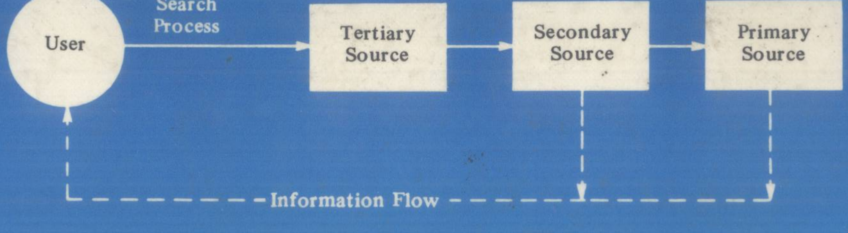
SCIENTIFIC AND TECHNICAL INFORMATION RESOURCES



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SCIENTIFIC AND TECHNICAL INFORMATION RESOURCES

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MARCEL DEKKER, INC. New York and Basel

Library of Congress Cataloging in Publication Data

Subramanyam, K
Scientific and technical information resources.

(Books in library and information science ; v. 33)
Bibliography: p.
Includes indexes.
1. Technical literature. 2. Scientific literature.
3. Reference books--Technology--Bibliography.
4. Reference books--Science--Bibliography. I. Title.
II. Series.
T10.7.S93 507 80-28531
ISBN 0-8247-1356-7

Marcel Dekker, Inc.
270 Madison Avenue, New York, New York 10016

Current printing (last digit):
10 9 8 7 6 5 4 3 2 1

Printed in the United States of America

SCIENTIFIC AND TECHNICAL INFORMATION RESOURCES

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A Series of Monographs and Textbooks

EDITOR

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Pittsburgh, Pennsylvania

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PREFACE

The material presented in this book has its origins in the lectures given since 1973 to graduate students taking the Resources in Science and Technology course at the University of Pittsburgh and the Drexel University. The book is addressed mainly to two groups of users: (1) students and teachers of librarianship and information science, and (2) practicing librarians and technical information officers in science and engineering libraries and information centers.

Guides to the literature of science and technology can either be inventory guides, listing numerous publications (e.g., C. C. Chen's *Scientific and Technical Information Sources*), or expository guides containing narrative descriptions of sources (e.g., D. J. Grogan's *Science and Technology: An Introduction to the Literature*). Inventory guides are more useful as reference sources for practicing librarians than as textbooks for students and teachers of technical information. In view of the diversity and growing volume of reference works and other publications in science and technology, it is impossible for technical librarians and students of technical information to become familiar with large numbers of individual sources of information. Instead, a more useful approach would be to try to understand the total process of scientific and technical communication and the relationship between information needs and information sources.

A major feature of this book is the integration of the inventory approach and the expository approach, and the presentation of a didactic model for scientific and technical communication. The model includes a consideration of the various phases of scientific information—including its generation through R & D, and its recording, surrogation, synthesis, and dissemination. Information is seen as both the source material and the product of R & D activity. The emphasis in this integrative approach to technical information has been on: (1) an understanding of the information needs and information seeking (and dissemination) modes of scientists and engineers, and (2) an overview of the structure and characteristics of the totality of scientific and technical literature and other sources of information.

The emphasis throughout the book has been on current practices in scientific and technical communication, historical aspects, and characteristics and bibliographic control of various forms of scientific and technical literature. Science and engineering librarians and students of technical information cannot afford to remain oblivious to the rapid growth of computerized information dissemination systems and services. Accordingly, recent developments and current trends in the computerized bibliographic control and dissemination of scientific and technical information are also discussed.

Scientific and technical information is a global entity; its bibliographic control and dissemination are supranational concerns transcending linguistic and geographical barriers. Several examples of multinational bibliographic control systems and services are discussed. The products and services of numerous professional societies and national and international agencies including national patent offices and standards organizations are described.

Over 1500 sources have been listed under broad subject categories. These include tertiary sources (guides to literature, bibliographies of bibliographies), secondary sources (bibliographies and catalogs, abstracting and indexing services, databases, reference works of various types), and primary sources (journals, including translated journals). Almost all of the sources listed are English language sources produced in the United States or overseas. All the major branches of the physical and natural sciences and engineering and technology are covered, but health sciences and social sciences are excluded. No attempt has been made to evaluate the sources listed. The listings are illustrative, and not comprehensive.

