ERG-RESREP-196 (August 1978)

Scholarly Research in the Academy

A View from Inside

Thomas Lee Eichman

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Abstract

Research in librarianship should be able to contribute to establishing information science as an academic discipline. Librarians, however, may be fundamentally uncomfortable with or hostile to research. Two recently published reviews of some of the literature on citation analysis and subject catalog use reveal assumptions about academic research that conflict with the author's understanding of its practice.

A theoretical model based on one proposed for information science by Laurence B. Heilprin is used to explain the author's view of academic research. This model helps draw attention to similarities and differences in the intellectual processes of indexing and authoring and to differences in search and research possibilities afforded by indexes vs. original documents. The usefulness of citation indexing to the practicing researcher gains graphic representation. The roles of personal memory and research comfort demands on the part of a research author are emphasized.

In conclusion, comparisons are made to applications of similar iconic models by two other authors, one for documentation and information processing in general and the other more specifically for the academic library. Heilprin's work is hailed as helpful in developing a cognitive view of information science.

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I never met a page outside a document!

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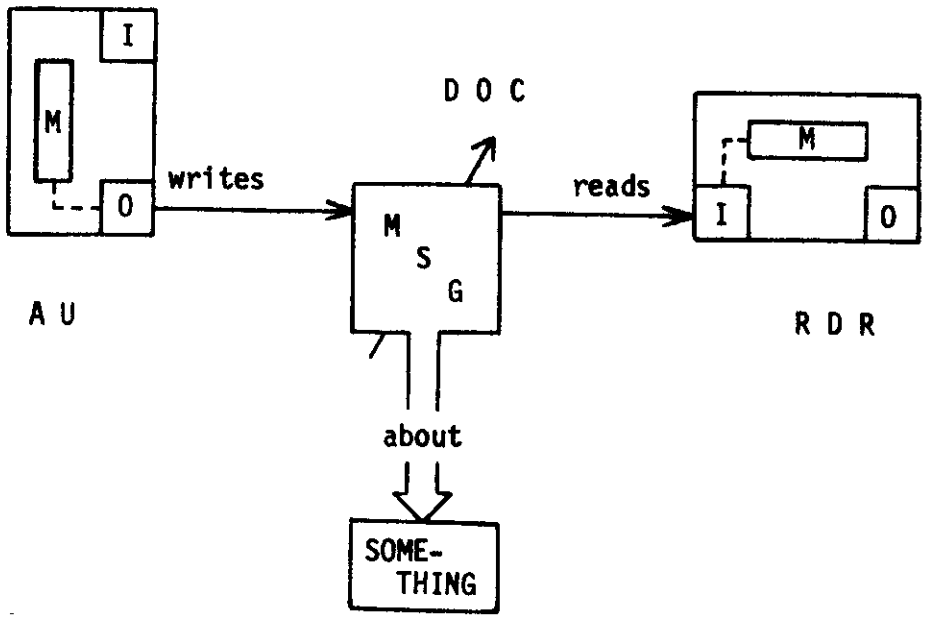


M = MIND
I = IN (afferent organs)
O = OUT (efferent organs)
AU = AUTHOR
DOC = DOCUMENT
MSG = MESSAGE TEXT
RDR = READER

Figure 1. Basic model of the creation and understanding of stored communication (fashioned after Heilprin's IS Path)

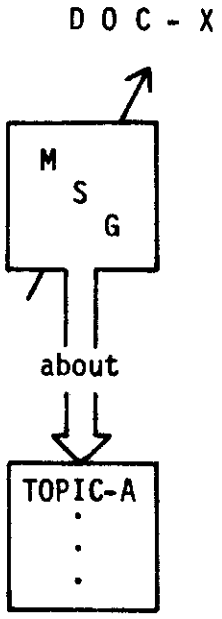


Figure 2a. Abstracted view of message stored in a document

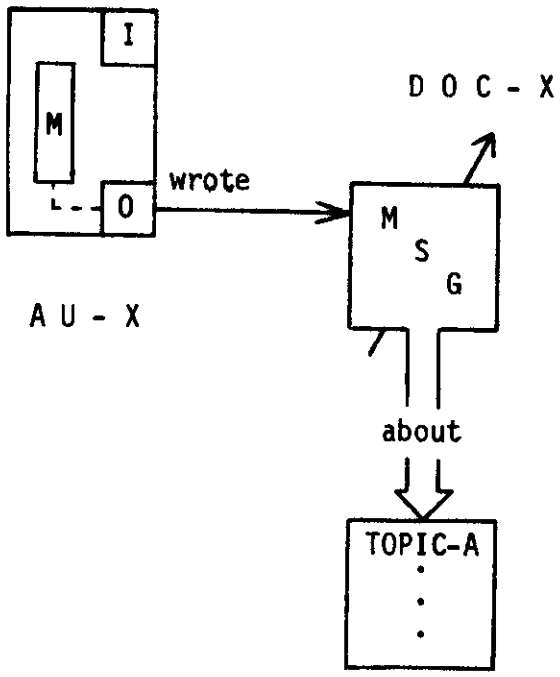


Figure 2b. Document from view useful in understanding nature of academic research

