ELEMENTS OF INFORMATION SCIENCE AND TECHNOLOGY

SECOND EDITION
REVISED AND ENLARGED

C. G. VISWANATHAN

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Elements of Information Science and Technology

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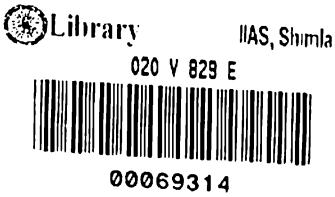

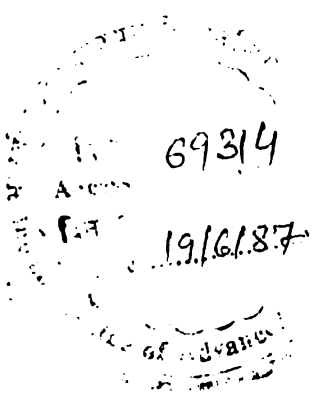

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PREFACE TO SECOND EDITION

The quantity of information sources has been growing with extraordinary speed during the recent years, and it is only with the aid of technology that it is practical, and perhaps possible to a large extent to ascertain what recorded information exists, where it can be located, and what facilities are there to retrieve the desired information. It should be admitted that technology for storing, retrieval and communication of information has been found helpful. But it can never be a substitute for the human intelligence which prepares the data for conversion into machine language to be fed into the computer by programmers.

In this edition, a new chapter 'Information Technology' describing various forms of these aspects, input, output, and communication has been added; while the necessary alterations and additions in the other chapters of the text make it up to date. Chapter Twelve "Look before you Leap—a word of caution before opting for automation" has been provided which will stimulate thinking on final decisions.

Most probably, it is the only book presenting both the creative functions of selection and preparation of the appropriate data on a given subject, and the technology available and feasible for processing it for storage, retrieval, and communication on demand in a balanced way to be published in India.

It is expected that this book will be able to command the respect of the colleagues, the faculty, and the students to undertake the task with interest. Suggestions for its improvement would be gratefully received for incorporation in the subsequent editions.

I gratefully acknowledge and record the permission granted by M/s. Marcel Dekker Inc. New York, and McGraw Hill Book Co., New York to reproduce a few lines in the course of the text from their publications. As required the full details of the authors and the titles of the books are mentioned at concerned chapter ends.

I also acknowledge the ready response and assistance given by my local colleagues Dr. S.S. Iyer, Central Drug Research

Institute; Mr. N.R. Satyanarayana, Department of Library and Information Science, Lucknow University; and Mr S.N. Agarwal, Industrial Toxicological Research Institute by locating and supplying the books and information wanted.

C.G. Viswanathan

"Savitri" C-2444, Indiranagar,
Lucknow. India.
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PREFACE TO FIRST EDITION

It is a long and exciting history of the communication of information through the stages, monologue, dialogue, or the Sruti and Smriti Shastras of Indic origin, hieroglyphics and archives to random access memory. The ubiquitous book of today is a product of cultural maturation : it remains a symbol of civilization and progress, as well as a memory store and media of communication of ideas and experiences and serves society in a variety of useful purposes and occasions. While printing, photography and the computer are the primary techniques of its production, the copyright, public libraries, and audiovisual media have all combined to shape our methods of communication of information. Mr. Herbert Goblans convincingly observes that information science did not start with computer.

The hope for mankind for its survival, maintenance of peace and understanding among nations of the world largely rests on the systematic organisation of available information and its communication. The assets of the society of the future would be measured not by the material products, but by the quality and quantity of informatton possessed and communicated to guide mankind in its undertakings. Hence *Information Science* has emerged as a new intellectual discipline of high significance cutting across all conventional disciplines-humanities, social sciences, fundamental science and technology, fine arts becoming inter-disciplinary in character.

While teaching Information Storage and Retrieval to students of Library Science, I realised that most of the literature thus far brought out by Western writers concentrate and emphasize on the methods and techniques of handling information for retrieval. While concurring with Mr. Robert Fairthorne that 'indexing is the basic problem, as well as the costliest bottleneck of information retrieval' one cannot fail to realise the disproportionate and imbalanced treatment given to this feature, overlooking the importance of traditional librarianship, its scholarly foundations, and its philosophy, which rightly forms the base on which *Information Science* rests. I, therefore, have projected the intellectual aspects of

Information Science with emphasis, as without this approach, the design, structure and performance of an information system tends to become more a mechanical operation, specially after the hardware revolution, than a creative activity. Attempt has been made to present *Information Science* as a natural corollary of Library Science. It is anticipated that the students of Library Science would find the book a first step towards undestanding the growing ramifications and complexities of this new discipline.

Non-print material, copyright law and P L R have a special significance, as they influence the sources of information and, therefore, are given due attention. The beginners would be able to obtain a comprehensive idea of all the integral elements that constitute *Information Science* as a whole.

The illustrations would facilitate the readers to follow the textual description of the equipment and organizational pattern of the information centre. A brief comparative study of the performance of the conventional and non-conventional systems and methods of indexing, subject analysis, and retrieval of information has been undertaken to show the identical objectives of both systems in the dissemination to the users but by following different procedures. The unified theory of bibliographical retrieval is thus revealed.

I am thankful to all the authors, specially A. C. Foskett, C. D. Needham, H. R. Sharp, F.W. Lancester, Joseph Becker and Robert Hayes, J.R. Licklider, D. J. Foskett and B.C. Vickery and the publishers of their works from which matter has been cited in the text with a view to its further elucidation. I thank John Wiley & Sons, New York, for the permission granted to reproduce certain lines from their publication 'Information Storage and Retrieval'. Similarly, approval has been obtained from the publishers of Science Citation Index (Institute for Scientific Information) for reproducing the diagram of Typical Literature Search and Permuterm Index. I gratefully acknowledge their kind courtesy extended. I have been privileged to obtain every possible bibliographic reference from the British Council Libraries at Lucknow and New Delhi and it is with immense gratitude that I thank Mr. O P. Rana and Mr. S.C. Biswas of these libraries respectively for their abundant goodwill and co-operation. My youngest son C. Anant

Rao, M. Sc. Junior Research Fellow, Wadia Institute of Himalayan Geology, spared some time to read through the proof pages and it is pleasing to record the assistance rendered by him. My wife, Mrs. Savitri Viswanathan, has been a continued source of encouragement and helpfulness in all my literary work and shared both the pains and pleasures of writing and its rewards.

I am conscious of the limitations in undertaking a most elementary work on Information Science, when there are advanced and technical books on the subject by Western writers. The demand and necessity for a beginner 's book of this kind undoubtedly exists, as almost all the available literature covers segments of the discipline, often concentrating on Indexing Systems, Techiques, and Automation. I shall be grateful to my colleagues and experts for their constructive criticism which may help subsequent production of an improved edition of the book. I shall consider fully rewarded for my labour, if the book receives the attention of the students of Information Science, and dispels the erroneous notion that Intormetirs Science is no less and no more than computer science and technology. Let us not forget that computerisation of information is only a means to an end.

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15th May, 1976

CONTENTS

LIST OF ILLUSTRATIONS

ABBREVIATIONS USED WITH BRIEF EXPLANATION

ASLIB	Association of Special Libraries and Information Bureau
BISRA	British Iron and Steel Research Association
DBMS	Data Base Management System
DSS	Decision Support System
DC	Decimal Classification by Melvil Dewey
EEC	European Economic Community
FID	Federation Internationale de Documentation (Formerly) Institute de Bibliography, Brussels
IRS	Information Retrieval System
IPSS	International Packet Switching Service
KWIC	Key Word in Context
KWOC	Key Word Out of Context
MARC	Machine Readable Cataloguing
MIS	Management Information System
MEDLARS	Medical Libraries Automated Retrieval System
NLM	National Library of Medicine, U.S.
OSTI	On-Line Scientific and Technical Information
PLR	Public Lending Right
QAS	Question Answering System
SCI	Science Citation Index
SDI	Select Dissemination of Information
UNESCO	United Nations Educational Scientific and Cultural Organization
UNISIST	United Nations Information Service in Science and Technology
UDC	Universal Decimal Classification

1

INFORMATION SCIENCE

Origin and Nature

Information science, which is gaining recognition as a new intellectual discipline, is as old as man and his civilization. It has a major objective and a responsibility of serving man in a variety of life's pursuits. The social needs to a large extent, determine the dimensions of Information Science and set down what it is expected to do, while how it should be done is left to technology.

The behavioural pattern of machines is no substitute for the intellectual exchange of ideas from the teacher to pupil and from mind to mind. The pragmatic approach alone is not good enough ; anyone can sit down and describe what could be done with a given technology. J.C.R. Licklider has already prophesied in his work "*Libraries of the Future*" (M.I.T. Press, 1965) that libraries will soon be replaced by "Procognitive Systems", in which the clash of human minds, the sharpening of wits in reflection and consideration will be replaced by the characteristic behaviourist haven of the social reduction of all enquiry to a question and answer situation between a learner and a mechanical moron. This kind of approach, in which technology dictates the objectives, has led to a trail of disasters unparalleled in the long history of library and information services. Students of library science should understand not merely what technology can do, but what should be required of it. Librarians should certainly be alive to the changing needs and scope of its activities and incorporate them into their academic programme, but at the same time should preserve the integrity of the profession, not for its own sake, but because professional integrity is the highest form of safeguard for those whom the profession serves

A precise conception of what constitutes Information seems necessary prior to the study of the principles governing its transfer from one to another, which is known as Information Science. Information is the product of the human brain in action and may be abstract or concrete, *e.g.* love, fear or book, pen. When an individual begins to think, a variety of images and sensations flash through his mind. If he looks at a beautiful rose, immediately he appreciates, almost simultaneously, its colour, fragrance, shape, and beauty, and may experience a desire to see many more of them grow in his garden. When he touches a piece of ice, he feels how cool it is, and begins to think of its uses, its formation, or its production. Or, if he listens to a melodious song, he enjoys the tunes and ideas conveyed by it, or, when served a savoury meal, he enjoys its taste, or, when reading an interesting literary work, a story or a biography, he becomes totally involved in the intellectual and artistic creation of the writer, and may feel like reading many more of this type of work. In all of the above experiences some information has accumulated in the mind, and memory retains these pieces of knowledge about a rose, a piece of ice, fine music, food, and a book and its contents, as well as its writer. A close analysis of the variety of experience gained by an individual would reveal the relationship of these units of thought with associated ideas, *e.g.* other varieties of rose, perfume, etc., or other literary works of the same writer or works of other writers identical in theme and impact on reading.

Another individual may derive a different set of experiences over these same units of thought. And each one's experiences on identical units of thought would remain isolated and prove less valuable, if both these individuals do not share their experiences. Nature's great gift to man is communication of ideas and experiences with his fellow beings by means of symbols and sounds, which ultimately have been evolved as the vocabulary of a language. Language is a decisive factor in communication and serves as a medium of expression of the information, both in verbal and written form. If it is to be a written communication *e.g.*, a written document, a printed book, it needs a script/symbol. The alphabet, with its perfected phonetics of vowels and consonants is credited to the inventive genius of the ancient Greeks in

Europe and of the Aryans and the Dravidians in India.

The skill of using words to convey reactions to life's situations is a mark of civilized living. Man, by nature, is communicative. The process of communication involves at least two individuals-one to communicate and the other to listen and respond. Several may also be recipients of ideas from one, as in the cases of broadcasting through radio transmission, by means of films and television, or in a class-room or lecture hall.

But a highly sophisticated method of communication is the act of quiet reading of recorded information, normally in the form of printed books and allied graphic documents, which may be audiovisual aids-records, magnetic tapes, computer printouts, etc. A document or a printed book can be read by one or several, at different locations and occasions, and this function of communication through the media of graphic records is fundamental to all libraries.

As an illustration of the importance and antiquity of communication of experience in human life, the Biblical story of Creation relating the coming of Adam and Eve to the Garden of Eden, and the conversation between the two over the fruit of the forbidden tree could be cited. Ever since man learned to live in organised communities, communication has remained a vital need. Without sharing the joys and sorrows, pain and pleasure, and all the experiences of life, there would have been little advancement and progress towards civilized living.

A child employs a crude form of language, if the shrill cries of the baby could be classed as child-language, to communicate sensations to the mother; while adult men and women, speak, read, and write a developed language for the purpose of communicating. Language has, on occasions, proved to be a fundamental barrier in communication, when groups of people attempt to communicate through different languages, not commonly understood, and when the meanings of the words and terms employed are distorted out of context, understood differently at different occasions, or not even comprehended. But on this score, the language, being the only means to perform the task of communication, could not be discarded as inoperative, and ineffective. In organised systems of transmission of information, the language employed is disciplined and controlled, so as to avoid the risk of

being misunderstood with its trail of disasters, and false and irrelevant information being communicated.

Information is knowledge put to use, which may produce good or bad results. Freedom of reading and knowing does not stipulate or even imply any checks and safeguards over the purpose to which the information communicated could be utilised. Information communicated could be broadly grouped into three categories: (1) developmental, (2) pedagogic, and (3) achievemental; when one uses a document for general cultural advancement, for enlargement of his vision, and for intellectual enjoyment, the information obtained is developmental; when a student studies a prescribed text-book or refers to an index, with a view to supplementing the class instruction the information communicated is pedagogic; if a scientist working in a laboratory refers to abstracts and indexes relating to the field of investigation or experiment, the information received is achievemental in quality.

Due to increasing technological sophistication, and the complexities of modern social life, an increasing need and dependence on information storage and retrieval has been recognised.

The Library in the Communication Chain

Information science is concerned with the principles and techniques governing the transfer or communication of organised thought (knowledge) from one human mind to another, and ultimately to society.

Information science is inter-disciplinary in character, and is emerging from a cross-fertilisation of ideas involving the ancient art of librarianship, the new art of computing, the arts of the new media of communication, and those sciences, such as psychology and linguistics, which in their modern forms bear di ectly on all problems of communication-the transfer of organized thought. The Soviet nomenclature 'Informatics' used for information science is adopted by certain sections of Information Scientists to mean "Computer Science".

The inter-disciplinary character of the Information Retrieval Problem consists of four areas—usage, operation, organization, and equipment.

1. Usage is concerned with communication as a human process involving concepts, information units and groups, language, meaning of terms, translation into controlled language, their semantics and syntactics.

2. Operation is concerned with communication as a library process, involving documents, abstracts, bibliographies, description input, publication, and dissemination.

3. Organization takes into account classification and grouping, arrangement and display of files, systems of indexing, programmes, sequence, and standardization.

4. Equipment is, obviously, meant to cover manual and mechanical devices ranging from traditional card catalogue cabinets, visible indexes, electronic equipment, computers (IBM), magnetic tapes and drums, punched cards.

Finally it should be mentioned, that human intelligence to create and control all these factors is of paramount importance, and the feasibility of effective organization of any or all of the foregoing areas will be determined by the reasonable limits of investment and cost in relation to output and use of information.

"Information Science has come through overlapping techniques and technologies. It has not come from the application of common principles. It centres on the knowledge and services needed for effective discourse by other people, and is more a federation of technologies than a set of special activities developed from common principles".[1]

"Information Science is not souped-up librarianship or information retrieval, nor is antithetical to either. Rather, information science contributes to the theoretical and intellectual base for the librarian's operations."[2]

A knowledge or skill to operate a computer, and retrieve the stored information would not constitute Information Science.

Dr. Bentley Glass in his "*The Times and the Timeless: the interrelationship of Science, Education and Society*"(N.Y. Basic Books, 1970) has convincingly maintained that "the data and the facts alone do not constitute knowledge, in the sense of understanding. Information is needful but the observation must be fitted into concepts and conceptual schemes or paradigms, that determine one's outlook and direct one's processes of investigation and enquiry,... the study of a science must penetrate beyond its data

and its laws and embrace also its method of enquiry and its historical process."

"The Library is a product of cultural maturation" observes J.H. Shera in his "*The Sociological Foundations of Librarianship*" (Asia, Publishing House, 1970). "The culture of the world is contained in its libraries' C.O. Houle. Printing revolutionised the scholarship of culture, the system of organisation of knowledge as represented in books, the methods of storage, the process of communication and the interpersonal relationship between those in authority of the book collections and their users". "The need for bibliography as a channel of the communication system becomes intensified with each change in the volume and methods of publication. Bibliography, like the library, is to be seen as an instrument for widening the scholarship of the culture to an ever increasing segment of the population."[3]

With the vast resources of the University Libraries and of the National Libraries, available for the use of scholars and others, especially the legal and ecclesiastical professions, the communication system assumed greater importance and received due attention for its study.

Then came the Public Library, as an institution to stimulate and discipline the minds of men engaged in diffusion of scholarship among the masses. Persons from all walks of life recognised the need for public library services, because that was the only agency that could admirably provide the needed information to the community in the best way. Free access to books and information became a fundamental human right in a democracy. The public library became people-centred, rather than a book-centred agency, which once was limited to the use of the privileged elite and select group of scholars.

This change in outlook of the public library witnessed towards the close of the 19th century drew the attention of professional librarians. Thus the history of the library as an agency of communication reveals a variety of forces and pressures that have shaped and reshaped its social role. From archives storage to auido-visual aid use is the long and exciting story of the public library, whose further potentialities were discovered soon after the political and industrial revolutions in Europe in the 19th century, when the library assumed the role of information centre

for the common man. Rightly, they were known as peoples' universities. The library is simultaneously the stronghold of individualism, unlike other mass media—the newspaper, radio, cinema, and television which are all declaratory and can try to indoctrinate with dogmas, but people go to the library to understand, in search of truth, and arrive at an independent decision and judgment. In short, the modern public library reflects the aims and aspirations of the community it serves. Its social role as an agency of communicating ideas, thoughts, and information has got firmly rooted and the librarian rightly performs the additional role as information scientist as well as his traditional role as librarian.

Communication of Culture

In the golden chain of communication the Gutenberg Press of Germany is a historical landmark. But the present age is discovering and experimenting other media in the form of satellites, video cassettes, cable TV, and computer systems—conveniently or humourously called the Hardware Revolution, which has assumed global interest. Media Professionals from all over the world met at a conference at Leverkusen near Cologne in the last week of September 1975 with the aim of finding satisfactory answer to the Question "what purpose the media development should achieve".

There was unanimous agreement that the significance of media development is being overemphasised. In the process of keeping up with the news, the media ignore problems of fundamental and abiding importance to man—problems of ecological disruption, the armaments race, and the critical fate of human race.

The forum made a plea that mediamen ought to provide the public not only with news, but more importantly with the inner meaning of overt phenomena, with a basic understanding of the springs of action. It implies that the media should be concerned not only with events, but also with what the public ought to do; it should provide guidance and action. The modern media is largely influenced by political compulsions. It, therefore, urged that the concern ought to shift from these obsessions to under-

standing of values—values of abiding importance to humanity. A cryptic statement 'that the hardware revolution is already on its way in the form of all kinds of electronic devices, but a corresponding revolution in software or the content, the approach is called for, a logical continuation of the printing press. Finally, the participants approved unanimously that the media aim at eternal values and varieties. The medium is not to be the message. On the contrary the message is to be supreme, using technology as its handmaiden.

These foregoing observations of media experts corroborate the views expressed in the beginning of this chapter.

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2

INFORMATION THEORY

The Basis and Need for Research

The 'Knowledge explosion' thrust forward the Information explosion. The increased complexity of business process, and the increased output of publications that followed the Second World War made the needs of business and industry more acute in finding improved and speedy methods of locating the available information.

The usefulness and value of stored information, may be collections of printed books, periodicals, serials, and other non-printed material in a library, or in a management information system (MIS), or in data base management system (DBMS) or in decision support system (DSS), or in question answer system (QA), and in information retrieval system (IR), vitally depends to a large extent on the qualities–*currency and completeness–call it up-to-dateness and comprehensiveness* possessed by the unit. For instance the U.S. Library of Congress is stated to maintain both these qualities for its collection, by adding 3,500 new items daily to the library after deletion of less significant items from the vast output of published information. It is staggering to note the limitlessness in the output of scientific journals and serials, e.g. 1800–1966 the growth is recorded from 100-100,000, and today none is able to provide the exact number of these items, and the rate of growth, as new titles appear almost every day. Obviously, these two qualities in maintaining the collection of information sources is almost impossible due to limited resources available, and the time consumed in their location and scrutiny.

Technology has advanced to a great extent enabling to construct computers, which can store all information available in large libraries of the world, in a cost-effective manner. It is not sufficient to find a means to store the information but it must be made quickly and easily available to those who want it. It,

therefore, is essential to develop the retrieval and information technology similarly. Even the ubiquitious telephone could be geared to play its significant role in the transmitting programme. "Unfortunately, communication devices are relatively slow and costly at the present time. However, numerous changes are occurring, such as for example the introduction of satellite communication channels, and the design of communication networks of sophisticated order. If this technology improves continuously, large quantities of data should be transmittable efficiently in the foreseeable future.... The availability of modern information retrieval systems has greatly improved the access to many stored information collections."[1] Machine retrieval of information appears to be a likely solution and gives library service a new dimesion.

The fundamental aim and function of research is to find solutions to problems confronted in the course of human activity in a variety of situations and in the midst of available data on accomplished work and output. Questions are raised and answers are found, but the quality and quantity of answers to these problems is new information. This seems to be an unending cycle, because the human mind is as restless as the restless atom, always on the forward march, engaged in ceaseless thinking and producing a prolific output of information. But some one has to size up this new product, sift, analyse, and standardise it, before it can be dressed up in a presentable form and communicated to those who may vitally need it. This function of the Information Scientist can as well be designated 'Distribution of Knowledge'. There is enough evidence to show that ancient libraries were centres of this activity in their own right and adoped their own methods of information search and research.

According to J.H. Shera, information is of six kinds :

"1. *Conceptual Information* : The ideas, theories, hypotheses about the relationships which exist among the variables in the area of a problem;

2. *Empirical Information* : Experience, the data of research may be drawn from one's self, or through communication, from

others. It may be laboratory generated, or it may be a product of the 'Literature Search';

3. *Procedural Information* : It is essential to design the methodology which enables the investigator to operate more effectively. Procedural information relates to the means by which the data of the investigation are obtained, manipulated, and tested; it is essentially methodological, and from it has been derived the 'scientific attitude'. The communication of procedural information from one discipline or field of investigation to another may illuminate vast shadows of human ignorance;

4. *Stimulatory Information* : Man must be motivated and there are but two sources for such motivation, himself and his environment. Stimulatory information that is environmentally derived is probably most effective when it is transmitted by direct communication–the contagious enthusiasm of another individual—but whether directly or indirectly communicated it is probably the most difficult of all forms of information to systematize. It is by nature fortuitous; it submits unwillingly to direction or compulsion.

The growing emphasis on 'team' research derives from the natural gregariousness of man and his inherent propensity for group organisation and has been stimulated by the growing magnitude of the research task itself. The body of accumulated knowledge has assumed such vast proportions, and its mastery has become so highly specialised, that an increasing number of research undertakings require the concerted attack of many minds, with varying skills, aptitudes, experience, and points of view. Team research magnifies and complicates the informational task, and greatly increases its importance. To the four types of information listed above team research adds ;

5. *Policy Information* : This is the focus of the decision making process. Collective activity necessitates the definition and objective and purpose, the fixing of responsibility, the codification of rights and privileges, and the delineation of function;

6. *Directive Information* : Group activity cannot proceed effectively without cooordination, and it is through directive information that this coordination is achieved."[2]

In team research, the total communication process is of fundamental importance, as it will help identify useful measures for improving the communication system in research laboratories

but its implications for the future role of the librarian as a disseminator of information to society as a whole are precise and distinct. Society needs cultural information and ordinarily looks to the libraries as a primary source. If the librarians do not rise to the level expected, it is certain others, may be nonlibrarian personnel like information scientists, computer salesmen, or technicians, will assume this role and gradually acquire the competency. There is enough risk for librarians in abrogating their age-old privilege of information officers' role together with the traditional librarianship. The terms 'Information Specialist', 'Documentalist' and 'Information Scientist', are currently adopted for describing a person, who searches and produces a pertinent fact in a book, periodical, or special report, rather than producing the reading material which might possibly contain the information needed, and leaving it to the reader to locate it. A further step is to evaluate the information located, and place it in a ready-made or finished form before the reader.