I am grateful to Professor Allen Kent, Director, Office of Communications Programs, University of Pittsburgh, for his valuable support and encouragement in preparing this book. I wish to thank Alexis Swyderski, head librarian, Yeadon Public Library, Yeadon, Pa., and Vibiana Bowman, systems analyst, Planning Research Corporation, Philadelphia, Pa., for their expert assistance in proofreading.

K. Subramanyam

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SCIENTIFIC AND TECHNICAL COMMUNICATION

1.1 Introduction

The date of the first scientific writing is not known precisely. Contributions to science were made by the early civilizations of Assyria, Babylonia, China, Egypt, and India. In these early civilizations, knowledge was transmitted largely through oral communication, and the fragments of papyri and cuneiform clay tablets that are extant from these periods do not give us a precise picture of the pattern of scientific communication during these early periods. The invention of the moveable type by Gutenberg in 1455 was a landmark event in the history of written communication. The printing press made it possible to prepare and disseminate multiple copies of manuscripts.

During the sixteenth and seventeenth centuries, great advances were made in intellectual, economic, technological, and social spheres by natural philosophers such as Francis Bacon and René Descartes, who placed great emphasis on the scientific method of inquiry. During this period, written communication was largely through books and gazettes. The book was not particularly suited to the rapid dissemination of new ideas, since the author had to work for several years and accumulate enough results to warrant publication of a book. Accounts of single observations and discoveries began to be disseminated through booklets or pamphlets. For example, William Harvey's work on the circulation of blood was published as a 72-page booklet in 1628 [1].

Though many changes have taken place in recent times in the modes of dissemination of scientific information, the basic function of scientific literature, namely, to serve as a foundation for advances in science, has remained unchanged. In his opening address to the Royal Society Scientific Information Conference, 1948, Sir Robert Robinson, President of the Royal Society, said [2]:

> The sciences have deep human interest and are not devoid of spiritual value. The object of our Founders was declared to be the improvement of natural knowledge. By that they meant, and we still do mean, improvement and spread of knowledge of nature. Neither they could, nor we can, condone the scientific miser who investigates for his own satisfaction, or profit, and keeps the results to himself for selfish reasons, whether they be aesthetic or economic.
>
> Faraday expressed it very well (he always did) when he described the three necessary stages of useful research—the first to begin it, the second to end it, and the third to publish it.

Sir Robinson was reiterating the principle that the march of science rests on its published record, and that ready access to scientific and technical information is a fundamental need of scientists everywhere. More recently, Elmer Hutchisson, director of the American Institute of Physics, asserted his "conviction that the written record of the accomplishments of scientific research constitutes one of civilized man's most important intellectual resources" [3]. Scientists constantly draw upon this growing volume of records, and also strive to contribute their individual share, however small, to the total body of recorded knowledge.

1.2 Characteristics of Scientific Literature

Scientific knowledge is the objective knowledge of the universe and its phenomena, generated by the scientific method of inquiry and validated to conform with empirical observations of natural phenomena. Every new addition to the store of objective knowledge is an extension of the existing body of knowledge as recorded in the primary literature of science. The new knowledge so developed is recorded on tangible media and thus adds to the stockpile of scientific literature. Therefore, scientific literature, which embodies the existing store of objective knowledge, is at once the foundation on which the incremental progress of science rests and also a product of such advances in scientific knowledge. In the humanities, new developments do not necessarily replace past achievements: Bernard Shaw's plays do not make Shakespeare's plays obsolete, and Picasso's paintings do not replace those of Rembrandt. But the nature of the objective knowledge of science is quite different; each incremental advancement in scientific knowledge in some way adds to, modifies, refines, or sometimes totally refutes the prior knowledge on which the advancement was based to begin with. Einstein's general theory of relativity is an extension and a generalization of Newton's classical mechanics; the heliocentric theory of Copernicus rejected and replaced Ptolemy's geocentric theory, then prevailing. This noncumulative quality of science is shared by the literature of science; hence the clamor of scientists and other users of scientific information for the most recent literature.

