whole pages of intermixed text and diagrammatic material at a rate in excess of 1,000 characters per second, while the Minnesota Mining and Manufacturing Company's Electronic Beam Recorder system, although limited to 64 characters (with an option for an additional 64 characters), produces up to 20,000 lines per minute on a 14 x 14mm. dry silver microform.

These new techniques substantially reduce the time lag between the publication of the original document and the dissemination of content-analysis information. For example, the normal publication time for *Chemical Abstracts* is now fourteen weeks. Accelerated acquisitions, express processing, and more rapid printing are expected to reduce this over-all cycle to four weeks for the CAS computer-based publications.

The faster dissemination of document-content analysis by the A&I services is already having its effect on libraries. They are now asked to provide their clientele with more prompt access to the cited originals. To meet these demands, libraries must receive primary-source documents more promptly. They must also speed up their processing

of the documents. In addition to the pressures placed on libraries by the increased speed of A&I services, the greater depth of indexing provided by computerized services also results in a corresponding increase in document requests. Thus, libraries must more rapidly make their collections available and be prepared to handle a greater volume of transactions.

Libraries cannot be self-sufficient and must rely upon the principle of shared resources in order to fulfill many document requests. Each year, for instance, the Chemical Abstracts Service adds more serials to its coverage³³ than the average industrial and small academic library receives.¹¹ The procedures used to transfer documents or facsimiles between one library and another are desperately in need of improvement. That improvement is possible. A researcher anywhere in Great Britain today is able to obtain a copy of a document within three days from the 21,000-title collection in the National Lending Library. In the United States, unfortunately, the time between request and receipt of a document which must be obtained from another library is measured not in days, but in weeks or months. The need for improved document-handling systems in the U.S. has been clearly stated by the Federal Science Council's Committee on Scientific and Technical Information in their *Recommendations for a National Document Handling System*.³⁴

Accelerated acquisitions programs, improved internal processing, and modernized techniques for increasing the efficiency of shared resources are an absolute necessity. If libraries do not keep pace with the information-handling innovations, their clientele will increasingly rely on other sources of supply, and library support will be channeled off to other recipients.

The library's role in the new computerized information-handling environment is in no way limited to document provision. It is generally recognized that the reference service in major research libraries is now less adequate than it was at the turn of the century, and this in spite of the fact that the resources of these libraries have doubled several times during the past sixty years.³⁵ The library community recognizes its problems and is seeking better methods of servicing its clients' requirements. A recent survey³⁶ of 6,150 libraries and information centers revealed that 1,130 or 18.4 percent were using or planning to use electronic data processing equipment. The majority of the four hundred major resource libraries participating with CAS in the preparation of the *Comprehensive List of Periodicals for Chem-*

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istry and Chemical Engineering are also now using or are planning to use computers or related equipment.

The machine readable data bases being developed today fall into two categories: (1) library records such as card-catalog entries and serial-holdings entries, and (2) computerized indexes to provide detailed access to the published record, particularly the serial literature. Many major library-record compilations currently produced are either already derived from machine-readable data bases or are being converted from manual to machine systems. Examples of these are the *British Union Catalogue of Periodicals* (incorporating *The World List of Scientific Periodicals*), the *Comprehensive List of Periodicals for Chemistry and Chemical Engineering*, and the *National Library of Medicine Current Catalog*. Potentially, the most significant development in the area of machine-readable library records is the Library of Congress' MARC (*Machine-Readable Catalog*) Project. MARC, which can be labeled an A&I effort performed by a library, is designed to supply centrally produced bibliographic data via magnetic tape to the library community. Rapid dissemination of machine-readable catalog data to research libraries should reduce the large-scale duplication of intellectual effort involved in traditional library cataloging and should speed up the availability of systematic bibliographic data on new publications.