In order to handle vast cumulated information, sift, codify, analyse and retrieve it in the form required has become so complex that machines have been developed to do all routine and non-intellectual and repetetive functions. These devices are known as computers, micro-film storage machines and reader-printers, and the technique for using such pieces of equipment depend on intensive indexing, and detailed subject heading lists. Coordinate indexing and extensive preparation of abstracts is being done by reference librarians or information scientists. All this activity is intensely practised in Research and Development programmes in science, engineering, technology, business, industry, and post-graduate research.

The success of retrieval systems chosen to provide information to the user will largely depend on the conceptual analysis of questions or enquiries of readers. The two qualities, pertinency, and 'relevancy of the information in its provision are vital, as more often the total quantity of relevant information retrieved may not be found pertinent by the user. This can be because the question, when expressed, does not precisely reflect or express the need, and again this is attributed to the linguistic terms used by the enquirer, whose connotation of the terms may be different from their understanding by the 'Information Scientist'.

This would result in maximum relevancy but minimum pertinency to the answer. This demonstrates the fact that, however sopisticated the storage and retrieval mechanism might be, but for the 'fusion' of the human minds in understanding, there is a high rate of probability that the information produced by a computer would lack relevance. At the turn of the 20th century, a turning point in the librarian's professional outlook was witnessed. Paul Otlet and Henri La Fontaine laid the foundation for an international movement for word documentation at a historic meeting in Brussels in 1892, the outcome being the present Federation Internationale de Documentation (F.I.D.), which in earlier stages was called Internationale de Bibliographie, Brussels.

Another important event of global significance was the commencement of the *International Catalogue of Scientific Literature* by the Royal Society, London, in 1901.

Perhaps these world movements were necessitated by the dynamics of social structure and the emergence of periodical publications, especially in science and technology, giving a new dimension to Information Science.

Librarianship, which had in its sphere both documentation and information science, forming a trinity of the discipline, gradually yielded to the separation of documentation and information science, although there exists much in common in the processes and techniques followed in serving the enquirer.

"The diversion from the bibliographic responsibilities of librarianship would not have occurred had there been a proper understanding of the role of the library, its functions and objectives, and an adequate recognition that there were many different kinds of libraries, with collections that were strikingly dissimilar, necessitating an adjustment in organizational machinery required to satisfy a wide variety of divergent demands."[3] The American Documentation Institute became the American Society for Information Science in 1967, while the Special Library Association and the American Society for Information Science, although largely constituted of nonlibrarians, undertook the task of bibliographic undertakings, creating a widespread rift and belief that traditional librarianship is not competent to perform the new tasks in the field of Documentation and Information Science.

The above is an extremist view, and could logically be countered and the hollowness of claim for the superior status for a Documentalist or an Information Scientist could be expressed by citing the forthright view of L.R. McColvin :

"I have always regarded a library as an information service, but is an information service necessarily a library? If so, an information officer should obviously be a librarian.... The man whose job it was to assemble the material in which the information is embodied, to arrange it and make it useful to those who wanted to use it, was a librarian and must have the training, experience and background of a librarian, and that the man who used it, who publicised and public relationed it, wasn't.

"This is an attitude we must respect. All the nonsense about information officers and documentators, and what not must often arise from one cause — that people who are incapable of doing the job of librarianship, or who are unwilling to learn to do it properly, want to justify their inefficiency as librarians by calling themselves something which cannot be assessed as can librarianship, in the light of accepted standards of professional experience and training. So it will be a good thing for everyone concerned if we revert to the old phrases 'special libraries' and 'special librarianship"[4].

"Ideally, a trained librarian should always be appointed to control any information service .... He will prove a surprising contrast to the young scientist who is working as a librarian for the time being only because it gives him sufficient spare time to carry on with his own research".[5]

"Librarians, educators, engineers, manufacturers, documentalists—all those engaged in the information field—require a basic common source of knowledge which will enable them to develop workable solutions jointly.... It would seem that today's aim in information storage and retrieval should not be to find a mechanical substitute for public or university or special libraries but to devise a complimentary electronic organization which can keep pace with the expanding publishing rate in specific fields and provide means for automating technical library processing operations. There is reason to believe that just as handwriting continued to flourish after the invention of the printing press, so general book libraries will remain a life necessity even though

various forms of mechanization may be introduced."[6]

Thus one comes back or goes round and round only to reiterate that the process of communicating the information to those who need it from whatever form of graphic record containing man's thought and experience is fundamental to librarianship or its philosophy and what the so-called Information Specialists or the new breed of librarians of the 20th century perform with sophisticated equipment is only librarianship with a new name to suit the changed social environment—man's dependence on machine for existence.

Information Services and their Value to Business and Industry

Until recently none could foresee that paper shortage, specially newsprint, would occur to the extent of compelling a drastic reduction in the output of newspapers, curtailment of pages, or suspension and even cessation of some periodical publications, because the raw material needed in paper production is not available in adequate quantities, which in turn has been affected by various external factors, with the use of paper diverted to other strategic industries.

While the publishers explore the possibilities of substitutes for paper, even computerised business houses find that the information stored and put out by computers proved disappointing. Once again the need to develop and maintain the organization's own information centre on traditional lines, and rely on them to study consumer preferences, and avoid the risk of external factors dislocating and retarding the business, has been fully justified.

The exploitation of the business data assembled from published information all over the world is the work of the information centre of the company, while the executives and technical personnel do not concern themselves from where it has been obtained, so long as it can be regarded as accurate information emanating from a dependable source.

Alan Armstrong mentions five categories of sources of information, which a company library (information centre) can use. There are "statistics, market research findings, government and industry plans, client and competitor information. It is for their knowledge of all these external sources of information that companies employ professional librarians and information scientists.

Tomorrow's librarians will be the information eye of the company, the eye which seeks and receives information from many sources, sorts what is important and alerts the brain (i.e. the executive) to act on what is seen.... The business library is a low cost and compact operation. A company library is a low cost method of avoiding duplication of the purchase of books, surveys, journals, standards, trade literature, government publications, legislation, directories, handbooks, which otherwise proliferate unchecked, because they can never be found by the person who needs them.... A business library is a final resort for the company whose chaos of published matter is clear and embarrassing evidence of bad administration.''[7]

Guide to Commercial and Industrial Library/Information Centres

The growth of commerce and industry has been spectacular since the beginning of the twentieth century. The development of industrial and engineering undertakings has been multidimensional and phenomenal in the developed areas of the world. The chief contributing factor towards this trend has been the impact of science and technology with huge sums of money invested in research and development programmes, both by government and private enterprises in selected fields—chemical and pharmaceutical, iron and steel, coal and energy, electronics and aerospace industries. A significant proportion of this expenditure was for organizing and utilising the existing and new knowledge/information to help production with a view to favourably competing with other highly industrialised nations and create new markets for the products. But R & D and production needs management information-customer demand, state of the market, labour feasibility, and economic growth—which could vitally affect the industrial concerns. The information needs are diverse and could be met from specialised branches of science and technology and production economics.

The growing dependence of commerce and industry on information sources, their organzation and dissemination, has resulted in the establishment of libraries/information services to a considerable extent. By the end of the twentieth century, it can be anticipated that almost all progressive and successful industries,

commercial enterprises, and technological institutions, will have their information services organized, and also pool their resources together with a view to economy and wider coverage of specialised information, *e.g.* UNISIST, OECD, OSTI. Surveys conducted to assess the nature and types, and functional pattern of libraries/ information services, forming an integral part of the industrial establishments reveal that scientific and technical personnel employed are supplied not only current awareness information in each one's specialised branch, but also positive and highly valuable data from related sources of information, (SCI).

"Of all the personnnel involved in information transfer, it is the manager or the senior executive who has the most difficult time.... Ideally, he is supposed to disseminate information to his staff, give guidance on policy matters, and at the same time keep in touch with the work, progress and problems of the department(s) for which he is responsible. Also, ideally he is supposed to be well read on a variety of topics, to understand the company's policy, to communicate regularly with departmental heads, and to contact other research executives. To overcome this problem a communication hierarchy is developed with degrees of delegation varying from one level to the next. The problem, then, is how to ensure that information is passed effectively throughout the hierarchy,both downwards and upwards, resisting the artificial restraints created by human nature. It is against this background of the communications process that literature has to be assessed."[8]

For research workers in industrial and allied organizations, among the main activities—planning, discussion, experimentation, arriving at conclusions, and reporting—reading perhaps occupies the first place, because it is from the ideas, facts contained in the documents, abstracts, that further activities emerge, take shape, and result in all-round progress. Time spent in reading and using the library and information services is in direct proportion to the quantum of responsibility attached to the job performed. In solving the problems of R & D programme and policy, the library/ information service plays a vital role. This can be measured from the figures of documents' use given subsequently. Library provision has been radically redesigned and constituted after the Second World War, chiefly due to the quantity of publication of technical information by research bodies. The new information was particularly spectacular in the fields of industrial chemistry, organic chemistry,

Table 1

ANALYSIS OF DOCUMENT USE*

Documents	Scientists	Engineers	Non-thechnical	Industrial Users	General average
Text-books	53	59	57	(26%)	56%
Periodicals	50	32	41	(44%)	43%
Abstracts/Indexes	26	19	15	(30%)	22%
Handbooks Data Books	12	24	14	(19%)	16%
Dictionaries, Encyclopaedias	10	12	23	(8%)	13%
Current Awareness Journals (very little deviation within the four groups)	—	—	—	—	10%
Reports	7	11	13	(10%)	9%
Trade Literature	3	9	8	(10%)	6%
Standards specifications	3	13	5	(8%)	6%
Conference proceeedings, pamphlets, monographs, patents (all groups)	—	—	—	—	6% or less

*(Slater and Fisher, 1969) ASLIB

synthetic chemicals, electronics, and engineering. The management of industrial concerns realised that provision of current information to the scientific and technical personnel was of immense value in making technological advances tending to increased production more economically than in the previous period. The

first few major industrial combines, like the I.C.I. (Imperial Chemical Industries Ltd.), the Glaxo Research Laboratories, Marconi Research Laboratories, the General Electric Company, set up their individual library and information services, with full-time professional librarians, and information scientists aiding research programmes. Modernizing the physical plants, diversifying the products, and expanding the business to overseas markets—all these factors influenced the creation of a new pattern of library and information service. "Important factors in the growth of library and information services are the effect of mergers, takeovers, rationalization, and an apparent growing awareness on the part of some research workers of their need for information rather than documents"[9]. The methods adopted for collecting and coding the information centred round preparation and maintenance of an index of company reports, co-ordination of computer-based commercial information service, translation of foreign language documents and abstracting the special research reports, for which ready-made commercial type of abstracting service was not available. The British Technology Index is a further useful aid in this field.

It seems worthwhile to describe the library and information services of one or two select industries so as to serve as a guide and plan for similar undertakings and to the special librarians, information scientists, and research directors.

The British Steel Corporation based on the Iron and Steel Act, 1967, is considered the world's biggest industrial merger, involving the take-over of 13 major companies with 200 subsidiaries, and 39 major steel works, employing approximately 250,000 people. Perhaps the United States Steel Corporation would rank as the first largest steel producer. In India also recently a similar merger of the steel companies located at different places, and with independent responsibility, has led to the formation of *Hindustan Steel Authority Ltd.*, under the management and better coordination, and unified responsibility. Another similar example is of the Heavy Electrical Industry, now under one unified authority Bharat Heavy Electricals. These two big industrial undertakings have full-time professional staff for library and information services and the research workers are provided current awareness information service, but the management as a whole has yet to feel the impact of adequate and efficient information services on decision making and production.

"The British Steel Corporation's R & D activity is organized on a divisional and corporate basis. Each of the divisions has a research and development department concentrating on product development, reduction of process costs, and the supply of technical services to the works, in addition to long-term research appropriate to the division."[10] Library and information centres, functioning effectively constitute an integral part of the divisions, *General steels, Special Steels, Strip Mills, and tubes,* or within the laboratories of *BISRA*, in Sheffield and London. The administrative head office of the corporation, located at London, maintains a separate library unit for co-ordination of functions and resources. Works' libraries for technical personnel for on the spot use are provided.

The richness of the library resources of the Special Steels Information Service at Swindon can be assessed from its holdings-60,000 books and pamphlets, 14,000 British and Foreign Patents, and 11,000 translations from foreign literature of relevancy to its activities.

Post-coordinate indexing of material not included in published abstracts and indexes is done. About 600 periodicals currently subscribed to are scanned by qualified information assistants, and abstracts are made and circulated to research personnel on the basis of personal interest profiles. The periodicals of more general interest are regularly circulated. A total staff of 18, of whom 9 are qualified in library and information science, with the rest non-professional, is employed for these activities.

While the Sheffield Information Service with a staff of nine, of whom four are graduate assistants serves the Steel Making, Mechanical workings, and Metallurgy Departments and renders SDI service to the staff at all *BISRA* units. Indexing of information in about 400 periodicals currently subscribed to is done by optical coincidence cards and the terms are controlled by a specially compiled thesaurus for *BISRA*. Literature searching is carried out from about fifty abstracting periodicals, with annual input of 50,00 abstracts. In addition, an index to all translations pertaining to steel industry is currently maintained. Enquiries run to about 3,500 annually, for information and are received from all over the country—industrial liaison centres, public libraries, and *BISRA's* commonwealth units. A number of reports are collected

and circulated and *Steel User News* is published from the Information Section.

An assessment of the level and effectiveness of varied information services provided by a large industrial and engineering concern—like the British Steel Corporation–and the surveys already canducted for other kinds of commercial, technological, and industrial organizations offers a base to arrive at an acceptable norm with relation to staff, management, and services in general for library and information services.

Library Staff and Potential User

The relationship between the library staff and potential user is extensively regarded as an important and constant factor in formulating the norm for the assessment of adequacy and efficiency of information services provided. The data collected over a wide range of industries—chemical, electrical, engineering, metallurgical products-reveal varying ratios from 1 : 10 to 1 : 150. It appears hazardous to state that a library and information service observing a high ratio of staff-user relationship would offer higher standard of service than another with lower ratio, because the relationship expressed is only quantitative in character. The efficiency, work flow, 0 & M, and the salary of library staff more often yield a much better information service than only with a large establishment lacking these qualities. It, however, is reasonable to state that a professionally competent, experienced, and well paid person, deriving job satisfaction would prove more efficient and reduce the number of library staff members, who may lack these qualities. Involvement in the production programme of the undertaking, on the part of the library staff and understanding of personal interests of research, scientific, and technical workers would certainly result in higher relevancy of information stored and disseminated.

Staff Functions

Scanning of periodicals, reports, and proceedings, preparing abstracts, wherever necessary, indexing of the materials, and issuing technical bulletins for circulation among the workers and sometimes to related outside agencies, are significant and essential functions of

the staff. It is frequently observed that work with periodicals' scanning consumes major staff time, and so the larger the number of journals to be processed, the lesser the attention that can be paid to other functions. Further, the ratio for staff and number of periodicals scanned would vary considerably, depending on the length of the articles, and their number, and depth of abstracting and indexing for any specific subject area. Normally, a library staff member would be able to attend to 30 to 40 periodicals a week.

In ensuring economy of highly paid library/information staff time, it is advantageous to relieve them of much of routine functions, like typing, operating a computer, taking photographs, filing, etc., though indispensable, which can generally be regarded as non-professional functions.

Cost Estimates and Analysis

Library and information services, being intangible, are difficult to evaluate in terms of monetary expenditure, which can precisely be stated for manufactures, production, and profit. Nevertheless, it is essential for industrial undertakings to estimate the cost and a large number of these organizations apply costing and control techniques for evaluating effectiveness, plan performance and operations involved.

The information requirements are in variety-searching literature, abstracting, translating, indexing, issuing bulletins, supplying photostat copies, and interlending. No precise costing on the basis of time and labour is possible in these areas of work. However, there are certain constant factors, time and labour, materials and equipment, present in the functioning of information services. An overall estimate of expenditure for a given period can be made for books, periodicals, non-book materials acquired, their binding and maintenance, staff salaries and wages, accommodation and equipment, heating, lighting, ventilation, and air-conditioning, and miscellaneous items like postage, packing, transport, and insurance. A recent survey of annual expenditure of 48 British industrial enterprises is reported to yield an average of total annual expenditure for each library of £ 18,950, and eliminating the nine largest concerns, the average expenditure is reduced to £ 10,190. This figure is certainly not a parameter to judge the adequacy and efficiency of similar information services elsewhere; but it can

indicate a basis for costing of information services, after giving careful attention to varying local conditions.

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3

INFORMATION RETRIEVAL SYSTEM: CREATION AND STRUCTURE, AND ORGANIZATION

Materials of Information

It is appropriate and essential to State the significant differences in the characteristics of the sources of information that prevail between the sciences and humanities, as well as the citation practices adopted. The scientists' attention and interest is the study of the physical universe, while the scholar of arts and humanities looks to the achievements of all persons, including scientists, which contribute to the cultural heritage as a whole. The existing literature of art, philosophy, religion, social sciences are never superseded as scientific works; e.g. the revolution in the study of science after Galelio and Copernicus, and Chandrasekar displaced the notions that prevailed before, regarding Sun, Moon, Earth, and Planets and Stars.

Books dominate the sources of information in humanities, while information in current journals of science and technology is chiefly of interest to the scientists, e.g. Homer, Socrates, Plato, Pliny, Descartes, Samuel Jonhson, etc., continue to be of interest and value to scholars of humanities. The Vedas, and Upanishads of India remain inexhaustible sources of information and authority, but for scientists, Journals and Serials beyond the past five years continue to be of little interest. There is perceptible difference in the time aspect of information.

Due to the facts stated above the citation practices between the intellectual pursuits reveal outstanding differences. In humanities, it is cumulative, more personal and ageless, while in sciences it is concrete, factual and current.

An effective and successful information service could be provided only by acquiring a significant quantity of material containing or dealing with information, relevant to the work and

objectives of the institution, of which it is an integral part. The material would be varied in quantity and quality, format and style, and language. It may consist of printed books, regular periodicals, serial publications, like annual reports, proceedings of the professional conferences, abstracts, indexes, maps, charts, plans, newspaper clippings and non-book material of particular interest to the organization.

Dr. Enright's conception of 'Metabooks' to imply an extension of books, and all the various formats it encompasses, from the microforms to video-tapes, gives an equal status to non-book materials. Metabooks are information sources, where ideas and knowledge are stored in the most convenient forms. They can attain the status as independent sources, or remain complimentary, supplementary, and stimulatory for research into other information stores.

"Multi-media resources are a reality in many areas of education *now*, and the resources involve a medley of books, meta-books, and periodicals. In order to facilitate efficient use of these mixed sources of materials, they must be organized in a readily grouped and connected manner frequently with imposed educational structures."[1] The significant role played by non-book material in information services is discussed subsequently in detail in Chapter IV.

Initial selection of basic material of non-transient nature and of permanent value for reference is comparatively easy, because of the availability of sources of information—ready-made retrospective subject bibliographies, guide books, annual surveys of literature in the field, year books, trade bibliographies, and booksellers lists, but the selection of current material to be added to the collection in order to bring the information up-to-date needs continuous study of subject periodicals, abstracts and announcements of publishers, and reports, of professional conferences, and their proceedings. Very great care and judgement is called for in selecting the material. Unless the information in the items selected would be relevant and valuable to those engaged in productive or fundamental research, it would be wasteful expenditure and would deplete the limited financial provision of the information service organisation. As no proven and infallible formula for discarding and selecting from the enormous output

of documents published is available and one such cannot simply be stated in algebraic equations, all that the information officer has before him is empirical data and common sense to guide him. In making a choice of sound recordings, adequate care and judgement of a different quality is called for. Much educational material on tape and record does not appear in printed bibliographies or commercial catalogues. As sources of original information, these non-book materials become complimentary to information available in books. Special subject records, even if available in foreign countries, will be a sound acquisition for the collection. As book grants of libraries are limited, acquisition of non-book material can appreciably reduce the amount to the extent of their price, besides the cost of equipment necessary for using them and their maintenance in good order.

Whenever a new information service is started, a considerable quantity of gift material may be offered by allied organizations and individuals. As it is offensive to refuse the acceptance of documents donated, they must be acknowledged, but need not all be processed; otherwise irrelevant information which would add unnecessarily to the bulk of the collection and consequently result in complexity in retrieval function would figure in the library.

A pertinent question is, "what should be the minimum and maximum size of the collection"? This can be answered, not in precise numerical quantity, but in general terms. The size of the collection will depend on the activities and specialist personnel attached to the organization.

Sometimes, non-commercial, unpriced, and private documents are found to contain information of great value to the activities of the organisation. These records may be private monographs, annual reports, manuals and instructions of private firms to their staff. Efforts should be made to locate such special type of material and acquire them, which can be done by maintaining a sort of public relations programme.

Vertical files of newspaper and journal clippings and visible indexes of correspondence files of the organization which contain important information, should be given adequate significance in building the information collection.

Book and Non-book Resources Merging : An Integrated Plan

As new media of information in the form of non-book materials is gradually increasing, and its value is considered equal to traditional book collections as sources and media of information communication, it is suggested by experts in the field of education, specially at secondary level, that the non-book material should not be segregated from printed books but stored in a different area of the library. "The provision and utilization of all types of information should be integrated, that book library services should not be separated either in the library itself, or in the school, or even within an authority. If such separation is occasionally necessary for reasons of space, it must surely be considered only as a temporary expedient. One half of the service cannot survive without the other.

Within the library the user should feel able to turn from one form of information to another with the minimum of effort. He may not, as we have seen, even know in which type of material the answer to his enquiry might be. The design of the library should aim to allow the use of as many different types of material as possible throughout the whole area"[1].

This conception of integrated approach to information available both in book and non-book materials could produce good dividends in terms of maximum use by the adoption of a common Code of cataloguing and classification for the organization of both types of material *vide* C. L. A. : *Non-book materials : the organization of integrated collections, 1971.* While appreciating the reasonableness and advocacy for an integrated approach of multi-media sources of information in library/information service, one should comprehened the background, physical structure of a library and its programme and policy of serving the community. Perhaps such a plan might become unsound in the case of national, university, and major city libraries in view of their large collection of printed books numbered in millions, as the new media material, which is comparably selective and small in size, would get totally overwhelmed or appear insignificant, and may not directly attract the users to them. In school library information service and perhaps in small and medium sized public libraries, however, this scheme of integration might prove rewarding.

The Design of Information Retrieval Systems

Sociologists are of the view that information storage and retrieval is itself a subject of sociological enquiry, and that social construction of knowledge has implications for the general construction and codification of all knowledge, but the theories and procedures of information scientists indicate diversity in their approaches concerning the construction of knowledge and systems of information retrieval.

The creation and transfer of information, according to W.D. Austin in his *'Personal Communication'*, undergoes four gradual steps:

(*i*) The phenomena observed;
(*ii*) The images in the mind of the observer;
(*iii*) The expression of these in writing (and other media); and
(*iv*) The extraction and coding of these elements in these media to function as retrieval 'keys'.

As documentalists, we are concerned with only the last two of these, although concepts such as reality and cognition are significant as they affect the performance of the system devised. But social scientists hold the view that even the first two levels are vital to the efficient performance of information systems.