The second important attribute of science, which is shared to a large extent by the literature of science, is its universality. Scientific truth is "supranational," and transcends political, sociological, cultural, and linguistic limitations, although these factors influence the organizational dynamics of scientific research in any given society. For example, the organization of scientific research activity in the United States is different from that in the Soviet Union because of the vast differences in the political ideologies and socioeconomic infrastructures of these two countries. However, Soviet physics could not be different from American physics inasmuch as the laws of physics, regardless of the nationality of the physicists who discover them, or of the language in which they are expressed, are as immutable as the natural phenomena they depict. Any aberration that may be deliberately or inadvertently superimposed upon scientific truth by political demagoguery or other ideological considerations, as exemplified by the Lysenko affair in the USSR, is bound to be discovered and rejected sooner or later [4].

Likewise, scientific literature, which is a record of the objective knowledge generated by science, is quintessentially universal, although there may be vast differences in its language, bibliographic format, and physical medium. These differences can be resolved by appropriate transformation (e.g., translation and reformatting), and then the scientific literature produced in one country can be used by the scientists of another country. The abstracts in *Referativnyi Zhurnal*, a Russian abstract journal, are translated and incorporated into *Applied Mechanics Reviews* of the American Society of Mechanical Engineers. Many physics journals produced in the USSR are translated from cover to cover by the American Institute of Physics, Plenum Publishing Corporation, and other agencies, and are made available to English-speaking physicists throughout the world. This could not have been done if scientific literature, like science itself, were not essentially universal. The same cannot be said of the literature of other branches of knowledge, however. Some branches of the social sciences and the humanities are more or less culture specific, and are not transplantable across cultural-geographical interfaces. Islamic law, for example, cannot be practised in the United States, even if books on Islamic law can be translated into English, because of the culture dependency of law. Such translations are useful, though, for academic pursuits.

Scientific literature is the validated record of the achievements of science. Traditionally, scientists have been zealous in guarding the high standards of scholarship and quality of the work reported in scientific literature. Research articles submitted by scientists for publication in scholarly journals are refereed by a panel of experts to ensure accuracy and quality. In order to obtain impartial assessment of the manuscripts, the refereeing process is usually done anonymously. The author is not aware of the identity of the referees, and in some cases, the referees also do not know the identity of the author. Scientific societies play a dominant and useful role in maintaining this tradition of validation of scientific literature.

Scientific literature is also a "public" record of scientific knowledge. The channels of communication (e.g., the primary journal and the conference platform) are accessible to anyone who satisfies the requirements of quality as set forth by scientists themselves. Also, the literature of science is "public" in another sense: With the exception of documents containing proprietary matter or information pertaining to national safety, the literature of science is accessible by anyone for use. Very elaborate bibliographic control mechanisms have been set up to promote easy and rapid access to scientific literature. Since science is sustained by its own literature, the accessibility of scientific literature is crucial for the unimpeded growth of science.

1.3 The Structure of Scientific Literature

The structure of scientific literature can best be understood by tracing the progression of scientific information from its generation as a result of research and development (R & D) endeavors through its dissemination in primary literature, its surrogation in secondary services, and its eventual integration and compaction in reviews, textbooks, and encyclopedias. Figure 1.1 is a schematic diagram of a bibliographic chain showing the progression of scientific information from the idea stage until the new information generated is disseminated through various channels and eventually becomes an integral part of prior scientific knowledge. The numbers within the small inner circles indicate the time frame in years, with research starting from the idea stage at time zero. The products or bibliographic packages emanating from each of the activities are shown in boxes connected to the activity circles in the diagram.

1.3.1 Primary Sources

Unpublished Documents: Primary information derived from R & D activity can be communicated by a variety of channels. When the investigation is still in progress, there is a continual interaction among the members of the research team, and between the research team and members of the larger scientific community who may be interested in the research. At this stage, information flows in both directions: as input to the research team in the form of data and ideas from the scientific community, and as output from the research team in the form of experimental data and preliminary findings. Such interaction almost always takes place through nonformal channels (e.g., oral