From the user's standpoint, speed and the substantial increase in indexing depth provided by the new A&I tools is most important. Prior to the advent of computerization, one could expect four to six subject index entries per article. Today, computer index files based *only* on article titles, e.g., *Chemical Titles* and *Bioresearch Index*, provide about six useful entries per article, as do the MEDLARS tape files. Magnetic tape index files such as CAS' *Polymer Science and Technology*, the NASA files,³⁷ and the Derwent Information Services (*Ringdoc*, *Farmdoc*, *Polydoc*, etc.) provide fifteen to twenty useful index points per item. Search files based on citation indexing can be considered to have an "index density" of about fifteen entries per item, since that is the number of references in the average journal article.³⁸

Many complex problems are associated with the utilization of A&I service-produced mechanized data bases. Libraries must have access to computer facilities, money to subscribe to the tape services, and, most important of all, they must have competent staff to deal effectively with both the library clientele and the computer staff.

The wide variety of hardware and software used today compounds

the difficulties. Mechanized data bases have been developed independently. Different organizations having different missions use a wide variety of computer configurations, computer languages, and input conventions. For instance, the tape services available from the Institute for Scientific Information are written for the IBM 1401 and 7040 series computers, while the tapes available from CAS are for the IBM 360/40 and 360/50 computers. A survey conducted by CAS of the computer configurations available to the cooperating libraries indicated that although many libraries intend to use IBM 360 series computers, their present configurations vary widely. The SLA Documentation Division and ALA Library Technology Project survey³⁹ showed that over seventy different computers are already in use by libraries.

Financing the use of computer indexes is also a major problem. Although most computerized information services sell custom searches from a central office, it is natural that libraries should seek their own computers in the same manner that catalogs, bibliographies, and abstracting and indexing tools are put with the collection to aid in searching it. However, there are ways of reducing the costs. These are exemplified by remote, direct computer access via typewriter or cathode-ray tube console and shared computer access (multi-programming). Nevertheless, the local application of computer index files greatly increases the expense of library operations.

From the research librarian's point of view, mechanized access to selected portions of the over-all collection presents other problems. Mechanized searching services are not available for the social sciences or humanities to the extent that they are available for science and technology. In addition, even those available for science and technology are almost totally limited to serial, technical report, and dissertation literature. Thus, the research librarian finds himself in the position of being able to offer services to one segment of his clientele that he cannot offer to another. Yet the cost of these services will be supported by a sizeable part of his total budget.

There is little doubt that the capital investment and operating expenses involved with computer-based services will initially represent amounts that far exceed traditional costs. It would not be surprising to find computer and computer-related costs greatly exceeding the annual expenditures for books, serials, and binding; these latter costs normally amount to 39 percent of academic-library operating expense.⁴⁰

Libraries and Abstracting and Indexing Services

The financial problems thus raised place library objectives and library administration in an entirely new perspective. The major costs of searching for information and of using a library for research purposes have traditionally been paid for by the user; for it has been he who has taken the time to perform the searches. Any radical change in this arrangement implies corresponding changes in attitudes of the users and the organizations which libraries serve. Both the individual researcher and his organization must reappraise the value of information before libraries can bear the increased costs of computerized access to the content of library collections.

The use of computer data bases in libraries introduces several other difficulties. Two major ones are obtaining trained library staff with appropriate subject backgrounds, and finding trained data processing and computer systems staff oriented to information handling. The latter is rapidly becoming the top priority problem in modern libraries and information services.

Whether libraries utilize all or only parts of the full range of machine-readable records that will become available in the next few years is dependent on many factors, some of which have been referred to. That these new data bases present complex problems is undeniable. Also undeniable is the fact that advanced technology has given the library community a rare opportunity—not only to provide higher levels of existing services, but also to allow imagination alone to limit its new services. The proliferation of scientific and technological literature and the demands for the dispersal of its content dictate that the library and the A&I communities cooperate fully to develop an integrated information dissemination system to satisfy the needs and desires of tomorrow's clientele.

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