D.J. Foskett, while admitting the relationship between these levels, states that knowledge is structured in the information system and that its criteria of measuring fullness are derived from the structure of the universe, and not from the structure in the mind of any particular individual. If these were not so, we could never arrive at any kind of consensus, which, manifestly, we are doing all the time.

Amidst varying theories, currently prevailing on information retrieval systems, one could perceive with reasonable conviction that close understanding and partnership between information scientists and subject specialists is essential in the creation of an effective retrieval system, because the body of knowledge structured by itself would not yield the information needed by a variety of potential users, but for providing the means to get at it through adequate coding of all the elements that constitute each and every

concept contained in it. The first part of this activity is the legitimate field and concern of the subject specialist for by virtue of his scholarship and training in a given discipline, he is competent to select and assemble the pieces of information or units of thought, lying scattered in documents. His knowledge of bibliography, indexes and abstracts, and the relation that one discipline has with another—collateral and coordinate subjects—enables him to cover the whole field and render the coverage of information as comprehensive as possible. A subject specialist could not be held responsible for the efficient performance of retrieval functions, simply because he has not acquired the competency for this work. This is not to say that his contribution in building the information system is less important. It is the information scientists, who have training and experience of the methodology and technique of providing the 'keys' to the retrieval of information, who could energise the assembled body of knowledge to function when needed. The equipment may range from simple visible index to computer. By and large the unified theory of bibliography conceived by J.H. Shera, seems of fundamental concern in the organisation of information systems.

The central purpose in information work has two mutually supplementing functions: (*i*) to collect relevant information in graphic form in documents, and (*ii*) to make it available to the user, when needed. The mass of information has to be stored, analysed, and searched out. The problem of retrieval becomes increasingly complicated as specialised growth in the fields of knowledge assumes vast proportions, and the same information could be pertinent, though in a modified form for different uses on different occasions.

This calls for a scientific method to be adopted at all steps of retrieval of information. Knowledge of availability, location, identification, evaluation, selection, arrangement of concepts in headings, their delineation in logical or correlated sequence, and their presentation in readily usable form are necessary ingredients in information work. These will necessitate the study of indexing methods, abstracting techniques and mechanical devices helpful for information input and output.

The traditional subject entries, whether classified or alpha-

betical, tend to become unwieldy, less specific, and probably difficult to locate with the continued growth of the mass of information found in documents. This has lead to the development of 'post coordinate', indexing systems in place of 'pre-coordinate' methods of indexing, controlled language, weights, roles, links, and thesauri, which are studied and presented in a subsequent chapter.

Manpower required for information work is more concerned with the kind of people to perform different categories of work involved than with the number of persons. Recruitment and selection, placement and employment of specialists, technicians, etc., should be based on a practical basis, education and training.

"The satisfactory functioning of library/information services depends to a great extent upon (*i*) attracting staff who are motivated towards this kind of work and are capable of meeting its growing and changing demands, (*ii*) employing them on tasks and under conditions to which they are best suited and in which they can be most effective.... Accurate job description is particularly important in the library/information field because of the pace of change — change in technology, in organizational size and structure, in attitudes and in traditional roles"[2]. Research is being undertaken to assess the extent of their influence on information work and methods, and on the personnel employed.

On the Practical Plane

The foremost practical consideration in the design of an information retrieval system is to determine, whether it would be (1) a document retrieval, or (2) a fact retrieval, or (3) a data retrieval system. The distinctions among the three types are obvious. The first one would provide the documents already recorded and stored, which are relevant to the enquiry; the second one would yield a *'specific answer'* to a question, *e.g.*: Is India a Republic? A. Yes; Is India a monarchy? A. No. The third one would give numerical or coded information, *e.g.* Q. What is the distance between the earth and the Sun in miles? A. 93,000,000. Although the second and the third

groups provide specific actual information, the distinction is that the former one is *'linguistic'*, and the latter one is *'numerical'* in form.

Traditional Information Service in Libraries

Reference retrieval has been extensively practised in libraries by referring to the card catalogue of the library and ready made commercial indexes, abstracts, directories, encyclopedias, year books, gazetteers, e.g. *Poole's International Index to Periodicals*, *Chemical Abstracts* etc., with a view to providing in response to an enquiry, a list of references to documents that are likely to contain information relevant to it. Then it is for the user to locate and look into the documents and determine the extent of appropriate information pertinent to his need or question. Such a method involves little sophistication, though time-consuming, and it would be within the limited resources — manpower and material – in libraries of the developing areas of the world.

But a slightly improved system than *Reference Retrieval* is *'Document Retrieval'* in which documents are stored for direct access to them. The user retrieves the documents themselves, which are pertinent to his enquiry, in the form in which they are stored, but still it is necessary for him to scrutinize them in order to find the appropriate facts or information that may be contained in them.

A highly sophisticated and precise system is 'fact retrieval' or 'data retrieval' which extracts from the store, correlates, and provides to the user the precise data required to answer the user's question.

Beyond these system parameters, there are certain external factors that may influence the choice of the system. The user's needs and his preferences govern the decision on the design of an information system. The higher the level of sophistication in increasing the systems effort and performance, the lesser is the reader's effort to get the answer to his question. In this context, the cost factor is a significant consideration, and the adoption of a highly sophisticated system of information retrieval would be justifiable, only when the user's time and effort saved is worth the price.

In specifying the level of sophistication for an information system, it is necessary for the designer to be aware of the variations in the alternative choices, in order that the feasibility of the operations by manual, semi-automated, and fully mechanised methods can be judged and finally adopted. "However, if a designer selects that level of sophistication, his options with respect to mechanization and staff will be limited to those systems that maintain a staff-subject matter specialists to perform the analysis function."[3]

It is also essential to assess the extent to which the file of stored information is or can be structured, because the feasibility and reliability of automatic retrieval systems depend on this grading. A highly automated system operating at a high level of sophistication, when circumstances require, needs to be structured, in order that the information can be identified and extracted, manipulated or processed with a minimum of intellectual performance. Numerical data spontaneously yield to structuring as required and therefore automatically manipulated or processed with fairly reliable results.

Non-numerical but quantifiable facts can be structured as desired and therefore can be automatically manipulated. But subjective or narrative information in natural language, being inherently complex on account of variations in its semantics and syntactics, logical inference, and relevance, is highly difficult to structure. However, experiments, and efforts continue to be made by specialists and researchers to produce an automatic machine language for processing the information. The prevailing trend in operational retrieval systems is the maintenance of an indexed collection capable of providing the user a reasonably comprehensive number of citations or actual documents pertinent to his enquiry. This is by and large considered as adequate for a good variety of purposes. Perhaps the future points towards a highly sophisticated level of information, retrieval system, involving heavy outlay by employing subject specialists, using specially built computers almost fully automatic in their output, and centralised location of such an information centre and participation or cooperation between different national institutions, with a view to reducing the cost of service.

Types of Information Systems

Apart from the age old and traditional library catalogues, indexes-printed, card, etc., — the most important computer based information systems in vogue are : (1) the Management Information Systems, (MIS), (2) Data Base Management Systems, (DBMS), (3) Decision Support systems, (DSS), (4) Question-Answering Systems, (QAS). A brief account of these systems is given to distinguish the processing of information adopted in each case.

1. Management Information System is designed to suit the needs of managers in an organization, and therefore limited in scope and special processing is done with a view to enable the manager to achieve the special purpose of the organization. The data collected and processed is governed by this objective, e.g. manufacture of paper for printing currency notes, their colour, water marks etc., while the general paper manufacturing organization is concerned with similar data, but will not provide the precise data for producing paper for currency notes, unless it is scrutinised carefully to get it.

2. Data Base Management System is designed to store, maintain, and retrieve data facts available in the system in explicit form, i.e. in natural language. In any automated system information appears in the form of specific data elements stored, which have to be identified in the corresponding record; names of individuals, addresses of people involved, job classification are the characteristics used to identify personnel records. Each one of these individuals is provided a specific number which serves as identifying means to locate his records.

Care is taken to maintain the data base up-to-date by addition of new items, or deletion of obsolete ones, and to safeguard its misuse or unauthorised transmission of the data.

Each request for information must state the specific values of the records identified, in order to exactly locate them. The difference between the general information retrieval system and the data base management system in regard to the output of information is that the latter contains a good deal of numerical data, and is relatively precise to the request.

3. Decision Support System shares the advantages of both the general information retrieval system and specific informa-

tion retrieval systems like MIS and DBMS. The subject field covered by other systems is of special value in the processing and functioning of this system. Irrespective of the information available in IRS or MIS, DBMS, it is included in the DSS, in order to help the management in making a decision. So one can state that DSS is at once both comprehensive and special with regard to the information yielded.

4. Question-Answering System is designed to yield factual information in a natural language base. "Work on simulation of human linguistic processes is of particular interest to us here, because, in recent years, it has usually taken the form of work on *question – answering*, or factual retrieval systems."[4] The obvious and main difference between a document retrieval system and a question–answering system is that different kinds of questions are asked of a document retrieval system and different kinds of answers are looked for. For example, if one wants to know the total population of India and also of a specific area in it, a direct answer would be available from a question-answering system, but the same specific information could not be expected from a document retrieval system, which is organized and structured to give the names of a document by given authors which contain the information. Certainly, the QAS is direct, and more time-saving than the document retrieval system. "Question—answering systems provide access to factual information in a natural language setting. The stored data base often consists of large numbers of facts relating to special areas of discourse, together with general world knowledge covering the context within which conversations between persons usually take place. User questions may be received in natural language form, and system responses may also be furnished as natural language formulations. The task of the question–answering system consists in analysing the user query, comparing the analysed query with the stored knowledge, and assembling a suitable response from the apparently relevant facts."[5] The comprehension of language both of the question and response seems a barrier in providing the precise answers. A number of sophisticated processing steps are necessary to provide direct answers to questions. The subject and its frontiers, its relations with the closely surrounding subjects and the mutual impact should be understood

It is only then a question–answering system that can be depended upon to furnish answers to questions put forward by the user in natural language. The semantics and syntactics of the terms/ words of the question is also a necessary requirement.

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4

NON-BOOK MATERIALS IN INFORMATION SERVICES

The traditional concept of a library or an information centre has been that the reading material in them is limited to the printed books and documents to a large extent, allowance being made to include in them, a few manuscripts and archives of utmost rarity and historical and cultural value as original sources of information for investigation and study in the disciplines of historical and social sciences. Perhaps, this exclusion of non-print reading materials in the acquisition policy of libraries even during the early decades of the twentieth century was due to the close association and functioning of libraries and museums housed in one and the same building. The museum collections contained non-print material, which the libraries considered inappropriate to mix with printed books.

Subsequently, it has been recognised that information sources should include non-print materials also, as they are equally effective media of communication of information, especially in experimental and descriptive sciences, and adult and secondary education; they possess features that are not found in printed books. The foremost characteristic observed is the distinct method of storing information and production of these materials, which tend to ease the problem of books storage and preservation.

Definition

It is essential to arrive at a satisfactory definition of 'non-book materials'. A most comprehensive and general definition of the term would be that they are special reading materials demanding different methods of acquisition, cataloguing, use and storage apart from those applicable to books. These non-book materials provide a special appeal and value to certain classes of users, *e.g.* the students up to the secondary level of education, the musicians

photographers, and artists, and scientists and technologists, and disabled persons.

Scope

The non-book materials of potential value in information centres will cover a wide variety of:

pictures; maps and charts;
filmslides and transparencies; and reproductions;
models and specimens;
cassettes and cartridges;
gramophone records;
motion-pictures;
video tapes;
documentary films of educational value.

Among these, cassettes and gramophone records are popular with the general public and are freely lent from a large number of libraries and information centres.

Sources of Selection

As compared to the products of book industry and trade, the non-book materials are generally produced in limited quantity by a group of select producers, because of the high cost of production and restricted demand for them. The non-book material industry involves the activities of the original recording artist, the manufacturer, and the distributing dealer. These three divisions of labour stand reasonable comparison with book production, which depends on (1) the author/writer, (2) the printer and publisher, and (3) the book seller.

Commercial suppliers duly advertise the non-print material produced, in different trade journals and educational periodicals. It would be necessary to obtain these announcements or the trade catalogues in order to make a selection. In the case of institutions, which bring out highly specialised non-print material in graphic and expository arts, and experimental medicine and technology, the information centre has to secure the information by public relations with them, as the material is often limited for the use of the institution producing.

If the source of information is motion pictures, they are ordinarily not acquired by purchase; they are provided for use either on rent or loan. Some motion pictures produced by commercial concerns for prestige reasons or by government subsidy or assistance, may, however, be freely accessible for viewing. The information centre should make a survey of available motion pictures of interest to the community served and make a selection from them. In order to maintain the state of information up-to-date, the trade catalogues, brochures, and publicity announcements of dealers and producers and national and international governmental agencies should be collected periodically, sorted, and arranged by producers, as no subject grouping of these fugitive material is possible and worthwhile.

When it is known that information centres/libraries are interested in non-book materials, sales representatives of producers of these materials periodically visit the institutions and provide a fruitful field of selection. The producers frequently display their non-print ware at professional conferences in which information scientists and librarians participate, in order that they can examine their appropriateness for acqusition to the collections of their organizations. The sources of availability also offer some help in their choice, but quite often, they may not be relevant to the policy and programme of the library. Therefore, it becomes essential to carefully assess the usefulness of non-book materials in relation to the subject fields of interest to the community served before purchasing them.

Organization for Use

The non-print materials in the collection of a library/information centre have to be systematically grouped and arranged on specially designed (cupboards/shelves) storage accommodation and records to identify and locate them have to be prepared. This requires special treatment, as the rules of classifying and cataloguing printed books have to be adapted for them, because non-book materials have to be described in a way totally different from the descriptive cataloguing of books; e.g. a L.P. record does not indicate the matter recorded and the indexing of specific concepts/terms therein is virtually impossible as no exact reference could be made. Pictures, photo-

graphs, and paintings are only provided with a bare line or two of their title and not with subject contents as of chapters of books. The same characteristic prevails in respect of film slides and collections of models. All that is immediately ascertainable is their title and the name of their producer, who is generally less important than their title, for the users, which feature is also true of motion pictures and similar materials.

There is a need to maintain an inventory of all these non-print materials in order to organise and maintain them, together with the equipment, projector, amplifier, transformer, tape records and players, etc. Special rules of cataloguing this material are called for. "The library, if we extend the service concept as far as the users like, should be the source of all information and the means by which information is made available. Because each of us is his own reading machine and need not check out anything to accompany a book does not mean that the library should never involve itself in the collection inventorying, and circulation of equipment. Such involvement is almost inevitable if the library undertakes to collect non-print material for the use of its community."[1]

Storage Equipment

Storing and preserving non-print material acquires different kinds of accommodation, unlike uniform book shelves. Gramophone records could be conveniently stored in divided steel shelves, which are slightly tilted toward the back in order they do not fall and break. Filmstrips are ordinarily kept in non-corrosive metal containers and are likely to be misplaced. Further, the filmstrips are best preserved in an atmosphere, free from excessive heat and humidity. Motion picture films are kept in round cans with a width to accommodate 16 m.m. or 35 m.m. films. The physical characteristics of these non-print materials influence the pattern of their storage and special acoustically equipped rooms planned and located nearby for their demonstration. It is not essential that a moving picture film based on a literary work, e.g. *Gone with the Wind*, or an ancient historical episode, e.g. *Ben Hur*, is kept by the side of the book. The readers of the original work will be informed of the existence and location of its filmed version

in a special note in the descriptive part of its catalogue entry, and thereby collocation of related information could be achieved.

Classification

The non-print material should be classified by the same system of classification, as adopted for printed book collections of a library and for the documents of an information centre, as the representation of concepts by means of painting or line drawing, and electro-recording of terms of a text or an address does not alter the information content in them, e.g. the D.C. class notation for the printed book, *World's Air-Craft* and the Moving picture based on the same work will be 629.13. The subject matter with which non-book materials deal is more important than the materials on which too much emphasis need not be made. The varying sizes and shapes of containers in which this material is preserved influence not only the design of shelving accommodation for them with a view to economy and conservation of space in library stack areas, but also their arrangement and display on the shelves. A broken order of arrangement would be appropriate.

Alternatively, a more rational method of organizing non-print materials would be by adopting a faceted scheme of classification. Pictures, especially film slides internally produced in an institution, where the subject matter or the topic is the only approach, and point of access to them need subject analysis and representation. Indicating all the subjects analysed on which the film slides provide information by means of *uniterms*, would facilitate exact, precise and quick retrieval. In order to ensure consistency of terms used for identical and related concepts they have to be controlled by a sort of thesaurus, in two parts, one listing them alphabetically for all the terms with class notation against each of them, and another arrangement of the terms in the order of the class numbers.

Detailed directions in the choice of terms representing topics are to be drafted by the individual library/information services agency to suit its policy and programme. All the principles and procedure examined and described in chapters on indexing methods and Physical Forms will equally be applicable to the organization of both non-book material and printed books with only slight

modifications which could be justified, if they could increase the effective use of information. (Newspaper libraries maintain collections of pictures and photographs which are of topical interest and in classifying them, they may chiefly be grouped under three basic classes—*Personalities*, *Places*, and *Events*; scientific or educational institutions maintain collections of film slides and transparencies for individual study and demonstration in the classroom. This collection can be similarly grouped; e.g. in medical colleges there will be a large number of these teaching aids. Each film slide or transparency representing a particular organ of the body will be the personality on the slide, while the bed, anasthaesia room, the operation theatre, from where the exposure of the organ was done will be the place and the disease studied together with its treatment will be the event. The organ, disease diagnosed, and the treatment, followed by the other secondary facets will determine the citation order and the notation of the topic.

Organizing a Collection of Pictures, Slides

Maximum facility of subject access to the pictures calls for determination of the basic categories of subject headings and their class numbers. The call number adopted should be distinguished from the one used for printed books to avoid confusion in locating and replacing. Precise description in identifying a picture should be provided in the entry below the heading on the card.

As a time saving measure, the name of the producer, which is generally least important to the user, may be omitted on the entry, and attention being thus concentrated on subject access. Coordinate indexing systems ensure maximum access, with greater relevancy than other methods of information retrieval, and can safely be followed.

The view that a fine picture cannot be described adequately and minutely even by thousands of words bears out the importance of its value as a piece of information to the user, and therefore the material value of a news picture or a film slide, however trivial it may be, will have an appropriate place in the collection for its value as a document of information, e.g. the amateur photograph by a passer-by of a car accident, could convey precise details much better than words could express them.

In general libraries, the collections of pictures and slides are sometimes given secondary attention and maintained in major groups in folders or boxes which are provided generic headings, so broad as to include various specific kinds that may fall into the class and arranged by simple alphabetical order on the shelves. It will be left to the reader to locate the exact picture required from the folders or boxes, while expense in classifying and describing them on individual catalogue entries is saved, but only at the reader's expense. A decision on this must be taken by the library/information centre regarding the standard of treatment to be provided to the pictures.

Gramophone Records and Moving Pictures

If the picture collection is valuable as visual information, records and talking-moving pictures provide audible information to the user. The effect of sound in conveying very valuable information to the user, better than a picture/slide could be measured by the examples provided. The performing musician, learning a song by hearing the voice of the original artist, could never achieve a similar effect by any other media; or a physician, hearing the heart beat recorded on tape in the diagnosis of cardiac disease, cannot find another effectively communicating media in its place. It is comparatively easy to identify a record or its cassetted version by hearing the recorded sound. Complete descriptions of plays or concerts, containing the names of composers (author), titles, and also the performing artists, time and length of tape are readily available on the cassette or record, and renders it easier to catalogue them than untitled pictures. Commercial firms provide printed unit type catalogue cards, containing standard description of the record, and those can be filed in the library's catalogue, after the addition of the heading, sequential number and location symbol on it, thereby saving a good deal of staff time. They can also supply complete catalogue or list of such records for which this facility is available in order that libraries could make a selection of the required records; e.g. the Long Playing Records Library catalogue cards are available for most classical records, and have a selection of spoken word, and of Jazz and Folk Music; or the Schwann catalogue can aid the user and the librarian. Care must be taken to assess the users'

approach, which should be distinctly provided by their entries. The British National Film Catalogue (B.N.F.C.) is a quarterly list arranged by U.D.C. It is an excellent source material for the selection of films of the majority of British films and of those foreign films which are available in the U.K.

In the dissemination of information, in the field of linguistics, and technology, and preserving the original human voice, the non-print material is not only quick and easy to produce, but is an exact replica of the original information, in matter, manner, and style. Vast improvements in recording sound, from the time of its invention by T.A. Edison in 1877 to the present, have been made, the most recent being the synchronization of sound and light principle on which sound motion pictures, transform sound into optical signals. The subject analysis and access point to the recorded sound, especially music, requires particular attention, because of the manner, form, melody, being more significant than the subject matter of the piece of music. However, the title of the record, as the pivotal point of access to it, has proved more satisfactory and will ensure uniformity in search strategy.

Motion pictures, being costly material, are either acquired by libraries in limited numbers, or more often rented for exhibition. The information on this material, besides the entry of its title, as access point to its search and retrieval, should provide an annotation, evaluating the motion picture, as the title alone would not bring out the details regarding the contribution made by several people—producer, director, actors, musicians, photographer, sound engineer, etc. In order to inform users of the available motion pictures held in the collection of a library and otherwise available on loan or rent, a guide to the material should be prepared to serve as a source book.

Guide to Non-print Material Collection of a Library/Information Centre

The effort and cost of organising a collection of non-print materials in a library could amply be justified and prove valuable if it is used to the maximum capacity. As compared with the wide ranging use of printed books by almost all groups and types of readers, this special material holds an appeal to a select number of readers, depending on the specialised programme and functions

of the organization of which this collection of non-book material forms an integral part. For instance, educational institutions derive utmost benefit out of the collection of film slides, records, and moving pictures bearing on the curriculum of studies; while a public library's record collection has to have a more popular appeal. Providing a guide to the use of non-print collection stimulates its use by readers whose interest in the collection gradually develops. Audio-visual aids have become a compelling media of instruction and information, in both developed and under developed communities.

There may be a separate guide book for each category of non-print material – one for film-slides and transparencies, one for pictures, one for records, etc., or it can be combined. The purpose of such guide books is to direct readers on the procedure to locate, identify a non-print item, in the catalogue/index and in the storage accommodation.

A specimen entry for a Music Disc and Audiotape recital given subsequently could help readers, in identifying and locating the material, and to some extent judge the relevancy of the information to their use.

For approximately the first hundred years in the history and development of cataloguing rules, especially of descriptive cataloguing, of non-print materials, there was little of standardization and uniformity with regard to the items to be included in the description to be provided, and the order of items to be followed, or the access points to the material. It was only after the production of the AACR 1967, the rules governing the entry and description of non-book materials, provided guidance and standards for their entry tending towards consistency and uniformity, which ultimately help effective location, access, and control. There is a recently published work "*Non-book materials cataloguing rules: integrated code of practice and draft revision of the AACR British Text Part III*" prepared by the Library Association Media Cataloguing Rules Committee (National Council for Educational Technology and the Library Association, 1973) and a more comprehensive work, "*Non-book Materials: the organization of integrated collections*" by Jean Riddle Weihs, *et al.* (Canadian Library Association, 1973); both offer practical directions to librarians engaged in the organization of Audiovisual Media of communica-

tion of information. The note on p. 198 of AACR 1967 (British Text) renders the unnecessarily imagined or fomented complexity in cataloguing Non-book Material. "The rules for entry, heading, and description of books and book-like materials (Part I and II) are applied also in the cataloguing of non-book materials (Part III) to the extent that they are pertinent and unless they are specifically contravened or modified by the rules in the following chapters."

D

784.3 Music from the time of Christopher Columbus/revised by Michael Morrow. London, Philips, 1968 (SAL 3697)

DISC. Stereo, 33.3 rpm. 30 cm–2 sides Musica Reservata. John Becket, Conductor. Includes 17 pieces of 15th and early 16th century Spanish Music.

1. Ti 2. Morrow, Michael 3. Musica Reservata 4. Cl.

Specimen Entry for a Music Disc entered under title and additional access points/tracings indicated.

L

821.91 Blunden, Edmund

Twentieth century poets reading their own poetry; Edmund Blunden.–Twickenham: Audio-Visual Production, 1971

AUDIOTAPE. Cassette, mono.–13 min.

Contents: The midnight skaters–Concert party–Busseboom–The sunlit vale–Report on experience–Familiarity–Values–Serena–The Hong Kong House–At the Great Wall of China-Thoughts of Thomas Hardy.

1. Au 2. Ti 3. Cl.

Specimen Entry for Audiotape Recital with title.

5

COPYRIGHT LAWS AND P L R OVER READING MATERIALS—BOOK AND NON-BOOK : THEIR IMPACT ON LIBRARY AND INFORMATION SERVICES

Copyright and P L R

The principle of affording legal protection to the authors of printed books against unauthorised reproduction in any form of the original work is the basis of copyright laws enacted, and this equally applies to the creation and ownership of non- book materials. There will be numerous problems relating to copyright, royalty payment to authors and actors, of the holding of masters, and the making of loan copies, and reproduction of musical hits (songs) of films on records. But the solution of these problems will be on the pattern of those evolved and accepted for printed books, with slight modifications, in view of the fact that the reproduction of non-book material will be far less in number than printed books.

A recent and new dimension to copyright laws has been added by way of PLR (Public Lending Right) to provide additional benefits to writers and theoretically ultimately stimulate the production of a large number of good books, which would be in active circulation and use among the reading public.

P L R in the U.K.

Authors' Lending Rights were debated in the British House of Commons, in December 1971, on a motion by a Private Member. Considerable discussion on the sources of revenue to pay special royalty to the authors for the use of their books took place. Proposals (1) to amend the existing sections of royalty to authors, with a view to increasing it, (but it will tend to increasing the cost of books

and thereby deplete the standards and quantum of service to the people, (2) to grant from Central Government funds required for additional expenses to meet the PLR, (3) to turn over the cost of PLR to Library Authorities as their responsibility, were put forward. It is significant to note that there was no counter proposal against the PLR.

In replying to the debate, the Under-Secretary for Education and Science, referred to the Working Party set up by the Paymaster General to investigate the possibility of amending the Copyright Act, and the consequential problems, which may be created by the amendment (1) whether PLR should cover music, gramophone records, maps and paintings, (2) whether periodicals should be included; what types of library should the Right apply to, whether academic libraries, in particular should be included; whether there should be a distinction between the use of books for reference and lending; whether authors having been given a PLR should be entitled to forbid the lending of copies of their works altogether.

The working party viewed the PLR as a creator's rights, and if it were to be introduced by way of copyright, it would seem simplest to amend only those sections of the Act protecting creators and by adding the principle of lending to the public to the actions restricted by copyright. There was no reason in principle why such a right should not apply beyond books, to periodicals, sheet music, artistic works—such as paintings, prints, and photographs—and to the original literary or other works embodied in gramophone records, films and audio-visual materials generally. The sharing and distribution of remuneration to authors, for works by several writers, particularly for periodicals, would pose practical problems, and with regard to non-book materials, there was a risk that the total amount realised over their circulation might be small and insufficient to justify the costs of doing so. There was no reason to exclude any type of library from operating the PLR scheme. The right would apply to public libraries, commercial and subscription libraries, the national libraries, libraries of government institutions, business and industrial undertakings, academic libraries, and professional associations. Privately owned libraries made available to the public would, however, be excluded, unless lending for gain took place.

Two basic methods for assessing, collecting, and distributing the renumeration were suggested. The first, which was probably only applicable to books, was a surcharge system, by which libraries would pay an additional charge above the published price of each book on which PLR was being claimed.

This surcharge might be fixed separately, at the discretion of author and publisher, but reasons of practicality, a uniform percentage applicable to all PLR books, and, perhaps regulated by an independent tribunal seemed preferable.

P L R and the L.A.

The reaction of the Library Association to the report of the Working Party* is contained in a statement issued simultaneously with the publication of the report on PLR. It said there was no logic in excluding any type of library, including school libraries where text-books of certain authors are widely used, from the purview of PLR, if authors are to be given special compensation for the multiple use of their books. The statistics of the sale of hard–back bound books revealed that 50% of them were purchased by the libraries in the U.K. (this is equally true in other parts of the world), and the library market is vital to authors and publishers, because, without it a large number of hard-back books published would never have been in print. As the prices for these books are fixed having the libraries as potential and large scale buyers, they are quite high, which may be called 'Library price'. In addition to this, the libraries would be required to pay a surcharge for compensating the author and publisher as well. A suggestion was made that an addition of 5 p. to price of every hard-back book published would yield approximately £2,000,000 a year, the amount demanded by the authors in 1970. Publishers could make this price increase immediately effective and no legal sanction needed for this increase. The increased price of a book being negligible, it would not be taken seriously by the libraries and individual buyers.

But if a substantial levy is made on the libraries, at 20% on library book funds, it would appreciably deplete the number of new books purchased annually, as no other item of expenditure in a library budget could be reduced for this purpose, and may ultimately result in sub-standard library service of the community.

If this were to be avoided, the only other course left was for the central government to sanction a grant for compensating the authors. Publishers would be influenced to concentrate on the production of popular works and best-sellers, gradually eliminating the works of little known authors, however valuable they might be, from being published. The unestablished author would lose all his moorings by the changing pattern of publishing and the library's collections will tend to lose the comprehensive quality. Also libraries of industrial and commercial establishments, in order to save the levy amount, might plan to close their library units, which would result in the unemployment of professional librarians of these special libraries, and retard the improvement in the organization of information service over which the government and industries have invested considerable financial resources.

Further, the L.A's Working party on PLR recommended that for the purpose of PLR, no distinction should be made between book and non-book material. The effect of International Copyright Conventions in this matter is a serious objection to the introduction of PLR in the United Kingdom. Many libraries buy as much as one half of their material from overseas. If foreign authors are to benefit from PLR in such cases at the expense of British libraries it is wholly inequitable that British authors should have no reciprocal right as against library buyers in the great majority of foreign countries. Blanket licensing was considered satisfactory as a method for collecting the proceeds of PLR, but the amount to be raised by the collecting society was to be determined by an independent tribunal, as it would be fair to both libraries and publishers. In a few cases, it would be inequitable to use the book fund as the sole measure of a library's liability under a blanket licensing scheme.

It was pointed out that no distinction should be maintained between Books and Periodicals in regard to PLR, but publishers of periodicals, who charge a higher price from libraries than from private individuals should be excluded from the benefits of PLR. Lastly, the desirability of a legislation which removes the power of the owner of PLR to withhold his works from public lending was emphasised, in order to ensure the comprehensive quality of library service. The administrative costs of raising PLR sum should not be disproportionate to the sum collected. The cost

of operating PLR has been reported to be approximately £3,00,000 a year by the Department of Education and Science in its document, *Public Lending Right: an account of investigation of technical and cost aspects* (HMSO, 1975). The amount is based on the findings to date of the technical investigation group appointed by the department in March 1974 to examine the technical cost and problems involved.

P L R and Parliament

Mr. Hugh Jenkins, Under Secretary of State, who is expected to introduce the legislation in the British Parliament observes in his foreword to the report that "the report demonstrates that the implementation of any form of public lending right is no simple and easy task.

Two ways of implementing a lending right have been examined: (1) by counting books by sole authors, and bought after the inception of the scheme by library authorities would benefit 87,000 authors who would be eligible for payment under PLR; (2) by recording loans of books by sole authors, based on a sample of libraries would render 113,000 authors to be eligible for the payment under PLR. Both figures include some foreign authors, who are eligible for inclusion under the scheme. It is stated that adopting and implementing either of the two schemes would need about two years, time. The British Parliament was apprised by the Under-Secretary that further investigations are needed before clear and legislative proposals can be introduced for a PLR scheme for authors. The Society of Authors and the Writers Action Group is being kept informed of the progress towards the legislation of PLR.

The PLR Act 1979 was enacted by the British Parliment providing legal sanction for the establishment of the PLR system in Great Britain. The Act required the rules for the administration of PLR be laid down by a scheme. This was done in 1982, including details of (transfer) (assignment), transmission after death, remuneration, trusteeship bankruptcy, etc. Amending orders were approved in March and November 1983, to serve as a practical guide for the administration of the PLR Act. The complete provisions made by Parliament for PLR are embodied in the primary

legislation (the Act) and the secondary legislation (the scheme) stated above.

Who are Eligible for Payment under PLR System ?

Authors (writers and illustrators of books) whose literary works are lent out from public libraries are eligible for payment, once a year, (February), and the amount received by each author is proportionate to the number of times (established from a sample) that his books were lent out during the previous year. PLR is different from the Copyright, as even authors, who do not own the copyright are eligible to receive the payment. Books and their authors must be registered at the office of the Registrar, PLR System.

Further an author is eligible for registration, if he or she is a citizen of Britain or of some other EEC country and resident in the United Kingdom. One is considered a resident for purposes of PLR payment, if he or she has a home in the United Kingdom. In case of a British citizen having no home there, he should normally have spent 12 months, out of the preceding 24 months in Britain. A writer who fulfills the criteria of citizenship and residence, even though he may live elsewhere, can apply for registration. Provision is contained in PLR Act for reciprocal arrangements with foreign countries. In order to limit the range of authors eligible for PLR payment a translator, editor, compiler or reviser of a book, even when his name is on the title page of a book, is not treated as an author. Also, if the responsibility for the writing and illustrating a book exceeds over three, that book is uneligible for PLR payment. Only living authors are considered for registration. Once a book is duly registered during the life time of an author, payment would continue to be made to his legal successor for 50 years after his death.

What Categories of Books are Eligible to be Registered ?

Each separate edition of a book is registered and treated as an individual item in the PLR System. Also, each volume of a work, in two or more volumes, is considered as a separate item.

In general, a book is eligible for registration, if its author is eligible for PLR benefits, if the book is priced and sold, minimum pages 32 for prose, 24 for dramatic and poetical works, not more

than three authors given on the title page, the authorship personal, and not a musical score and a newspaper.

Procedure of Assessment and Payment under PLR

The Registrar of PLR compiles the register of authors and books to be held in the computer, after rejecting those found ineligible for PLR.

A representative sample is recorded, consisting of all loans from 16 public libraries. This is then multiplied in proportion to total library lending to produce for each book an estimate of its total annual loans throughout the country.

Annually the computer compares the register with the estimated loans to discover how many loans are credited to each registered book for the calculation of PLR payments. The computer does this work by using code numbers—the ISBN printed in the book.

The amount voted by parliament is, two million pounds, including the provision of the administrative expenses, and the remaining is divided to work out how much can be paid for each estimated loan of a registered book. This works out at 1.02 pence per title and the figure is likely to change annually.

Any book earning less than a pound is not paid for, and also the top limit per author for his works is fixed at £ 5,000 per annum, even though the calculated amount is more than the sum.

An author applying for PLR payment is required to declare that the particulars given on the application are true, and this should be certified by a JP or Notary Public.

The Minister for the Arts (the Rt. Hon. the Earl of Gowrie) while presenting the First Report on the operation of the PLR Scheme, in July 1984 to the Parliament stated "that the money that is now paid to authors, in proportion to the number of times that their books are borrowed from public libraries is a fair and sensible way of rewarding them for the multiple use of their books by borrowers". (for fuller details of the Report refer to the PLR Scheme 1983-1984 Annual Report to Parliament by the Minister for Arts as prescribed by the PLR Act 1978, London, HMSO, ISBN 010 193030 5).

The foregoing study of the PLR Scheme in operation for the first year yields some valuable lessons mutually beneficial to both the library and the development of the scheme itself. It seems to

have a healthy impact. In his review of "*Setting up PLR*" a Report by the Advisory Committee, September 1984 "by John Sumsion, the Registrar of PLR" P.R. Labdon observes that it is an essential basis for understanding PLR. The PLR database is a powerful tool, potentially for a better understanding of public library use, and some of the possibilities are demonstrated in the appendices of the report". Types of authors whose works are ten times more popular, an influence based on the number of times their books are loaned, than another set of authors whose books record lesser number of loans, are cited in the appendices to the report. This feature would be of interesting comparison with a similar situation which came up for discussion, when the writer of this book was associated with the Westminster Public Library System, when late Mr. L.R. Mc/Colvin was its chief in 1956. The loan records indicated that fiction was several times more popular than non-fiction (subject books). This was essentially a quantitative assessment and could not be depended upon to provide any database for assessing the qualitative value of use of library books, and for demanding larger financial grants for the library on the basis of the number of loans, which get inflated because of fiction loans. In the payment of PLR also, this feature prevails, as fiction writers stand on the top at £ 5,000 pounds, while subject book writers whose works record a small number of circulation, receive amounts, sometimes less than 100 pounds. In order to encourage authors of books of subject value, it seems reasonable to increase the PLR amount by at least three times the sum, and justify by the fact that writers of subject books are governed by various limitations, such as authoritative references to sources of information cited or summarised in the text, while absolute freedom for authors of imaginary writings, like poetry, fiction, etc., normally involves less effort and time. This is not to suggest any lesser importance to fiction, for there are several authors of classical fiction (like Scott, Dickens, Thackeray, Balzac, Dumas, etc.,) whose works would continue to be of interest and value for ever.

Finally, the determining factor for a book to earn PLR payment, whether fiction or non-fiction is the librarians of public libraries, who approve the acquisition of titles selected. "Our strong feeling is that the most significant single determinant of PLR payment is the local decision (of the librarian), whether or not to purchase

the book, whether or not to obtain replacement or duplicate copies. The dimensions of book selection must be expanded to include the concept of PLR as a contributing factor in decision making."[2] Also, PLR scheme provides information to authors about the popular appeal and value that their works command among the library users. Perhaps it is pleasant to know how far an author is successful.

Copyright law and the protection or monopoly it affords to the owner of copyright, should envisage the crucial problem of private interest versus public interest. If the law could uphold both those interests in a fair manner, by determining the limit and extent of (1) the right/monopoly of the creator/writer over his literary, scientific or artistic work, their reproduction, translation, broadcasting, transmission, and (2) the quantity and manner of use of creations for public use for education, cultural enrichment, and recreation, several complex issues, that have come up due to advances in technology (photo-duplication and computer) could be solved. Those vitally affected by the first part of the law are the author and the publisher, and by the second part of the law are the scholar and research worker, the teacher and student, and members of society in general, who read, listen, and enjoy, use the works thereby help uphold social values.

Almost all countries have enacted copyright laws, with a view to stimulating authorship and to making the intellectual works available for the use of the public. The basic approach commonly maintained in copyright laws of all countries is for fostering the growth and spread of learning and culture by conferring legal rights to authors in the reproduction of their works they create, in order they may derive the necessary incentives and reward, from the public, and these rights are to be clearly spelled out and the limit specified, as otherwise it would be harmful to public interests. Librarians, research workers, information scientists, and social scientists, who perceive the social value of the works of authors as their use by the public for cultural enrichment and better living resist any erosion in their right to the use of the material for public benefit.

2. LAR 86 (12) Dec. 1984, p. 519

PLR and Copyright in India

In this context, it seems appropriate to briefly examine the provisions and spirit of the Indian Copyright Act, 1957 (Act XIV of 1957). The former act was The Imperial Coyright Act, which was operative till 1957.

In accord with this act a copyright office is established with the Registrar of Copyright to function under the superintendence and direction of the Central Government, with a seal for the Copyright office and a Copyright board with a Chairman and two or more members.

Works in which copyright subsists– (a) original literary, dramatic, musical and artistic works; (b) cinematography films; (c) records–are protected by the Copyright Act, all over India.

This act confers the exclusive right (1) to reproduce the work in any material form; (2) to publish the work; (3) to perform the work in public; (4) to publish any translation of the work; (5) to make any adaptation, to the author of the work, who shall be the first owner of the Copyright.

The term of Copyright in published literary works is the lifetime of the author plus fifty years from the beginning of the calendar year next following the year in which the authors dies.

A register of copyrights, in which the names and addresses of authors, publishers, and owners of copyright are entered, shall be maintained in the office of the Registrar of Copyrights.

An application in the prescribed form accompanied by the prescribed fee, has to be made to the Registrar of Copyrights for entry in the register.

Infringement of copyright is punishable with one year imprisonment or fine or both.

Measures adopted to further improve and strengthen the authors' rights have been considered by the Author's Guild of India, which was established in New Delhi on 25th February 1974. Subsequently a National Convention of Authors met in December 1974 with Mr. R.K. Narayan as its president. In January 1976 during the Second World Book Fair at New Delhi the second National Convention of Indian authors was convened, at which plans to organise a co-operative publishing concern on the model of the Sahitya Pravarthaka Cooperative Society of Kerala, and to introduce a bill of Public Lending Rights (PLR) by which authors

would receive additional royalty on books purchased and circulated to the readers by the libraries, were discussed and adopted. Whatever concerete measures the Government may adopt over the PLR scheme, they should be fair to the authors, publishers, and libraries and the public, realistic, and practicable.

The PLR scheme as it operates in Britain and West Germany can be a model to India. The Central government and the State governments, where the Public Library Acts are in force would do well to design a PLR Scheme suited to local conditions and make it a legal obligation by passing a PLR Act.

In order to induce and encourage the authors to write standard works in the field of non-fiction, in the Indian languages, in which there are small number of such books, the PLR Scheme may prove helpful. The Authors Guild of India should assume the responsibility, and also the libraries should contibute their effort in convincing the government that it is a right step in proper direction, specially when the Book Publishing industry in India is little organized, and the royalty of authors is too poor and more often remains unpaid by the publishers.

Advanced and developed countries like the U.S.A., and the U.K. are engaged in the process of revision of the existing copyright laws, with a view to covering the entire range of the creative works of the authors, including audio-visual works, motion pictures, sound recordings, and computer-based information retrieval systems.

† LAR. v. 74 (10) October 1972. pp.191-192.

6

INDEXING SYSTEMS : METHODS AND FUNCTIONS

An index is commonly understood as an alphabetical arrangement of terms, topics, names of material, persons, places, usually to form a subsidiary part of the printed book at the end, together with reference to pages and sometimes to paragraphs or individual entries, where the terms occur. The facility of an index is quick location of the information sought under the names of topics or terms, wherever they may be found on the pages of the text or in a classified arrangement of subjects, i.e., schedules of a book classification scheme, *e.g.* Decimal Classification. The aim is to enable users of the document to obtain the information quickly and directly. When one looks for information in an index to a book, *e.g.* under 'Tariffs' he is referred to look under 'Free Trade and Protection' against which, the relevant page numbers, where information on 'Tariffs' will be found. If another person were to look under 'Protection', he also is directed to look under 'Free Trade and Protection' against which its location is recorded. In both these cases, direct access to information- location is not provided, because of the single entry under 'Free Trade and Protection', which, for its retrieval depends on cross-references.

The current trend in indexing is to cover all access points to information in a document and to make these approaches more specific and direct than in a conventional form of an index or in a library catalogue, containing subject headings based on ready made lists of subject headings, *e.g.* Sears' List of Subject Headings. According to C.D. Needham, 'indexing covers all the processes involved in the input to the system—the analysis of the subject content of the documents, classifying, and the creation of catalogue entries'.

The material of indexing are documents, graphic records in a variety of forms, books, periodicals, pamphlets or any information

in print or writing even – constituted by words, which are also the medium of enquiry by users of the information. The retrieval systems are rightly concerned with the concepts behind the words, because the words employed by the users for information in a document more often do not reflect the same concepts, as are intended to be conveyed by those terms adopted by the writer of the documents. In order that a retrieval system proves satisfactory, it, therefore, becomes essential that conceptual identity of words adopted in the document and of words used by the enquirer is established. For example, a document under the title '*History of Ancient Culture and Civitization of Greece*' could be approached in different ways, under :

Ancient History of Greece
Greek History
Greek Civilization
Helenic Civilzation
Greek Culture
Cultural History of Greece
History of Civilization in Ancient Greece
Greek Society
Life and Thought in Ancient Greece

But in order to maintain consistency, uniformity and standardization of the subject headings chosen to represent the subject content of the document, *Sears List of Subject Headings*, which is an example of controlled vocabulary, is referred to pick out the appropriate matching headings/terms to represent the above subject approaches, *e.g.*

HISTORY

> Use for general works on history as a science. This includes the principles of history. The influences of various factors on history and the relation of the science of history to other subjects. Works on the interpretation and meaning of history, the course of events and their resulting consequences, are entered under HISTORY-PHILOSOPHY. Works limited to the study and criticism of sources of history, methods of historical research and writing of history are entered under HISTORIOGRAPHY.

See also:
Archaeology
Ethnology
Geography, Historical
Historians
World History

and headings beginning with the word HISTORY; also names of countries, states, etc., with the subdivisions *Antiquities*; *Foreign Relations*; *History*; *Politics and Government*. For the history of a subject see the name of the subject with the subdivision *HISTORY*, or, for literature and music headings, *HISTORY* and *CRITICISM*, *e.g. ART-HISTORY*, *ENGLISH LITERATURE - HISTORY* and *CRITICISM*.

HISTORY, ANCIENT

See also ARCHAEOLOGY; *CIVILIZATION, ANCIENT*: also names of ancient races and peoples; and names of countries of antiquity

x Ancient History
xx World History

CULTURE

Works limited to the culture of individual nations are entered under names of countries with subdivisions *CIVILIZATION*; or *SOCIAL LIFE AND CUSTOMS*.

All these for varieties of enquiries information have to be retrieved. But this would be possible only if the actual concepts dealt with in the document and enquiries are analysed, and a common or intermediate language is created into which both can be translated and equated. This intermediate language is called an Index Language. Book classification schemes, and lists of subject headings used for alphabetical subject catalogues are familiar examples of index languages. A feature of index language, though consisting of two parts–vocabulary and syntax as in natural language, spoken and written—is that it is subject to regulation in order to ensure the use of word or words consistently at al' occa-

sions and context, to connote the same concept. In short, it adopts a controlled vocabulary. "A controlled vocabulary is part of an artificial indexing language, as is a formalised structure."[1] A familiar and intensely artificial language is the notation of a classification scheme, *e.g.*

D.C.

630 Agriculture
631.4 Soil
631.43 Soil Physics
631.432 Humidity

The notation at the same time, helps consistent classing of subjects by representing the concept involved. "The use of an artificial language enables us to adopt concept indexing rather than term indexing. In concept indexing we try to establish a standard description for each concept and use that description each time it is appropriate, whether it has been used by the author himself or not. When we are searching our files, we again use the standardised descriptions and should be able to match these much more consistently and reliably.... It is possible to take concept indexing a stage further than the simple standardisation of subject description. We can identify the same basic concept wherever it occurs, even though it may not have any common factor in the terms used for it."[1] Similar to *List of Subject Headings of L.C.* and of *Sears*, a list of terms showing their classification according to the ideas they represent is called a 'Thesaurus' *e.g.* Roget's *Thesaurus of English Words and Phrases*; *E.J.C. Thesaurus of Engineering Scientific Terms.*

Among a number of synonymous terms available for expressing a concept one is preferred and references to it are made from the unadopted ones, in order to ensure its use consistently for indicating identical concepts. Homonyms (Homographs) i.e. words of the same form as another but different in sense, *e.g.*

Pole (Wood)
Pole (Magnetic)
Pole (Electrical)
Pole (Spherical)
Pole (North, South)
Pole (Citizen of Poland)

should be distinguished. The genus-species relationships must be fully understood. All these essential requirements have to be followed in compiling an authority list. Even in precoordinate indexing systems, these guiding principles are followed, *e.g. LC. List of Subject Headings*, in order to indicate the authority for using a given term.

Similar lists used in post–coordinate systems of indexing are called 'Thesauri'. But there is a difference between a thesaurus and a list of subject headings; the thesaurus does not ordinarily contain headings for composite subjects; and it attempts to establish precise relationship among broader and coordinate terms, which in a list of subject headings is done to the extent of downward references and by use of the symbols xx and sa for all kinds, *e.g.*,

Arrangement in

Thesaurus	List of Subject Headings
Milk	Milk
Boiled	*See also*
	Butter; Cheese
Certified	Milk, Dried
Bottled	x Dehydrated Milk;
In Bulk	Dried Milk;
	Powdered Milk
Homogenised	
Pasteurised	
Condensed	
Dried	
Powdered	
Sterilised	

The analysis of a document and the translation of concepts into indexing language aim at exhaustive indexing in post-coordinate systems, while in subject heading process, in conventional cataloguing and indexing, the aim is to summarise by selecting an all embracing heading of the broader subject of a document,

which includes the rest of the specific subjects, both coordinate and subordinate to it.

"Subject analysis is a fundamental process in indexing and enquiry work, and no retrieval system can make good the deficiencies in subject analysis."[2] A detailed discussion of conventional systems of indexing, forming part of the study of classification and cataloguing techniques, has not been undertaken here, as it is presumed that the student of library and information science will have studied them in detail in a different context.

The traditional indexing systems—(1) alphabetical subject headings, (2) classified indexing' (3) Uniterm or key-word system, and (4) facet classification—have been scrutinised for their performance by the *Cranfield Research Project* of ASLIB. The conclusion reached was that none of them is superior to the other and all depend on terms—single words or combinations of words, chosen to reflect the concepts in the documents. When employed for retrieval of information, these systems produce results wherein partial coordination of concepts is effected. This is because whatever coordination within limits was possible has been effected at the input stage and therefore is predetermined. Enquiries for information independent of the precoordinate language could not be retrieved and this is an obviously limiting factor.

Logically, subsequent developments in indexing employ post-coordinate language systems producing tools for information retrieval, affording full freedom to the user to choose, combine, and create his own subject field. As coordination of concepts takes place at the output stage and is based on the subjective approach of the user, the retrieval method is found more satisfactory. This may be called post-coordinate indexing. A single document may contain multiple concepts or combinations of them and may be asked for in different ways. This will mean that the concepts indexed will amount to a sizeable number and this will require some kind of machine operation for search strategy and retrieval in order to ensure complete coverage of all possible approaches and cope with the bulk of the topics treated in a document or at least as many of them as are considered significant to the users of the information file. This kind of exhaustive subject analysis is called for when dealing with specialised collections chiefly consisting of periodical and serial documents maintained for the use

of research workers in Science, Engineering, Technology, Business and Industry, and Social Sciences.

In the indexing of documents, there are two distinct processes: the first is analysis of the subject content of the document, and the second, converting the terms analysed into the index language.

Analysis

The first process—subject analysis of the document—is fundamental and on the quality of analysis will depend the degree of efficiency of a retrieval system. "Document analysis is here understood in the following sense: the extraction of meaning from documents. There is little hope of understanding the kind of intellectual operations involved in the analysis of scientific documents or questions pertaining to them other than through a study of textual analysis in general, as carried out in many disciplines-history, sociology, cultural anthoropology, exegesis, etc."[3]

"(A) Document analysis has involved the development of *ad hoc* metalanguages as defined here; (B) which have been worked out independently, in separate fields (exegesis, scientific information, anthroplogy, etc., and which exhibit many structural similarities in the semantic and in the syntactical component; (C) the distinction between semantic and syntactical structures is however merely out of convenience, in the design and operation of MLS so that the problem of accounting for the observed convergence can be formulated as one of mapping metalinguistic structures into one another, both within and between given MLS, irrespective of the semantic or syntactical status which is ascribed to them in the latter."[4] Analysis of subjects in a document is done with a view to determining the nature and number of subjects that could be indentified and to find out the relationship existing between them. Subjects contained in documents are of two kinds: (1) those representing a single concept; *e.g.* Electricity or Water and can be considered simple subjects; and (2) those representing more than one concept, *e.g.* Indo-European languages, or South African Race Discrimination, and these are considered compound subjects. In the case of compound subjects, the relationship between them must be shown in order to attain specificity of term used. In doing so, different subject entities involved must be understood in their capacity as link factors.

Conversion

The second process is concerned with the translation of the terms analysed in a document into the index language. The syntactict of the subject headings follows a certain citation order of the terms, by which the order of priority for the terms is obtained, *e.g.* in a document dealing with the *wages of agricultural labourers in Asia*, the citation order of the subject heading may be either of the two forms :

1. AGRICULTURAL LABOUR. ASIA. WAGES
2. WAGES. AGRICULTURAL LABOUR. ASIA

In the first one, priority is given to the term, *AGRICULTURAL LABOUR*, which is the first element of entry, and the terms, *WAGES* occupies the last position. In this citation order, the user directing his enquiry for information on *WAGES* fails to find it at the first search stage. But in the second citation order, though the user gets at once the information on *WAGES*, the approach to information on *AGRICULTURAL LABOUR*, which limits the ambit of *WAGES* in this case, fails to be provided for, as it is subordinated to the term *WAGES*, which is given first priority as entry term.

In order to get over the inherent defect of the predetermined order of citation of terms, '*see also*' reference entries are employed. In the above example, the following 'see also' reference entries would become necessary :

LABOUR AND LABOURING CLASSES, see also
names of classes of labourers, *e g.*,
AGRICULTURAL LABOURERS; *MINERS*, etc.

or

LABOUR AND LABOURING CLASSES, see also
AGRICULTURAL LABOURERS
LABOUR AND LABOURING CLASSES, see also
WAGES.
LABOUR AND LABOURING CLASSES, see also
Country subdivisions under the heading;
e.g. LABOUR AND LABOURING CLASSES. ASIA

This is what is done in pre-coordinate systems of indexing of which alphabetical subject cataloguing is one, besides classification schemes, and classified catalogues. The aim of summarising the subject contents of the document as specifically as possible in the form of subject headings or class notation is pursued. The class notation of the document according to a scheme of classification would also help in the formation and structure of these headings in the preferred order.

Conclusion

In pre-coordinate systems, which are basically one-place systems, characterised by a citation order of the terms of the composite subject headings, it becomes necessary to provide multiple entries under all likely terms which may be the user's approach to the information. These entry points—added entries or reference entries—being less specific, need further search till the appropriately chosen or precise heading is met, have to be continued. The result is that a number of entries increase the bulk of the storage file and ultimately add to the cost of construction of the information file and involve more time in retrieval of the information.

The post-coordinate systems, it will be seen, do not observe any citation or significance order, avoiding the necessity of making less specific indirect entries, but suffer from certain other limitations, like restricting the simultaneous searches to a stipulated number, and are found superfluous for general library work, where the product of retrieval is more often books than pieces of information and books can be located in a larger variety of ways than single subjects as in information work.

Post-Coordinate Systems

In order to get over the problems and deficiencies of the pre-coordinate system of indexing, a striking departure from the conventional methods and processes of constructing an index has been attempted by the use of single concepts instead of composite subjects as terms of entry. 'Post-Coordinate Systems tackle

the problem by shifting the process of coordination to the search stage.' (Needham)

"Post-coordinate systems enable us to transfer the act of coordination—the bringing together of the elements which together make up a composite subject—from the input, or indexing stage to the output, or searching stage. By doing this, they eliminate all the problems associated with the significance or citation order."[5] It will be observed that the post-coordinate systems have, in their turn, given rise to a set of different problems—selection of terms, genus-species relationships, and increasing cost of maintenance and investment. A post-coordinate system is identical in performance to a synthetic scheme of classification, because single concepts are chosen and listed and the desired combinations of these concept items are made possible with full autonomy for the user.

Another valid comparison between the traditional classified catalogue and the post-coordinate system of indexing will seem appropriate. Just as there are two parts of a classified catalogue—the main file in which the arrangement of the entries for documents conforms to the classificatory order of the scheme of classification followed, and the subsidiary dictionary file in which the terms in natural language representing the digits/symbols of the class notation are arranged in alphabetical order followed by the class number—there are in a post-coordinate system of indexing, again two parts—one, in which entries consisting of a combination of a heading and a document description set in order of the accession number, and the other in which document descriptions reduced to a number which can only identify but cannot describe a document, is filed in alphabetical order of the terms so as to facilitate the search strategy and coordination at the output stage. In order to obtain descriptions of documents with the numbers chosen, it is essential to turn to the subject file.

Individual entries in a card catalogue providing description of the document enable the rejection of a document unsuited, but in post-coordinate index systems, it can be done only after the subject file is looked through for all the numbers selected and scanned pertinent to the user's needs, although they may have relevance. In such cases, the search for appropriate kind of documents is

restored by choosing a different set of numbers of documents. This is, to a certain extent, possible if the terms selected and used as search elements convey exactly the sense and subject content of the document. Descriptors have been introduced for indexing of specific information.

Descriptors

The descriptors method for subject specification of information, and for retrieval was introduced by Calvin N. Mooers during 1947 - 1949, and was adopted by some information services organizations in the following decade on a fairly successful scale, while the traditional library practice in information retrieval was little appreciative and influenced by the descriptor system, mainly because of practical consideration.

The descriptor method, an intellectual operation, is of special interest and value for the development of information science for the reasons stated below :—

1. It is an intellectual technique based on the procedure of book classifications (Dewey, Bliss and Ranganathan) involving and permitting facet analysis and coordination of subjects ;

2. The descriptors yield to mechanical selection and computerisation ;

3. The method demonstrated its efficiency and practicability at various levels of organization.

Mooers struck on the term descriptor to designate the new terminology used in information retrieval systems which were being developed to suit individual organizations. Gradually the term descriptor acquired a sense that the range and meaning of a term/ terms collected and used by a particular organization was limited to the service and use of the members of that concern. It, therefore, became necessary to clearly define the group of users and their scope of interest, and provide clues or directions from common terminology to the 'descriptors' adopted with specific meaning and signify the concepts reflected by them.

The lists of 'descriptors' may contain common words for 'terms' but the idea for which a descriptor stands differs with another list, which has the same word but represents a different idea. Due to this reason, this method in information retrieval

systems did not gain much popularity and gave place to natural language (vocabulary) methods, as K.W.I.C. and K.W.O.C.

Key Word in Context index (K.W.I.C.) has been developed by H.P. Luhn of the I.B.M. for use in mechanical production of indexes. This form of index is compiled by feeding to a computer the titles of documents to be indexed, and having the computer make one entry for each word in the title. The computer moves the titles laterally so that the significant word for a particular entry always appears in the centre of the column. Non-significant words/terms in the title such as articles, prepositions, conjunctions, etc., are omitted in the index. This is done by having a *Stop List* of such insignificant terms stored in the computer. A block of entries from a K.W.I.C. index is reproduced :—

of the frequency	PULSE FRONT on a synchrotorn	PRTE-A-03,023
doped silicate+	PULSE LASER	JAPI-A-0037,
Giant	activity in	3200
synchronization of Giant	PULSE LASERS	PHILJ-A-0024–0630
	PULSE MAGNETIC PULSE MODULATION of magnetic field	PRETE-A-11-63-156

In the above specimen from the *Chemical Titles*, details in right hand column are references to the articles indexed. With the help of these references, the full details of these articles can be found by referring to the listing at the back of each issue of the publication.

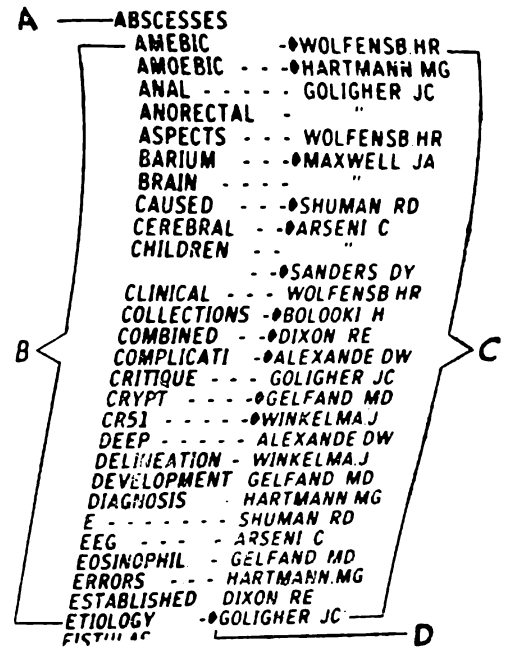
Keyword Out of Context (index) K.W.O.C. method is adopted in computer indexing. The principle followed is one of the oldest, i.e. consisting of simply using terms in a title to serve as index terms. As early as 1856, Crestadoro of Manchester P.L. adopted this keyword method for title-a-line catalogue.

Such catalogues displayed each term cited separately at the head of the entries to which it referred. A specimen of K.W.O.C. is given below :

PERMUTERM® SUBJECT INDEX

A *Tells you every word that appeared in the title of one or more articles. ("Primary term")*

B *Tells you every other significant word that appeared in all article titles that contained the primary*



LIBRARY	A modern outline of library classification.
LIBRARY	Introduction to library classification.
LIBRARY	Library classification on the march.
LIBRARY	Library education.
LIBRARY	Manual of library classification.

The disadvantage with such indexes is that the search is limited to one index term; no coordination among terms exists. When the number of titles under a given term is very small the process of scanning causes no difficulty. But when it is large (in large collections) scanning becomes complex and unwieldy. But a special advantage is that it needs little intellectual effort in putting the terms into the system.

Both K.W.I.C. and K.W.O.C. methods for indexing are easily adaptable to machine manipulation. What is required is that the titles should be produced in machine readable from, *e.g.* MARC.

Science Citation Index of the Institute of Scientific Information (U.S.A.) is a close example of the integrated search system for a comprehensive coverage of the periodical literature of science. It consists of three separate but related indexes: the *Citation Index* (CI), *Source Index* (SI), and *the Permuterm Subject Index* (PSI). Each covers the same articles adopting different ways of indexing to satisfy different approaches to the information. However the *Citation Index* and *Source Index* can be used as a stand alone combination to perform citation and author searches as well as to perform bibliographic verification. Likewise, the *Permuterm Subject Index* and *Source Index* can be used as a stand-alone combination to perform subject and author searches. It, therefore, is necessary to use the *Source Index* to yield the specific information with either *Citation Index* or *Permuterm Subject Index*. The SCI covers the periodical literature for the given calendar year.

Permuterm Subject Index needs some description by way of special features possessed by it. It lists every significant word of every title of every article appearing in more than 2400 key technical and scientific journals in every major language and every discipline from all over the world. It shows each title word related to every other title word with which it appeared, in every possible word pair combination. The other qualities of SCI are:

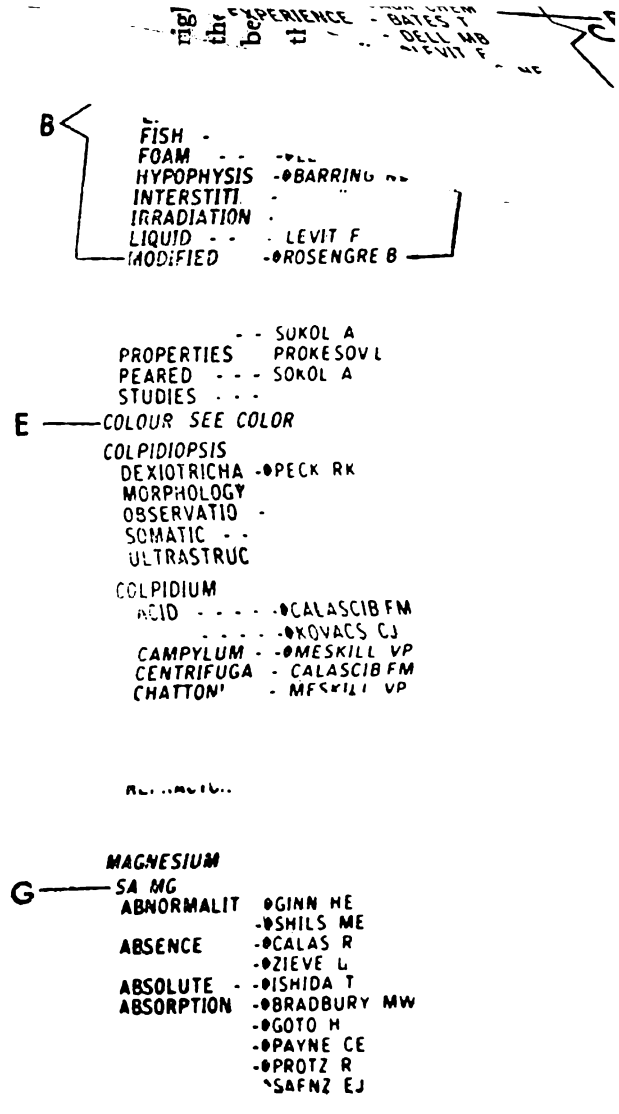
C Tells you the author of the paper in which the primary term and co-term appeared in the title. (And once you have the author's name, you look it up in the companion **Source Index** which tells you the full title of the article, the journal and page where it appeared, names of co-authors, specific type of article or item involved, language in which published, and number of references in its bibliography.)

D Tells you the articles you need to check to cover all the co-terms listed under the primary term.

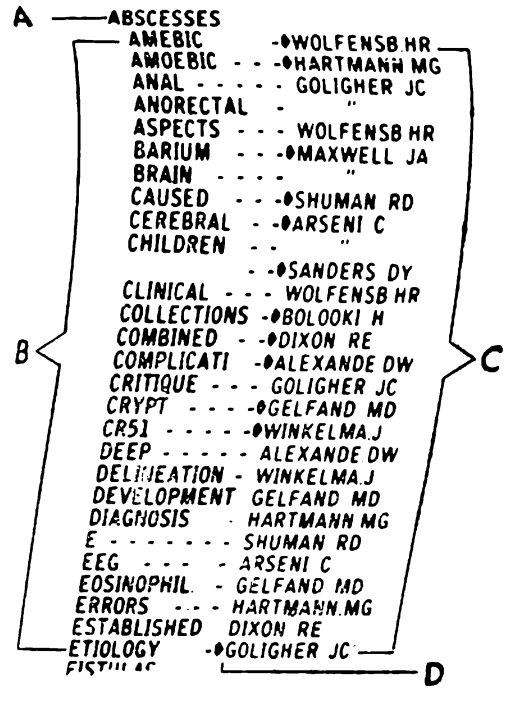
E Tells you PSI spelling of primary term when *alternate forms exist.*

F *Tells you journal title* when author is anonymous.

G Tells you related primary terms that should also be checked. ("See Also" cross-reference)



PERMUTERM® SUBJECT INDEX



A *Tells you every word that appeared in the title of one or more articles. ("Primary term")*

B *Tells you every other significant word that appeared in all article titles that contained the primary*

LIBRARY	A modern outline of library classification.
LIBRARY	Introduction to library classification.
LIBRARY	Library classification on the march.
LIBRARY	Library education.
LIBRARY	Manual of library classification.

The disadvantage with such indexes is that the search is limited to one index term; no coordination among terms exists. When the number of titles under a given term is very small the process of scanning causes no difficulty. But when it is large (in large collections) scanning becomes complex and unwieldy. But a special advantage is that it needs little intellectual effort in putting the terms into the system.

Both K.W.I.C. and K.W.O.C. methods for indexing are easily adaptable to machine manipulation. What is required is that the titles should be produced in machine readable from, *e.g.* MARC.

Science Citation Index of the Institute of Scientific Information (U.S.A.) is a close example of the integrated search system for a comprehensive coverage of the periodical literature of science. It consists of three separate but related indexes: the *Citation Index* (CI), *Source Index* (SI), and *the Permuterm Subject Index* (PSI). Each covers the same articles adopting different ways of indexing to satisfy different approaches to the information. However the *Citation Index* and *Source Index* can be used as a stand alone combination to perform citation and author searches as well as to perform bibliographic verification. Likewise, the *Permuterm Subject Index* and *Source Index* can be used as a stand-alone combination to perform subject and author searches. It, therefore, is necessary to use the *Source Index* to yield the specific information with either *Citation Index* or *Permuterm Subject Index*. The SCI covers the periodical literature for the given calendar year.

Permuterm Subject Index needs some description by way of special features possessed by it. It lists every significant word of every title of every article appearing in more than 2400 key technical and scientific journals in every major language and every discipline from all over the world. It shows each title word related to every other title word with which it appeared, in every possible word pair combination. The other qualities of SCI are:

(1) it is in natural language of the authors, not involving a controlled vocabulary (Thesaurus) or any artificial system of classification and hierarchical arrangement of terms;

(2) it is permuted, showing every word used in a title, as a primary entry, and every possible two-word combination with every other word in the title as a secondary entry. This would mean that a six word title would be found under 30 separate indexing entries for that article alone. Further, each of the six words will appear in every possible combination with every word from every other title in which it appeared. Thus PSI proves to be a search stimulant as well as a literature retrieval tool.

The page of SCI information (on opposite page) demonstrates how the indexing system works. SCI is fully computerised from its commencement and provides varieties of searches.

REFERENCES

1. A.C. Foskett: The Subject Approach to Information. London, Bingley, 1971, pp. 48-49.
2. C.D. Needham: Organizing Knowledge in Libraries: an Introduction to Information Retrieval. London, Deutsch, 1971, p. 96.
3. Jean-Claude Gardin: Document Analysis and Linguistic Theory. Jl. of Documentation, V.29, No. 2, June 1973. p.137.
4. *Ibid.* p.146.
5. A.C. Foskett: The Subject Approach to Information. London, Bingley, 1971, p. 308.

mation about current citing articles is obtained from the **Source Index** portion of **SCI.**

DEGUENT P—TRANSPORT FUNCTIONS—AND LIGHT SCATTERING
IN SIMPLE DENSE FLUIDS
PHYS REV A 2 2542 70 36R N6

Issue No.
Journal
Volume
Page
Publication Year
No. of References

Searcher obtains articles relevant to his subject

PHYSICAL REVIEW A VOLUME 2, NUMBER 6 DECEMBER 1970

Transport Functions and Light Scattering in Simple Dense Fluids

Jean Pierre Boon and Philippe Deguent
Faculté des Sciences, Université Libre de Bruxelles, Brussels, Belgium

The general expression for the transport coefficients at finite frequency is given by the spectral function of the autocorrelation of the flux corresponding to the transport phenomenon considered. Because the explicit analytical solution of such a correlation function involves the whole many-body problem for strongly coupled systems, appeal must be made to a model in order to derive the explicit frequency dependence of the transport functions. In the first part of this paper, we calculate these functions analytically (i.e., the diffusion $D(\omega)$, the

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5. A.C. Foskett: The Subject Approach to Information. London, Bingley, 1971, p. 308.

ISI'S
SCIENCE CITATION INDEX®

How the Science Citation Index Works

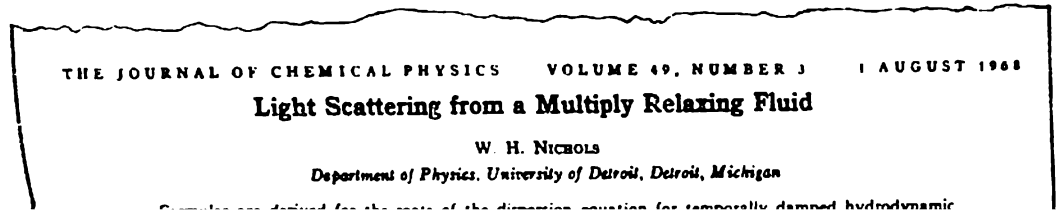
Researchers in science and technology have traditionally supported their current articles with reference citations to previously published articles. To affirm or refute an argument or thesis. To expand on the subject. To correct the record. To clarify. To refer to a method or procedure. To credit or criticize a previous researcher. To indicate alternative directions. To provide a general frame of reference for their own research. So important to good research articles has this practice become, that scientists can determine much about the subject content of a new article by examining its reference citations to earlier articles.

And this is exactly what Science Citation Index does. Each year, through a series of man/machine operations, ISI® examines the reference citations of over 370,000 current articles, from over 2,400 journals, from all over the world. It then lists these articles so that they are grouped together in the SCI according to the reference citations they have in common.

The method is called "citation indexing" and it draws together related articles more effectively than any other indexing system. Without the logical inconsistencies of human indexers. Without the use of indexing terms that create semantic difficulties or become obsolescent. Without the delay required by other indexing methods.

Here's a Typical SCI® Search

A searcher is interested in "light scattering in dense fluids." He begins his **SCI** search with an



THE JOURNAL OF CHEMICAL PHYSICS VOLUME 49, NUMBER 3 1 AUGUST 1968

Light Scattering from a Multiply Relaxing Fluid

W. H. NICHOLS

Department of Physics, University of Detroit, Detroit, Michigan

to this subject. A 1966 article by W H. Nichols thus becomes the starting point.

1000

NICHOLS WH

68 J CHEM PHYS 49 1000

In the **SCI**, the Nichols article is represented by its reference citation.

Searcher looks up citation of this article utilizing last name of author to enter **Citation Index** portion of **SCI**. There he finds all current articles that have referred to (cited) the earlier Nichols article. Searcher has now identified 10 new items that have a high probability of being related to the subject of his search.

Cited Author — NICHOLS WH — 68 J CHEM PHYS 49 1000

Citing Author	Journal		Volume	Page	Publication Year
BOON JP	PHYS REV A		2	2542	70
CANDAU S	ANN PHYSIQ		4	21	69
CARDAMON MJ	J OPT SOC	L	60	1264	70
CHU B	ANN R PH CH	R	21	145	70
DANIELME HG	J ACOUST SO		47	151	70
FISHMAN L	J PHYS CHEM		74	2178	70
MOUNTAIN RD	J RES NBS A		A 73	593	69
NICHOLS WH	J CHEM PHYS		51	5659	69
NICHOLS WH	J CHEM PHYS		51	5659	69
TONG E	PHYS REV A		2	2129	70

Current articles referring to earlier Nichols article

Additional bibliographic information about current citing articles is obtained from the **Source Index** portion of **SCI**.

Citing Author — Co-author — Full title

BOON JP
DEGUENT P—TRANSPORT FUNCTIONS—AND LIGHT SCATTERING IN SIMPLE DENSE FLUIDS
PHYS REV A 2 2542 70 36R N6

Issue No.

Journal — Volume — Page — Publication Year — No. of References

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7

PHYSICAL FORMS OF INDEXES

Uniterm

Uniterm is a convenient synonym for Unit and Term. Here unit is adopted for a single concept and term for a single word. Uniterm would therefore be a single word embodying a single concept.

If a given document to be indexed contains several significant concepts, all of them are selected directly from the document and normally expressed in single words/terms found in the document itself. These terms are called 'uniterms' e.g. S*ymbols vf Christianity* in the *Chuich architecture* of the mediaeval period of the *History* of *Europe*. There are six significant concepts, leaving out 'medieval period' as it is expressed by two-words. These six keywords would require the making of six 'Uniterm' entries. In order to accomodate the subsequent data related to a concept previously recorded 5''x8'' cards are used in uniterm files, as can be seen on the specimen entry given on opposite page.

Mortimer Taube adopted this simple form of post-coordinate index called the uniterm index, which has been widely practised since 1953. A standard uniterm card has these features: the space for the heading at the top and the body divided into ten columns, in which the document number is entered, using the terminal digit posting. The final digit of the document with the number 652 is entered in column number 2 of all the 3 uniterm cards shown in Figure. These cards are arranged alphabetically by the headings rendering the search for information as simple as possible. If the user decides on the search terms, in this case Christianity, Churches and Architecture—these cards with the respective headings are removed from the alphabetical file and compared to find out which document number/s appears on all of these cards. These document numbers provide a link or clue to the numbered sequence file of the documents called a subsidiary file, although a description of the document, as an abstract is

contained in it. It will be interesting to present the views of Jean-Claude Gardin on the components of ML so far as the UNITERM index is concerned.

"The minimum component of any ML=Metalanguage, the field of document analysis, is the lexicon, viz., a list of content terms, either extracted as they occur in a given NL=Natural language (in which case ML is restricted NL, made up of certain 'key words' or redefined for the purpose of the analysis (ML proper, made up of descriptors).

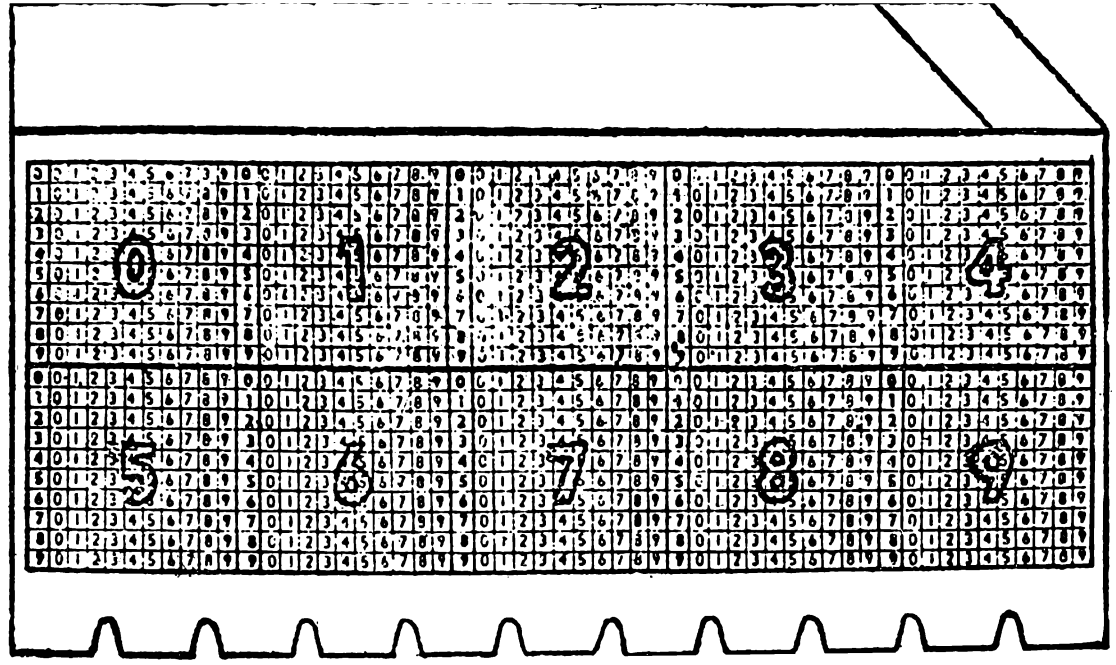
If the list of content terms is presented in alphabetical order, if it carries no relational information of any kind, and if no provision is made for syntactical structure other than through the co-ocurrence of terms in a document representation, then the ML is said to be 'unorganised', both on the semantic and on the gramatical sequence.

Optical Coincidence Cards

As it is likely, in operating a uniterm file, some matching (common) numbers of documents may be overlooked and such overlooked ones may contain important information to the user, an improved form of information storage file has been introduced. This is known as Optical Coincidence or peek-a-boo device which renders the search not only easier but avoids the possibility of any relevant number being omitted or overlooked. This is done by punching a hole in the relevant position on the prenumbered card. (See diagram on opposite page).

An optical coincidence card contains a blank space at the top for the heading, as in a uniterm card, but the body of this card is divided into numbered sequences. Small sized cards will provide 1,000 positions, while a large one will contain up to 10,000.

The procedure of entering the information into the system is simple. Select the terms required to describe a document, remove these cards from the file; drill out a hole in the position corresponding to the document number using a simple hand operated punch or an electrical model in order to be very precise in punching exactly at the position. Instead of holding the selected cards against the source of natural light, which shines through the drilled holes of the cards, an auxiliary equipment—a light box


0
1
2
3
4
5
6
7
8
9

CHRISTIANITY

0	1	2	3	4	5	6	7	8	9
50	31	22	43	64	35	36	77	18	29
210	41	102	313	214		416	107	118	59
	81	502					327	328	119
		652					457	598	979
		702							

CHURCH

0	1	2	3	4	5	6	7	8	9
10	51	32	73		95	66	47	68	109
320	41	102	313			416	77	108	249
		652					457		

ARCHITECTURE

0	1	2	3	4	5	6	7	8	9
60	11	22	13	74		36	107	18	29
710	61	502	43	114		316	457	598	979
	81	652	513			576			1129

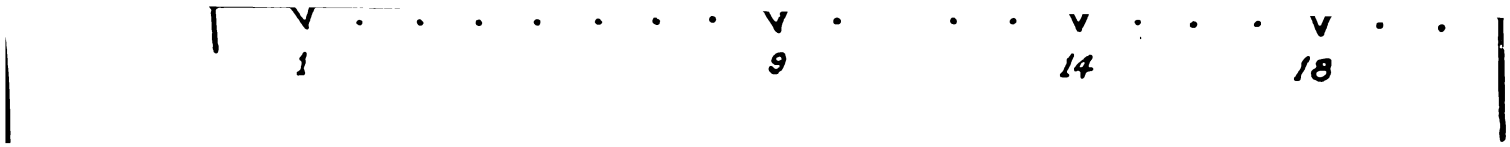
UNITERM cards showing terminal digit posting of the documents processed.

containing a diffuse source of light, with one of the sides of the box made of translucent material is used. When the cards are placed on the box, the light shines through from below or behind. In this position, further manipulation with lesser number of cards than originally selected is made easily possible by withdrawing a card from the bunch, which may not be having a punch at the corresponding numbered square as the other cards.

Both Uniterm and Peek-a-boo methods of index are basically common in principle, but the cost factor differs, as Uniterm cards are much cheaper, require no additional equipment like a punch and light box, and specially manufactured cards as for a Peek-a-boo index, while a Peek-a-boo index avoids the possibility of error, caused by inaccurate posting of numbers in the Uniterm cards. But when a numbered square on a Peek-a-boo card is wrongly punched, its rectification is not possible, except by discarding the card, and replacing it with a new one. "An interesting compromise is to use a Uniterm system to start with, transferring to Peek-a-boo when some experience has been gained in the choice of vocabulary exhaustively required and similar factors-or, to use an inelegant but expressive phrase, when the bugs have been ironed out."[2]

Edge-notched Cards

Yet another physical form of index of entries is the use of Edge-notched cards. The essential difference between the Uniterm and Peek-a-boo cards and Edge-notched ones is that the latter is structurally different and contains bibliographical information for only one doucment. Each concept relevant to the subject matter of the document is represented in code form by a series of notches punched out from holes along the margin. If finding out what information is available in the storage file on a given topic, the searcher must first locate the code number assigned to that topic. Then he could remove those cards which have that position notched to the edge, with the help of a needle (similar to a hand knitting needle) which is inserted at the relevant position passing through the file of cards. As the needle is raised with the cards, the notched ones drop down and those cards not raised by the needle would represent the items relevant to the user's need.



DOCUMENT
DESCRIPTION

CONCEPTS:		CODE No.
ARCHITECTURE	=	1
CHRISTIAN/HINDUISM	=	9
CHURCH/TEMPLES	=	14
EUROPE/INDIA	=	18

FIG. 2. EDGE - NOTCHED CARD ONE SIDE

In this example, the compound subject—Architecture of the Hindu temples in India—is illustrated by notching at the position of code numbers assigned to the concepts in the document. If all the four selected code numbers for the topics were to be distributed all along the perimeter of the card, then the needling operation is done four times, every time from among the left out entries below, till all the relevant cards for the topics are sorted out. As the bibliographical description of the document is contained on the card itself, the user, need not proceed to a subsequent file for it, as in the case of other kinds of indices. This punched card device is popular as a retrieval device in small special collections of documents. (See diagram on opposite page).

Whether pre-coordinate or post-coordinate, all systems of retrieval techniques, contain part intellectual or creative and part clerical or mechanical work. In the traditional precoordinate system, providing alphabetical subject catalogues for books and other documents, selection of specific subject headings/to answer all possible subject approaches to the information by readers, is an intellectual effort, while its conversion to the norm of list of subject headings and alphabetical arrangement of entries in the catalogue is a routine function. Even the citation order of the different elements of the subject heading requires knowledge of syntax and semantics.

In post-coordination systems, taking a decision on the conceptual subject headings by which the document is analysed and entered is an intellectual work, while the mechanics of fitting these entries into the file adopting any of the devices - uniterm, peek-a-boo, edge-notched cards, and computer storage and retrieval is a routine/clerical function. This operation involves no individual imagination but strict adherence to instructions already formulated for adoption by the information scientist; e.g. punching a hole at the relevant number on the optical coincidence card or accurate posting of an accession number of the document on the uniterm card in the appropriate column, or punching a code number of the topic on the edge-notched cards or feeding a computer with a roll of paper tape/magnetic tape for recording the description of documents, are all purely clerical or mechanical items of work. It will not be far wrong to infer, that the more complex and sophisticated a retrieval device and system, the more costly it becomes

and involves a larger number of skillful or technical operations, while the intellectual level and quantum of work remains at the same order in all systems. The only obvious advantage obtained for the high cost of installation and operation of computers for this purpose is that clerical operations are performed by these machines more quickly and more accurately than by normal processes. Transfer of information which is assuming unimaginable bulk is done with the maximum speed so as to keep pace with the present needs of research.

The part of the work calling for intelligence and imagination-the choice of terms for use as headings in indexing and searching should also take into account which of the available synonyms for the concepts should be chosen and also help establish the relationship among them and with the document. Unless this first function is carefully performed, it is likely that the percentage of pertinent information retrieved would be very low.

"Though relevance may be high, recall is likely to be low, and the only kind of situation where the results are likely to be tolerable is in a clearly defined subject area with well established terminology and with readers who can state precisely what they want. If we are to achieve good results under normal conditions, we must use as closely controlled a vocabulary with post-as with pre - coordinate indexing."[3]

"It has been assumed that the mere compounding of simple terms, assigned by the indexer without regard for such compounding, will result in the satifactory retrieval of documents. This assumption-whether we are thinking in terms of manual or machine systems–is clearly open to question. Unless we devise further controls it is likely that we shall retrieve both too many documents and too few."[4]

The fundamental purpose in selecting the terms, which summarize the subject content of a document is to fully satisfy the user's demand for information, which is always one of relationship of the terms. Overlooking the importance of this quality in indexing work, results in pseudo-coordination, also called false coordination, false drops. In order to eliminate this wasteful effort, certain forms of controls have been introduced and developed :

1. Thesaurus of the subject (e.g.) ASTIA Thesaurus, W.R.U. Semantic Code etc., containing compounds frequently required and used consistently.

2. Links - a common form of interlocking device, which is a code symbol indicating association between two concepts and thereby minimising false coordination in retrieval, e.g., EJC Thesaurus specimen.

Preferred Forging
Instructions, UF (use for) Cold Forging (Broader use of term) BT Metal Working (Narrower term) NT Drop Forging (Related Terms) RT Cold working heat treatment.

3. Role indicators: If association of terms is brought out by links, the nature of association is shown by role indicators; the specimen entry from the Chemical Engineering Thesaurus given here illustrates how the role indicators, function. "The Primary significance of the role indicators is that they provide a mechanism for handling syntax of the type required in particular subject matter. The individual terms are produced from "Semantic factors" which are then particularised by "analytic infixes" modifiers and numerical suffices to pinpoint the particular term of interest within a grouping of terms. These semantic factors and analytic infixes thus represent a means of defining terms by their relationship to vary general concepts."[5]

Thus, the techniques of classification adopted enable the correlation process to be successful.

A Input to a chemical reaction
B Product
C Waste, contaminant, impurity
D Special agent, catalyst, accelerator, stabilizer
E Solvent, media, environment, support
F Independent variable studies for how it is affected
G Dependent variable studied for how it is affected
H Active concept, subject of study
I Passive concept, object of study
J Device material or method for acccomplishment
— Modifiers, adjectives, proper names, companies, persons.

4. Weights: The terms descriptors chosen, although exhaustive of a document, may prove insignificant in relation to the concept concerned. So it is necessary to indicate their relative importance to the document. This is done by adding symbols to the terms, a device to indicate the quantitative importance/ weighting.

Weight Use Indication

1. Concept good enough for indexing but not central to the theme of document.
2. Concept - though significant, but not central.
3. Concept - central to the theme of the document.

The introduction of controls theoretically aims to overcome false coordination and secure high percentage of relevancy in the information retrieved, but in actual practice, the difficulties due to syntactic analysis of terms has reduced their potentiality.

Thus, it will be seen that the systems for retrieval of information may fall into:

1. Pre-coordinate — in which coordination of terms takes place at the indexing or input stage, as in subject cataloguing in libraries, either using a list of subject headings (an authority list) or a classification scheme and its notation, preferably a faceted one. Here summarization of the concepts is the norm.
2. Post-coordinate — in which coordination of terms is brought about at the search or output stage. Here exhaustive indexing of conceptual terms is the norm.
3. Search procedure — (a) in which terms (simple or compound) are means of approach to locate the entries (items) of documents, e.g. pre-coordinate devices, uniterm, peek-a-boo, all are term entry systems. As many entries for an item as we select terms to describe a document are made, is known as *Term Entry System*; (b) in which entries (item) of documents are searched for those containing relevant terms

assigned to them, e.g. edge-notched cards, centre punched cards. Here only one entry for each item is made, but care is taken to do this in such a way that access can be had to it through as many terms as we desire. This is called *Item Entry System.*

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3. A.C. Foskett: The Subject Approach to Information. Lond. Bingley, 1971. pp. 317
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5. Joseph Becker and Robert M. Hayes: Information Storage and Retrieval, N.Y., Wiley, 1967, pp. 58.

8

MACHINE HANDLING OF INFORMATION AND ITS APPLICATIONS TO LIBRARY OPERATIONS

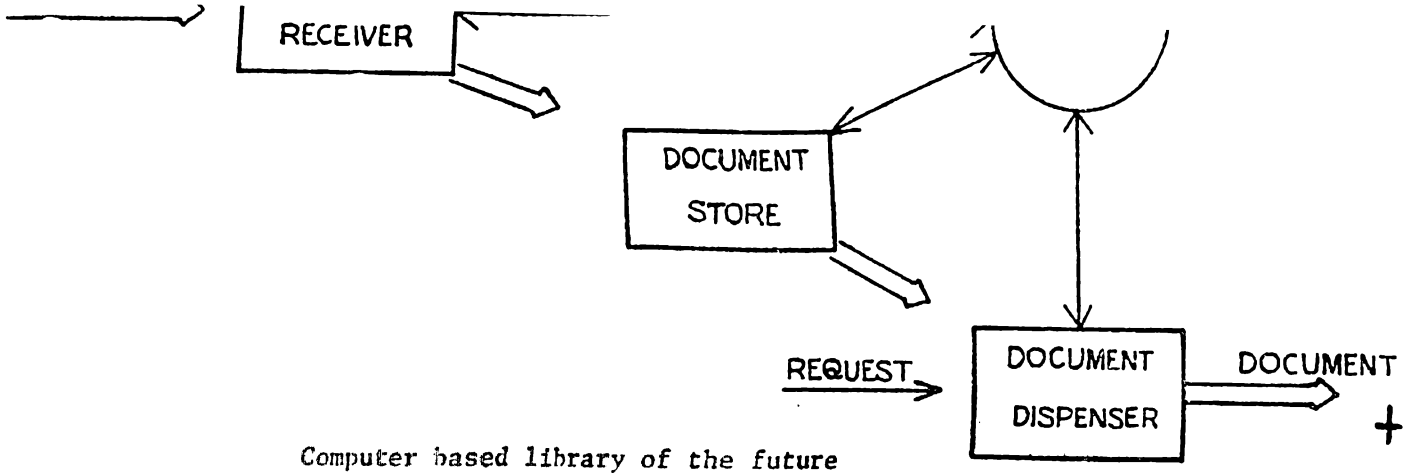
Machines have been designed and are being perfected to aid human activity, specially in relieving man from monotonous operations, in order that he may utilise the time thereby conserved to creative work and produce fruitful results.

Total Mass of Information

The library field is a potential area, where the need for introducing such mechanical aids not only exists but tends to be necessary in view of the vast quantities of information (documents) to be processed, organized and presented to the user in a reasonably helpful form and style. This can be substantiated by the available statistics of document production and storage in libraries. It is estimated that the total collection of printed matter in the world would be 200 million different books. The number is expected to double every 10 years; anticipating this growth rate of books by the end of 2000 A.D. the gross total of the library holdings will be five times the present figure, i.e , 1000 million publications.

Estimates of scientific and technical journals alone forecast that there are about 80,000 regular scientific and technical journals out of some 150,000 journals with valid information content. The corresponding number of abstracting periodicals in science is approximately 1,500 out of 3,500 covering all branches of knowledge.

It is a pity that no research has been undertaken to enlighten us, as to what percentage of this total quantity would be secondary information and what percentage of reader or users will actively use this output, as relevant to their needs. However, if these responsibilities are cooperatively assumed and shared by national,



Computer based library of the future

state, regional and city library systems, the total expenditure on such a research project could be distributed among them and it will tend to be a practical proposition. Perhaps more relevant mass of information could be segregated and investment of funds would be better utilised.

A schematic representation, combining the retrieval of documents and providing answer to questions in libraries following traditional methods is described in the diagram on the opposite page. The library functions represented in the diagram are to an appreciable extent possible to be done by automation. During the last one or two decades various experiments in this direction have been conducted by technologists, the last overall automation being the digital computer, and the largest manufacturer of computer being the I.B.M. The computer based library of the future, as indicated by the research conducted in this field by the U.S. Council on Library Resources, may even provide remote stations located in homes or office users.

The users' request to have a specific part of a document would be addressed to the appropriate station, where it is coded and forwarded to the programmes for computer control, which previously had indexed and organised the material stored in the document memory in computer. The library locates it and supplies the text asked for, in replica form. If the user further likes to refer to the original document - a bound volume - he could find it in the library, which is not shown in the diagram, but the arrow mark indicates it. MEDLARS, a fairly successful example of machine handling of literature is briefly described.

Similarly the library could supply answers to questions, in a limited way, by drawing upon the information memory in computer. Thus the conventional functions of a library would be performed more rapidly and easily. (See diagram on opposite page).

Mechanised Means for Acquiring Information

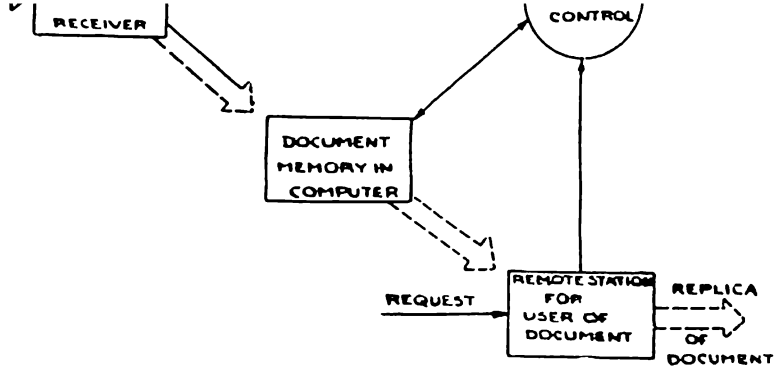
A library moving towards automation of certain functions which were until now performed by humans would first require a mechanized means for acquiring information. A simple and widely

followed method of making documents available for machine processing is to type the material on a key-punch or a flexowriter. The matter typed is transferred on to punched cards or tape, which in turn is read into a computer. This process is generally considered too slow to cope with the present volume of literature. An estimate of time and work to transcribe the entire library resources of the world, at 6000 words per day a key-punch operator could transcribe, arrives at an approximation of 1,000,000 man years of key punch operation. It is also suggested that the future input activity of the library could be controlled by a sort of cooperation with book producing and publishing industry. The matter of the book set in monotype is produced through a process that includes the preparation of punched paper tapes and research in the direction of adopting these punched paper spools directly read into the computers is in progress. If this experiment is perfected and if some standardisation of printing types adopted by book printing industry a large number of printed books could readily be accessible to libraries with automated input. The most complex problem is to invent a truely universal reader which could render the output activity as simple as the input. Again, the success of a universal reader would be influenced by the standards and principles of universal character reading, syntactics and semantics, and conceptual identity. Perhaps, continued research activity on all these aspects for quite a long time, might disclose possibilities of such a device for use in libraries and information centres.

Storage Capacity of Memory Chamber of a Computer

At the moment, the total amount of information - the number of bits or binary digits of information that can be stored in the computer memory is limited, for in relation to available world literature, even in specific branches of knowledge, the computer memory store can accommodate approximately 0.0001%. Further, the test of efficiency of a computer is measured not only by the large quantities of information that can be stored in its memory cell, but in relation to the speed with which information needed could be searched and retrieved.

The two classes of memory device are :(i) *a serial access memory,*



A Schematic representation showing the
Computer elements and attachments that
might perform some of the library functions.

e.g. magnetic tape, with unlimited storage capacity and possessing the characteristic of minimum searching time, as information is serially processed ; and (ii) *a random-access memory*, e.g., magnetic core of film in which information is widely scattered. The searching here does not follow any given order, as items of information are widely scattered as in the traditional accession records of libraries. The speed of access to information is significantly faster and substantially independent of their location. This is what is being designed in automation programme of libraries, with a view to covering large quantities of recorded knowledge.

Organization of Information in a Computer Memory

As the recorded body of knowledge adopting words and sentences of language to indicate the concepts cannot always be reduced to numerical form which digital computers can handle superbly, coding procedures have become necessary. This is similar to the adoption of an artificial language - notation in a scheme of classification to fix the relative location of a document, among others of similar content. But the outstanding feature of coding, especially of postcoordinate systems, is that the bibliographic entries are shorter than the prime-number codes and allows the user full autonomy of coordination at the output stage. Further, improved methods of permuted-title indexing, e.g. KWIC (key-word-in-context) are being practiced, besides controlled vocabulary, e.g. Thesaurus and IPL (Information Processing Language).

Operations Essential in any Information System

The various operations mentioned in the chart (see opposite page) shows common characteristics in the processes and techniques followed in a library and in an information service organization.

We can conclude that an Information Retrieval System is a device which aids access to documents specified by subject and all the operations associated with it. These aids range from the most simple forms like the contents page and indexes in books, of documents or their abstracts to a sophisticated digital computer or QAS-IBM 7090 computer.

ORGANIZATION OF

Library Services				Information Services				
1	2	3	4	1	2	3	4	5
Acquisition of Reading material; systematic arrangement and location by means of classification and cataloguing, preceded by book-selection	Preservation of reading material and its maintenance (storage)	Dissemination through Circulation and book lists	Bibliographic and Reference Service.	Survey of sources of Information	Selection of documents based on need	Recording, Abstracting and Indexing	Storage in Serial access memory or in random access memory	Scanning and co-ordination

In the words of Becker and Hayes "while today's information storage and retrieval interests have machine overtones, it is well to understand established library structure, to study proven methods and techniques, and to become familiar with the tools, which librarians have fashioned for conduct of their work.

Both the library services and the recent information services are involved in one and the same process of communication, but the variation is only on emphasis of specific aspects of information and the speed of their provision to the user, e.g. MEDLARS, MARC project."

Although attempts by librarians and information scientists to arrive at an agreed and precise *'unified theory of retrieval'* have so far not been successful, and all that can be said of our service to the reader or user is that all engaged in the task have *to organise, control, retrieve, communicate and inform by any means old or new.*

Apart from the high cost of installing a computer for information retrieval, there is a doubt if these automated systems will prove more satisfactory than manual and conventional ones with the results obtained. The search strategy sometimes yields such large items of information of which only a small percentage is of high relevancy to the use in question. So it has to be repeated again and again in different ways. If a balanced view is projected, it will disclose that one gets more quantity for the same cost as in a manual system, while the intellectual effort in indexing and planning the system remains a constant factor. Mechanization while decreasing the tedious performance of repetitive functions does not improve the quality of creative or original work as the initial stage of planning and designing a system is always the prerogative of the human brain.

MEDLARS (Medical Literature Analysis and Retrieval System)

An example of fairly successful computerised Bibliographic Retrieval Service can be seen in MEDLARS. The National Library of Medicine, U.S. (NLM) is the new name given to the Library of the Surgeon General's Office. The credit of having acquired and organised this library for medical service to the nation goes to John Shaw Billings, who held the office of Director of the Library for a period of thirty years. In 1895, the year of

his retirement, the N.L.M's collection numbered to 117,000 volumes, and 192.000 "pamphlets" and bound periodicals.

The Index Catalogue of the Library of the Surgeon General's Office published during 1880-1895 includes 511,000 journal articles. By comparing the 516,653 journal article citations added to the MEDLAR's data base between July 1971 to October 1973 the growth in scientific literature can be assessed. In view of the simple issue of coping with the volume of scientific documents increasing endlessly, the use of computers for bibliographic retrieval in Medical libraries seems logical. The chief aim in computer applications to bibliographical retrieval is to ensure subject access to the documents acquired.

MEDLARS began operation at NLM in January 1964 - the first large-scale computerised retrieval system to be available to the users.

MEDLARS is understood in different ways: (1) the mechanized data base, from which its major published products, *Index Medicus*, *Index to Dental Literature*, and *International Nursing Index* and many subsidiary publications are derived; (2) the computer machinery and photocomposition devices used for forwarding the publications; (3) the search of individual requests for information.

Procedure at MEDLARS

1. Request for Search received at NLM,
2. Analyst formulating the search in terms of Boolean Coordination of subject terms,
3. Formulation fed to the computer through which the entire MEDLARS file is then passed, comparing each citation against the criteria set forth by the search formulation,
4. Output of a printed list of citations sent to the requesting agency or person.

Out Turn of Work

In 1965 NLM handled 1800 searches, with one file and one search centre. In order to provide better facilities, a move towards decentralization of MEDLARS search services was planned. Tapes

could be replicated cheaply, and duplicate files could be built up at regional centres. Soon twelve regional MEDLARS centres were established in U.S.A., besides eight centres in countries throughout the world. The work of processing, i.e. performing computer opetations was limited to six of the RML centres, while the rest of them accepted requests, formulated them, and shipped the formulations to one or another of the processing centres for machine processing.

Cost Factor

MEDLARS files are serially ordered. Citations for a month would occupy one reel of tape which is designated for the monthly issue of *Index Medicus*. If one wants to search the recent 750,000 citations in the file, one has to pass the 40 tapes which held them. At about 3 minutes per tape, the process of reading took 2 hours, followed by another period of logical comparisons, formulating, and printing. At a computer cost of Dollar 250 per hour, it is most uneconomical to carry search for one citation only at a time. So select the optimum number of searches and pass them all at once against one reading of the entire tape file

In 1971, the peak figure of 18,000 searches were performed in the U.S. (4,000 at NLM, + 14,000 at other U.S. Centres) and an additional 5600 at foreign centres of MEDLARS.

Other Allied Information Retrieval Service in the U.S.

The Bio-sciences information Service, publisher of Biological Abstracts and related items offers BA Previews on computer tapes, covering 2,40,000 reports each year, the cost of these tapes is Dollar 5,000 per year. BA also offers individual retrospective searches through this file at a charge of Dollar 150.00

The ISI (Institute for Scientific Information) publishers of *Science Citation Index* and related items, leases computer tape data bases. This has been a computer based operation from the beginning ISI has been providing current awareness service (Automatic Subject Citation Alert) through searching its tapes.

Computer-based Information Retrieval Systems in Science and Technology :

The world has witnessed the establishment and rapid revolution of computer-based information retrieval systems in Science and Technology during 1963 to 1973. The foremost of the American pioneering efforts were of 1. MEDLARS, 2. Chemical Abstracts Service, 3. Bio-Science Information Service, and 4. The Institute of Scientific Information Service. These are examples of total coverage of scientific information needed by, specially bio-medical scientists of international cooperation in scientific information services.

9

INFORMATION TECHNOLOGY

The vast and unceasing growth of the mass of information, its proliferation, and specialisation has compelled libraries and information services, organizations and agencies to computerise the process of storage and retrieval of information and data, in order to meet the challenging demand made by users for quick and effective provision of data. The cost effective computerization in the beginning, has, during the last twenty years, proved uneconomical and slow, and unable to store further acquisition of information in the limited space available in the memory chamber of the computer.

Information science experts forecast that from 1980 onwards profound and far-reaching changes in the basic character of library and information services would occur. It is evident from the development and extensive adoption of new technologies for the dissemination of information, the quick growth and diversification of networking organizations, and the forceful and effective marketing by the information industry of its products and services to the users and their organizations. Advances made in technology applicable to information services indicate to a certain extent the likely changes in the nature of library operations and the role of libraries in society.

Due to these reasons, a revolution in information technology has taken place. Among these developments, special attention to (1) Microprocessors, (2) Distributed processing, (3) Computers and mass storage, (4) Communication technology, is called for due to their power and impact on the functions and services of libraries and information organizations. None would rule out further technological advances, as continuous research is on to produce a talking television and user-hospitable technology.

Microprocessor

A microprocessor is a central processing unit constructed on a single *chip*. Microprocessora are generally used in microcomputers and intelligent terminals. (A chip is a small sized silicon slice, containing one or more elcetronic circuits). It is remarkable for its low cost and functions like any other mini or large scale computer, but within limits - less fast, limited storage capacity in memory chambers. With all these embellishments absent, microprocessors are still appealing to the small library for a change from manual to automated system.

Even small libraries are finding it possible to adopt an automated system, as the cost is estimated at about Rs. 120,000. Library functions—cataloguing, circulation—are amenable to automated processing. Larger libraries also initially use microprocessors, as they do not have adequate resources to invest capital required for a large scale central computer system. A word of caution seems reasonable in adopting any technological change, as each one of them is subject to built in limitations, which could be overcome by newer technology, and as this process continues, the cost factor of automation assumes uneconomic and unmanageable dimensions.

Libraries in the Western world are anticipating profound far-reaching changes in the basic character of library and information services. "Among the most powerful forces affecting libraries of all types are the development and widespread adoption of new technologies for dissemination of information, the rapid growth and diversification of networking organizations, and the aggressive marketing by the information industry of the information products and services to both organizations and individuals."[1] Perhaps the advances of automation might possibly alter the role of libraries in society in the future.

Distributed Processing

When it is observed that a single processing system for the entire organization becomes impossible and unmanageable due to

lack of storage space in its memory chamber, and further inputs increase, a practical way is to divide the subject areas, e.g. Social sciences, Natural sciences, Technology, separately and set-up a minicomputer for each one of them, and interlink them, if required. This is called distributed access, which is almost similar to the method of divided catalogues, when a single one attains a stage of impracticality. But this method, in due course with increasing number of users and soft ware, again results in the same problem as in one single processing system.

Experience has indicated that instead of *'distributed access'* it is much better to go in for *'distributed processing system'*. In this method, the computer power and logic is distributed with a number of small processors at service points, either branches or parts of single structure. The mass storage of information (files, data) at one central station gets distributed, and the low cost of investment and maintenance of small processors is in its favour. Many commercial concerns with a large number of chain stores have adopted the distributed processing with appreciable reduction in cost and complexity.

Computers and Mass Storage

Storage of information for retrieval when required is the main function of libraries and information services agencies. It has been commonly accepted that without the aid of information technology, it is impossible to attain the objectives for which these organizations have been established. The problem has become acute, chiefly due to unpredictable growth of the sources of information.

New technology has replaced processor-based to storage-based systems. The computer systems are proceeding towards "memory centred and mass storage centred systems, with emphasis on input/output processes, communication processes, data-base management facilities, networking and distributed processing."[2] The hurdless to reckon with in storage-centred systems are the medium of storage, data channels, and the storage controls.

Storage devices and media can be divided into :

1. Optical-film, disc, fiche,
2. Magnetic-tape, disc, drum,
3. Semiconductor,
4. Bubble,
5. Charged Couple Devices. (CCD)

All these technological aids are subject to their efficiency in performance, and cost by which they are chosen. The most important tests-recording density, access time, and transfer time are applied to judge their performance level.

Magnetic Tape has been in use for some time for mass storage of information. There are three types: (1) Cassette, (2) Cartridge, (3) $^1/_2{}''$ magnetic tape. In all these kinds the access time is considerable - varying from two to ten minutes, because of lack of visibility and running the unwanted length of tape, forward and backward. Therefore time-data retrieval applications discard this medium of storage.

Cassette would remain popular because of its low cost.

Magnetic Disc has two major parts - the drive and the disc. The disc is the medium on which data is recorded and the drive contains the spindle rotating motor, etc., to operate. The access time is relatively quicker than in cassette.

Bubble memory is a chip with serial access memory and has a future because of high capacity of storage and low cost It is popular with small mass memory requirements.

Optical media is perhaps the earliest among the various types of devices, and also a low cost media for storage of information. In order large quantities of data is stored economically, technology produced:

(1) Microfilm,
(2) Microfiche,
(3) Video disc,

which continue to be in use in business and archival storage centres, because they have not only helped conservation of valuable space, but also contributed to their preservation for future. The original

printed books and handwritten manuscripts have been observed to deteriorate and decay in course of time, specially under exposure to excessive heat and humidity prevailing in tropical regions. Further no conversion into computer language or digits is involved, as exact text of the record is possible to be stored, retrieved, and displayed, which is always more convenient than other devices. The only limitation in their adoption is the need for a progector for retrieval and updating the data is virtually ruled out on the existing one. The advantages are more than the disadvantages and storing of data is stated to be five hundred times cheaper than in magnetic storage.

Optical disc stores optical images which are read and written by using laser beams. It can contain more data, at a lower cost than any other mass storage technology available.

Communication Channels

Communication of retrieved data/information to the points of use, where they are needed, perhaps is the touchstone of information technology. Sometimes the information is wanted within a given time limit to be of real value, and the communication media must be adapted to ensure its transmission before the expiry of the time limit set. Technology of communication of information, after careful research, has produced several devices, of which the following three are outstanding: (1) Fibre optics, (2) Satellite communication, and (3) Cable television.

1. *Fibre optics* is perhaps a new technical invention, capable of transmitting data in large volumes, and at immense speed through the medium of light particles as pulses of a laser beam. The cables used are of glass fibers, which contain the light rays carrying the data. It is stated that its major advantage is its tremendous band width and comparatively low cost. It is possible that atmospheric disturbances distort the carrying function, and it is also necessary to strengthen the signals every ten kilometer distance by utilising regenerators. It is very likely that this mode of communication may prove very popular and within the reach of small information transmission agencies.

2. *Satellite communication* has been utilized chiefly by state

agencies, because no individual or small organization for transmission of information has resources, which would allow a high capital investment for satellite communications. Further experince shows that it is economical, when the transmission is to cover long distances of 700 miles or over. It, therefore did not catch the attention of libraries and information service agencies to avail this mode of communication. The only argument in favour of satellite communication is that it can offer better quality transmission, because several atmospheric disturbances on the way could be avoided. It is still a matter of doubt, if the satellite method could provide low and cost-effective transmission in small areas or regions, cities, towns with many branch libraries/information service centres. The variety of data required by the academic community and the research workers in the field of science and technology is so varied that the satellite may not be able to transmit this information simultaneously to all users, e.g. recently the University Grants Commission, India Education Media Centre has begun telecasting science lessons at college level with the help of satellite all over India. In this case it is economical, because of oneness of information and image is transmitted.

3. *Cable television* appears to be a popular and cheap method of transmission of information even to homes. The Cable Television Companies are aggressively launching schemes for its use by installing coaxial cables that are capable of transmitting digital data as well as voice and facsimile. When more and more home computers are acquired, the transmission capability of home computers and television receivers can be tied together and interconnection between them established.

Libraries and other information services units would find this device within their means, as capital investment is not prohibitive and the users' convenience is assured.

The technological developments used for information storage, retrieval, and transmission discussed above is on an elementary level. Only a few of the devices are considered and the user is made aware of them. It is not possible at this moment to forecast what impact these technological advances will have on libraries of the future.

The British Library's Automated Information Service (BLAISE) is a fine example of providing information from a number of databases. It provides access to four types of database, which consist of (1) bibliographic databases holding citations to published literature of various types, (2) MARC databases having information on published works in a cataloguing format, (3) databases holding information on specific research projects, products, and materials, and (4) dictionary databases compiled with a view to providing assistance with a view to on-line searching.

BLAISE is a computerised information centre at Harlow, Essex, England for which access is available via a standard telephone linked up with a suitable terminal. The centre is also capable of providing information internationally through the Euronet and IPSS communication channels. The information located after a search is displayed on the computer terminal which can be printed on demand. "With the likely expansion of such services one must ponder on the wisdom of the continued publication of full text articles in many specialist journals, when there is the possibility of providing copy to interested persons on demand."[3]

People will listen to and read electronic books and newspapers, consult electronic files and databases and communicate one with another via a future generation of teleprinters. While there is little doubt that the domination of the printed page as the vehicle for the communication of the text will be challenged and probably usurped, there seems little likelihood of its complete demise: print gives too much pleasure to so many people for this to be allowed to occur."[4]

Further the recorded information, either in handwriting or print is the original base from which alone all electronic copies can be made and provided. Therefore the printed page will certainly continue to be the matrix for an indefinite time.

Can Technology change the Role and Functions of Libraries of the Future ?

Ever since libraries came into existence and played their role in society as information centres, serving all aspects of life—Philosophy, Religion, Education, Law, Science, Technology, Literature,

History, etc.,–there has been a trinity-Readers, Books, Management (Librarians), which continue to be present even today, and is expected to remain in future also. But there has been a slow and gradual process of change in the processes and functions of these institutions. The management also has been subject to change in outlook. What is the logic behind these changes? The idea and objective seems to economise labour, cost, and time, and provide better and more effective service to readers.

Library technology of recent times has introduced an element of automation in libraries for performing various functions—acquisition, cataloguing, circulation, and reference with a view to helping the librarians by relieving them of routine items of work. It should be understood that technology is only a means to an end, and not an end in itself. "Libraries, a cherished source of civilization, do stand in peril. Those responsible for their future growth and sustenance have a responsibility as never before to re-examine the ways in which these institutions—public and private, large and small, urban and rural—are meeting contemporary needs."[5]

It is not because other allied institutions opt for information technology and try to be on the top. Libraries should behave likewise. The vital concern of libraries is to deal with books and documents in any form and provide readers both original documents when needed as well as prepare information readily usable to those who require it for their immediate use.

As a great thinker Norman Cousins has put it "Library is a delivery room for the birth of ideas - a place where history comes to life." The government of the state has equally an important responsibility in helping the librarians to maintain these invaluable resources by not cutting down the financial grants for books and management, while fully providing for automation processes. They should guarantee that this incomparable national resource continues to flourish in future.

It is excellently communicated by the Librarian of Congress Daniel Boorstrin "that a clear demarcation is called for between Knowledge Institutions and Information Industry." There is certainly a discernible limit to the role and impact of technology

on libraries, which should adapt themselves with the changing phases and facets of society but not overlooking the fundamental objectives—repositories of learning and refuge of scholars, and fortresses of tolerance and freedom.

There has been a vociferous section of persons obsessed with the concept that the paper and print will have no place in the future communication of information, as the electronic industry would have made tremendous advances resulting in complete disintegration of books, book arts, and book industry and trade, and consequently libraries would cease to exist and grow. It should be realised that communication of literacy and information through electronic devices and computer technology would very much be limited in scope and it is not possible to extend its pervasiveness to every citizen in a country. It is mass literacy that is the need of the times, i.e. spreading knowledge and providing information to all. This can be done only by libraries, maintained up-to-date with sources of information, and located in the centre of villages, towns and cities, with mobile libraries serving the people, where a permanent establishment is not essential. The future of libraries will be an amalgam of services rendered by technology as well as the traditional printed books, which for several valid reasons would continue to attract people, who will not find automated services satisfying. It will not be inappropriate to conclude that the advent of information technologies does not herald the end of books and libraries, for cultures of nations are based on permanent values of life, and not on the fleeting electronic devices of communication.

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10

DOCUMENTATION AND ITS ROLE IN AN INFORMATION SYSTEM

Librarians and scientists engaged in research activity, having realised the limitations of traditional library operations and techniques in providing quick and adequate service to research, contemplated new ways by which specialised and current information could be organised and used. Information systems are viewed in a broader sense than conventional librarianship by including the entire process from the original publication of printed material to its dissemination from the information system. "With such a broad scope of interest this field of study has become a rather amorphous one. Since librarianship is closely related to it, there is no sharp dividing line between the traditional librarian and those called the documentalists, concerned with this kind of research. Similarly, there is no sharp dividing line between the standard data processing system designer and the system designer concerned with information storage and retrieval."[1]

Documentation, according to Jessie H. Shera, is another type of librarianship which can be 'distinguished from general library work in being more intensive—i.e., subject analysis is carried further, the range of resources accumulated is greater, and it has the quality of special as distinguished from general library service in its relationship to the specialised needs of particular uses and users.'[2]

Ranganathan stated that "Documentation is the complex of processes involved in pin-pointed, exhaustive and expeditious service of nascent thought to specialists.'

Another authority, Mortimer Taube, defined Documentation as "the designation of the total complex of activities involved in the communication of specialised information, including the activities which constitute special librarianship plus the prior activities of preparing and reproducing materials and the subsequent activity of distribution".[3]

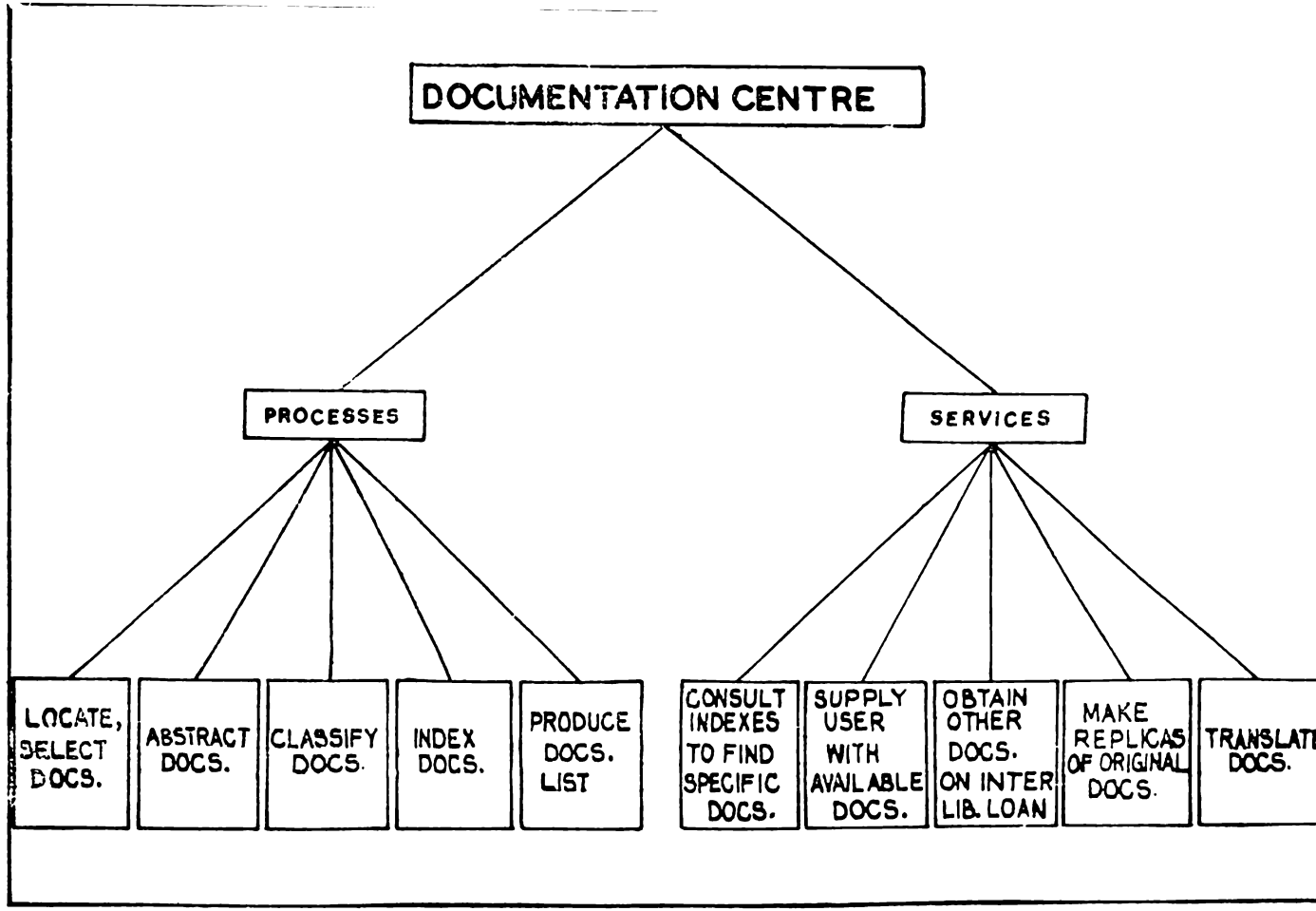
Webster's International Dictionary 1954 specifies Documentation as "the assembling, coding and dissemination of recorded knowledge, comprehensively treated as an integral procedure utilising semantics, psychological and mechanical aids, and techniques of reproduction, including microfilm and microfascimilie, for giving documentary information, maximum accessibility and usability".

There is still further an authoritative definition of ASLIB of Documentation which is "Recording, organisation, and dissemination of specialised knowledge". This one appears to be the briefest and succint definition of the term, as it brings out the most significant and fundamental concepts involved in the process of documentation work.

The purpose of citing several definitions is to emphasise the fundamental unity of the ultimate purpose of documentation, which is to provide information, old and new, to the user, in an organised form, enabling him to use it as best as he considers the final document list suited to his specialised purpose. It will be quite simple to understand what is documentation, if one knows precisely what librarianship is, involving bibliographic organisation and control. Perhaps, one apparently distinguishing characteristic of documentation, seems that the documentalist is largely concerned with current state of information available in serial publications and the close personal contact he cultivates with the users, which in large general or university libraries, by virtue of their policy, is not possible or not practicable. Each document list produced for a a particular purpose is a new creative collection of bits of information, which distinguishes it from a printed book or treatise. (See diagram Documentation Centre, on opposite page.

Techniques for the reproduction, and dissemination of printed material together with the application of mechanical devices and procedures for storage, and retrieval of information have been developed during the last two decades. The F.I.D. and UNESCO have been keenly interested in this activity and provided encouragement at international levels *e.g.* UNISIST.

One could even go to the extent of stating that the usefulness and necessity of documentation could be measured by the publication of the outstanding serial publications in the form of Indexing and Abstracting periodicals, *e.g.*


DOCUMENTATION CENTRE
PROCESSES
SERVICES
LOCATE, SELECT DOCS.
ABSTRACT DOCS.
CLASSIFY DOCS.
INDEX DOCS.
PRODUCE DOCS. LIST
CONSULT INDEXES TO FIND SPECIFIC DOCS.
SUPPLY USER WITH AVAILABLE DOCS.
OBTAIN OTHER DOCS. ON INTER LIB. LOAN
MAKE REPLICAS OF ORIGINAL DOCS.
TRANSLATE DOCS.

1. Applied Science and Technology Index.
2. Biological Abstracts.
3. Chemical Abstracts.
4. Engineering Index.
5. Library and Information Science Abstracts.
6. Index Medicus.
7. Mathematical Reviews.
8. Physical Abstracts.
9. Science Abstracts.
10. Sociology Index.

It would at this stage be appropriate to consider what a document is, "A single piece of written or printed matter which furnishes evidence or information on any subject". O.E.D.

"Document is a record of work on paper or the material for easy physical handling, transport across space and preservation through time. It may embody '*Macro-thought*' or '*Micro-thought*'." *Ranganathan.*

Articles in learned and scientific periodical are chief ingredients of documentation. Certain non-commercial or private or personal documents like research reports, trade patents, drawings, plans and specifications also come within the purview of documentation. The specialised information for a special purpose required by a user will influence the sources or fields of selection of documents.

Each document list, thus produced for a particular use of a specialist is an original creation as far as the selection and inclusion of the items in that document is concerned, although it contains references to other original sources (Periodicals/Books) which the user may or may not find it entirely pertinent in relation to his activity.

Excellence in documentation is measured by the assistance obtained by the user by referring to the document in making his decision to proceed to the original article containing full particulars of the problem studied or investigated, and making him aware of recent advances reported in various sources.

"Documentalists can scarcely do more than provide a multiplicity of useful links (or leads) between the information being processed and the currently accepted framework of scientific and

technical theory. The user of a documentation system must interpret his problem in terms of the framework of theory and concepts with which the documentalist has linked up various items of information.

"A knowledge of basic theory and concept must provide, therefore, the basis both for establishing and for using scientific and technical documentation systems.... The effectiveness of a documentation system may be considerably enhanced by giving thought to the planning of a series of searching operations."[4]

It seems not only essential but also very sensible that in planning the information system, the documentalists fully become aware and familiar with the symbolic language of the machine, which ensures more concise representation of concepts and relationships than by adopting words of the natural language of the original sources of information, in the process of communication.

Education and training for documentation work and research is provided at INSDOC Delhi and D.R.T.C., Bangalore.

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11

ABSTRACTING : AN AID TO INFORMATION SERVICE

As soon as the documents are selected by range and relevancy in relation to the problem of study, it becomes necessary to provide the information contained in each one of them in the form of an abstract, as the users may not find time to go through the original texts and as some of them may not be readily available at the time and place where they are wanted. Abstracting, therefore, is a follow-up activity intended to facilitate quick reference to the gist of documents and thereby save the time of the research worker.

An abstract of a document should be factually faithful to the original document and it should be expressed in simple but unambiguous terms. A knowledge of the fundamentals of the discipline concerned would be a facility in abstracting work, so that the semantics of the terms in the original document could be appropriately comprehended.

What is an abstract ? An abstract is "a summary or abridgement of a publication or article. It should enable the user to decide whether or not to refer to the original. An informative abstract summarizes all relevant arguments, data and conclusions" (Shera). We may compare the standard description of a book in a library catalogue entry, with an abstract of a document and would find that the reader in a library referring to the descriptive part of an entry is enabled to identify the book before locating it and also to a large extent decide whether he should or should not refer to or read it. The objective of a standard abstract and of a descriptive entry in a library catalogue appears to be similar, while the methods of making them, and the particulars given in them vary between the two.

Abstracts are prepared in relation to the purpose of the user, the field of investigation, and the intensity or depth of information

required. An annotation in a catalogue entry is an objective appraisal of the work, and tries to elucidate certain bibliographic features of the book, not explicit in the previous groups of description, but an abstract is typically a forthright epitomization of the document based on the original author's view point. Perhaps, the length of an abstract could partly determine the full coverage of information contained in the document. An average abstract would consist of 200–300 words, although lengthier ones, as in the case of foreign documents (i.e. documents in languages other than English) consisting of over 1,000–2,000 words may be necessary.

Another important factor, which determines the length of an abstract is the policy governing the abstracting service. In shaping the policy, the aim of the abstracting service has to be precisely defined; whether it is to make the reader aware of the existence of any new information of value to him or to present the entire range of information from significant sources, which may be as good as substitutes to the original documents and leave the reader to select these items pertinent to his study. Needham distinguishes these two kinds: "the former as '*Indicative*' abstracts and the latter as '*Informative*' abstracts. Whereas, the indicative abstract is often little more than a broad statement of content, an extension of the title, the informative abstract will give principal ideas, methods, findings and conclusions of the original. The indicative abstract can thus be seen as occupying a place midway between the usual form of entries in an indexing service on the one hand and a fully developed abstracting service on the other. However, indicative and informative denote '*ideal types*'; in practice it is a matter of degree".[1]

An 'indicative' type of an abstract is simply an outline of the original document presented in passive voice, present tense, discusses the article, which describes the research. An 'informative' type of abstract enables the choice of items of value and pertinency, presented in active voice, past tense, discusses the research itself. An 'Evaluative' type of an abstract discards irrelevant items of information and to some extent has an impact on the readers'

choice of the items. Specimens of the two kinds of abstract for the same document are given below :

Indicative Abstract

S.R. Srinivasan : Manpower Training for Mechanized Tract maintenance. Jl. of the Institution of Permanent Way Engineers. India. v.11(3), Dec. 1973, pp. 63–68.

An attempt to discuss broad principles of recruitment and training of staff for mechanized track maintenance.

Informative Abstract

The Indian Railways possesses more than 25 on–track tamping and lining machines ; and one ballast cleaning machine. More such machinery is shortly to be acquired. Efficient utilization of these machines would result in considerable economy in expenditure. Intensive use of these machines and their maintenance would to a great extent depend on judicious selection of staff and their effective training. Broad principles of recruitment and training of technical personnel required for mechanization of tract maintenance have been discussed and the need to implement them at Railway training centres emphasised.

It will be of interest and practical value to the students to compare the standards, format, features, guidance, and instructions provided in some select abstracting publications, *e.g.*,

Chemical Abstracts (ACS)
Biological Abstracts
Science Abstracts
Sociological Abstracts
Psychological Abstracts
Education Abstracts
Library and Information Service Abstracts (LISA)

It is true to a large extent that abstracting and indexing services have made much headway in science and technology, whereas similar abstracting services in humanities, social sciences and fine arts are limited in number and scope, not because of

neglect but because of the theory of knowledge and fundamental concepts on which they rest, and which has undergone little changes.

Borko and Chatman lay down the following 'Criteria for an adequate abstract'

Content

1.	*Purpose*	A statement of the goals, objectives and aims of the research or reasons why the article was written. This statement should be included in both the informative and indicative abstracts.
2.	*Method* :	A statement about the experimental techniques used or the means by which the previously stated purpose was to be achieved. If the techniques are original or unusual or if the abstract is informative, more details should be included.
3.	*Results* :	A statement of the findings. The informative abstract tends to be more quantitative than the descriptive abstract.
4.	*Conclusion*	A statement dealing with the interpretation or significance of the results.
5.	*Specialised content*	Certain subject matter fields require that the abstracts contain specialised information. Medical journals, *e.g.*, require that the abstract should contain details of diagnosis and treatment, drug dosages, etc. where applicable. In writing or evaluating abstracts in those fields, the specialised requirements must be considered.

The abstract is to be brief (100–200) and non–repetitive.

6.	*Form* :	More variation is possible in the form of the abstract. Therefore, form criteria must be applied judiciously and cautiously. The major criteria are clarity of content and conciseness of expression.[3]

Abstracting Services and Guidance to Their Use

A significant piece of guidance in the preparation of an abstract is contained in the ASLIB Handbook. "Only experience can give sureness in selection what should or should not be included in an abstract. Much help can be obtained from the study of *Abstracting Periodicals*, in conjunction with the original articles."

"Abstracting Service is a process of regular production of abstracts in a given subject field or group of fields. Such services may be comprehensive or selective." (Shera) Commercial type of abstracting services are more comprehensive than special abstracting services, organized by scientific or technical bodies for their specific need, which is limited and highly specialised.

The number and variety of abstracting services currently available in the world are indicated in the publication "Documentation and Terminology of Science" series, UNESCO. *e.g. Chemical Abstracts Service (CAS) 1907-date,* covering all branches of chemistry, published weekly under the title 'Chemical Abstracts' by the American Chemical Society, N.Y. contains several million abstracts.

Engineering Index Inc (EI)-1934-date, covering major engineering fields: electrical, electronics, plastics, chemical, materials mechanical, civil, published monthly under the title *'Engineering Index'* by the non-profit corporation in cooperation with the Engineering Society's Library, which makes available over 2,000 publications in 25 different languages. But the abstracts are in English only which number over 70,000.

Abstracting periodicals are similar to regular serial publications, issued periodically, (Wly, Mly, Qly, Hly, Annually, etc.). Entries in them are arranged in some kind of classified groups and order which is indicated on the page of contents. Each item is given a serial number, and the index at the end of the volume links the abstracts by means of these serial numbers. Over 50-60% of the total scientific and technical literature published is covered by the U.S. Abstracting Services.

In the United Kingdom, several secondary industries, *e.g.*, the Brewing, Gas, Zinc, Cement, Copper Industries have developed their own individual abstracting services.

In India, select government agencies/organizations have developed skeleton abstracting services for their use, *e.g.*, Indian Bureau of Mines, Library Bulletin (English-Hindi); Central Board of Irrigation and Power-Library Information Bureau-Abstracts of Current Technical Literature. These are neither comprehensive nor commercial. Even the periodical and serial publications of India are yet to be provided with satisfactory abstracting services. It would be helpful if certain uniform standards with regard to abbreviations, names of authors, titles/extracts and indexes, etc. are adopted.

Who is Competent to Write Abstracts ?

However complex the work of preparing a satisfactory abstract may be, attempts in producing them from the highly specialised and technical documents, *e.g.*, in medicine, engineering, technology have proved that valuable abstracts could be written in an objective manner, by virtue of specialised skills and methods acquired. This is the quick and easiest means of communication of ideas on relevant sources of information aiding study and research.

Between the original writer of the document (the author) and the library expert or the subject specialist whose abstracting would be dependable and therefore to be preferred ?

The author's approach to the problem will be more subjective than objective and so the abstract would provide biased information. The library specialist's abstract may lack the authority, depth, clarity and understanding associated with the work of the author or subject specialist. The subject specialist's abstract will lack uniformity, form and absence of canonical process. Further, the subject specialists will not stick to the abstracting work for long, as their chief interest and field of activity is research or study of the concerned discipline in their laboratories or workshops. On the other hand, a library expert, who combines competency in processing discipline and techniques (author headings, subject headings, index terms, classification, and general background of subject bibliography) will be most suitable for the work and with a good background of a subject or discipline, he will prove quite satisfactory.

Classification of Abstracts

Facility of use of a documents list can be assured, not by arranging the abstracts in simple alphabetical order by names of writers of the documents, or by the keyword of the heading, because the order of alphabets being predetermined, tends to scatter the closely related items, which is irritating and time consuming. The sensible method for adoption in classifying them is certainly grouping them by subject or topic relationship which in a documents list is influenced by the user's purpose. The hierarchy of topics in the list could be general to specific or specific to general, according to the particular need in view. In the worlds of Jessie H. Shera "To classify documents means to sort these into groups which form a logical pattern, and are denoted by suitable figures or letter symbols forming a sequence in which either the documents themselves or references to them can be filled or listed".

Each list/document of abstracts will adopt, according to the purpose in view, a scheme of classification for grouping and arranging them in order to present the close relationship among them in logical manner. It seems appropriate to state that classification for documentation is "indigenous", and no ready made schemes (like the Decimal Classification, the Library of Congress classification, or even a faceted scheme like the Colon Classification) is likely to be fully satisfactory, as the process of division, collocation, and hierarchy of topics is based on the subjective approach of the author of the classification.

The indispensability of classifying has been emphasised by Ranganathan—"Machinery or no machinery for retrieval, classification is a necessity . . . to facilitate literature search among micro-subjects", as the quantity of documents produced is in millions and continues to increase.

The present techniques adopted in Documentation and Abstracting and Indexing Services are rapidly being replaced by newer ones, and the search will continue till a stable 'theory and technique' is universally adopted. "There is as yet no unified theory of retrieval systems and a good deal of retrieval practice is still an empirical art, unsullied by theory". In shaping a retrieval system, a

complete understanding of and collaboration among the four important functionaries—the user, the operator, the systems designer, and the engineer—is very essential. It seems very presumptuous for any single individual to assume the role of the four specialists, for it is not ordinarily possible to acquire this competence. But any one can, with average intelligence, follow the product of these minds and benefit from the information system, thus designed. A word of caution seems fairly appropriate in choosing a particular information system. It is the cost factor. At least in the developing areas of the world, of which India appears to be the foremost, a total automation of information systems could not be considered for sometime to come.

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12

LOOK BEFORE YOU LEAP: A WORD OF CAUTION BEFORE OPTING FOR AUTOMATION

In the previous edition of this work, emphasis was laid on the basic foundations of Information Science. The contents, semantics and syntactics of the information stored for retrieval, whether in manual, or automated systems are designed, selected, tested, and structured by the human mind, in accord with the time, need, and significance of the purpose for which it is stored.

Technology, telecommunication, and electronic controls in computers have been advancing so rapidly that the automation adopted with a view to finding a place at the top in storage and retrieval of information becomes out of date by the time it commenced functioning. Several institutions have found that the discarding of the existing one, and adopting newer technology very costly beyond their resources. They are caught in a fix. Why all these ugly and unexpected situations have occurred ?

The unending production of information material, specially books and serials to a greater extent than what actually is needed and used, has increased the complexity of handling and transferring the information in time to those who need it. As for instance, 'the *World List of Scientific Periodicals*' forecast a total of 400,000 to be in print in Sciences and related branches only, by the year 2000. The same source in its 4th edition 1975 stated the number of periodicals and serials to be available as 2,800.

'*Geoarchive*' considered to be the most comprehensive data base in the geological sciences, indexes over 5,000 journals in its annual, and about 1,00,000 geological maps. This branch of science is so comprehensive that it covers the subjects of geophysics, geochemistry, geology, palaeontology, and mathematical geology. Even the applied aspects of this subject includes the serials in Petroleum production, Mineral production, Mining and related technologies.

The *'Chemical Abstracts'* 1975 contains 350,000 entries, while the 'Physical Abstracts' currently includes 100,000 a year. The Library of Congress, Washington subscribes to 117,000 journals in several languages. All these examples indicate the massive production of journals, which are more required in sciences and technology than books.

It seems appropriate to cite T.S. Eliot, the lines below from *'Choruses of rocks'*. He had a far sighted vision, when he stated,

> "Where is the wisdom we have lost in knowledge,
> Where is knowledge we have lost in information."

Wisdom and knowledge have lost their identity and got diffused in information. In storing lack of selectivity governed by the object of pursuit has resulted in the inclusion of irrelevant information, retarding the attainment of precision and pertinency to the expected level.

Lewis Munford in his *'Pentagon of Power'* 1970 observes, "Unfortunately information retrieving, however swift, is no substitute for discovering by direct personal inspection knowledge whose very existence one had possibly been never aware of, and following it at one's own pace through the further ramification of relevant literature. But even books are not abandoned, but continue their rate of production, the multiplication of microfilms actually magnifies the central problem—that of coping with quantity, and postpone the real solution, which must be conceived on other than purely mechanical lines–namely by a reassertion of human selectivity, and moral self discipline, leading to continent productivity. Without such self imposed restraints the over production of books will bring about a state of intellectual enervation, and hardly to be distinguished from massive ignorance." This is not only a wise, but also a timely caution, which, if heeded, will save the cost of expensive and impermanent technology from eroding the limited resources.

For anyone in the information field—user, student, teacher, or, society as a whole, it is essential to understand the inherent nature and historic potential of the commodity handled. Unless he is aware of this essential feature, the fundamental epistemology, which is the genesis of information, would be overlooked, and contribute towards ignorance. He also cannot be indifferent to

the ethical considerations of the use to which information is put to in society. Professional integrity will demand such a stand for the librarian and information scientist. To overlook this basic reality will amount to the very denial of the existence of man on the planet earth.

It is an axiomatic truth that our economic system compels that we consume what we produce, and thereby maintain the base and strength of the system. The unending production and increase in the quantity of information poses problems for its consumption.

According to Shannon's *Mathematical Model of Communication* the social and economic system is supposed to be uncertain and it has to be resolved; while the general conception of information is that it is knowledge put to use. This dichotomy in understanding the term 'Information' results in lack of agreement over the message communicated.

The signals in computers and their meaning is very important. In the mathematical theory of Shannon, the quantum of information conveyed by the message increases, as the amount of uncertainty increases. This can be reduced to a mathematical expression. A (message)=1 : 10, and B (message)=1 : 100 Here A is supposed to yield smaller amount than B, while B gives ten times more than A. On this base the computers are manufactured to store and yield large numbers of signals to convince the users of the *rarity* and thereby the *increased value of the message*. This is doubtful and would not stand a rational approach. However, the technological advances of the West are sustained on this hollow belief—the more the noise, the greater is the value of the message. The noise of signals reflect random acquisition and disorderliness, and the value of the message remains constant, irrespective of the fact, whether it is one out of ten or one out of one thousand.

All the obsession towards information technology is due to a wrong hypothesis, i.e., "the equation of information with communication, the identification of information with meaning, are uncritical common places of contemporary Western culture. What is the relationship between information and communication ? Between information and cultural boundaries ? Between information, noise and meaning ? How do we distinguish between them ? What do we most value ?"[1]

The answers to these questions are examined and finally

conclusion is reached that the most sophisticated technology—chips, minicomputers, microprocessors, and all other varieties of computers—adopted for storage and retrieval of information, is only a means to an end—the contents and semantics of information judged by the user as pertinent. The foregoing observations will help information science and technology workers to strike a balance between automation and human talent. All the effort to upgrade information technology in order to keep pace with the overproduction of the books, journals and other software should not result in ignorance explosion.

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INDEX

CATALOGUING THEORY AND PRACTICE

6th Edition

C. G. Viswanathan

Significantly, the work projects an analysis of the pros and cons of continuing the cataloguing procedures and techniques and maintain the catalogue in card form or in machine readable form or totally discard it in favour of computerised system, study its impact on both the users of the library and its staff. The cost effectiveness of total mechanisation has also been considered. (In Press)

PUBLIC LIBRARY OPERATIONS AND SERVICES

3rd Revised & Enlarged Edition C. G. Viswanathan

The Work is a brief manual to help both the performer and the user of library and information services. The need for efficient management of services from public libraries and information centres has attained urgency and indispensability, as the frontiers of knowledge has, in an unprecedented way, been expanding during the last few years, specially in the disciplines of science and technology, and also electronics,as well as a growing demand for efficient services from people in general.

With a view to meeting this challenge, comprehensive directions and dependable guidance to students of library and information science, and also to assist the practising librarians in the efficient performance of these operations have been provided.

Despite limitation of space, an attempt has been made to cover all aspects of library services. The illustrations, diagrams and tables elucidate the text. There are nineteen chapters in the book, of which chapters two, and nineteen relating to 'application of management theory to library operations; and the advent of machines for library operations' respectively have been newly added, while the rest of the text, wherever changes are required to bring it up-to-date, has been revised.

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