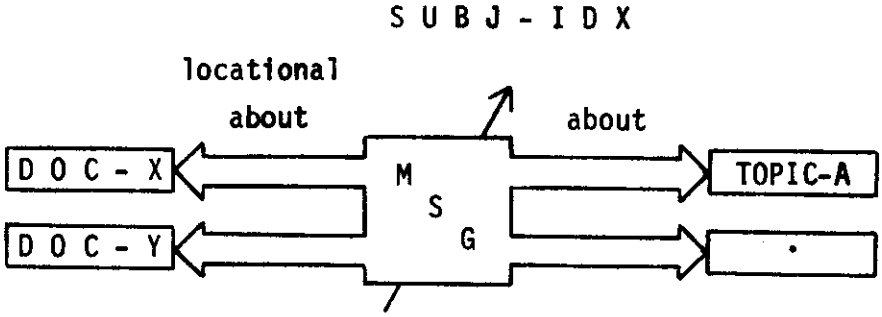


Figure 3. Static view of subject index

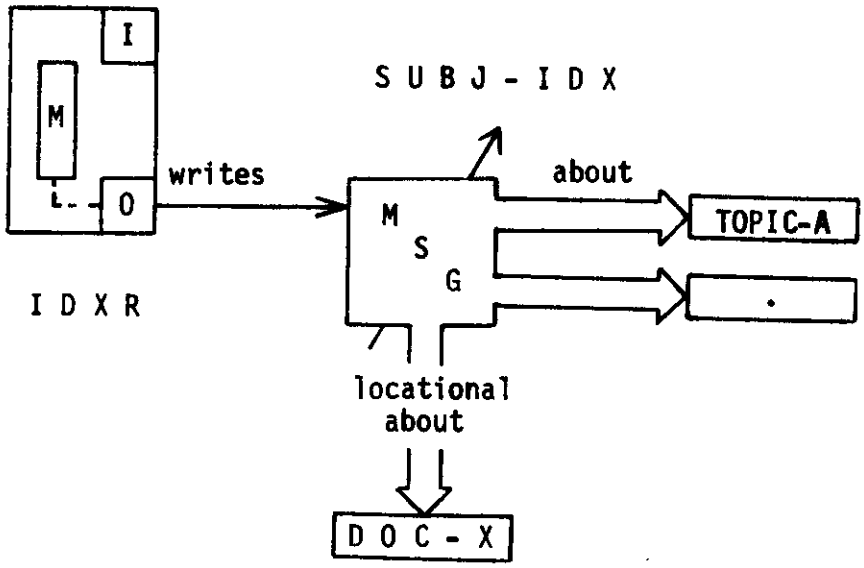


Figure 4a. Abstracted view of indexer creating an index

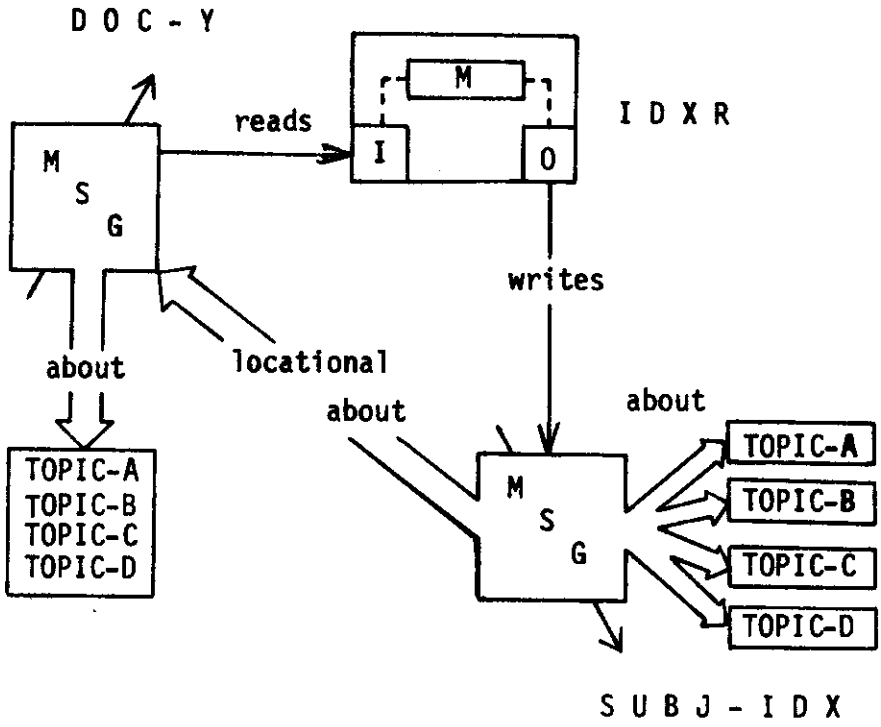


Figure 4b. More complete view of creation of an index

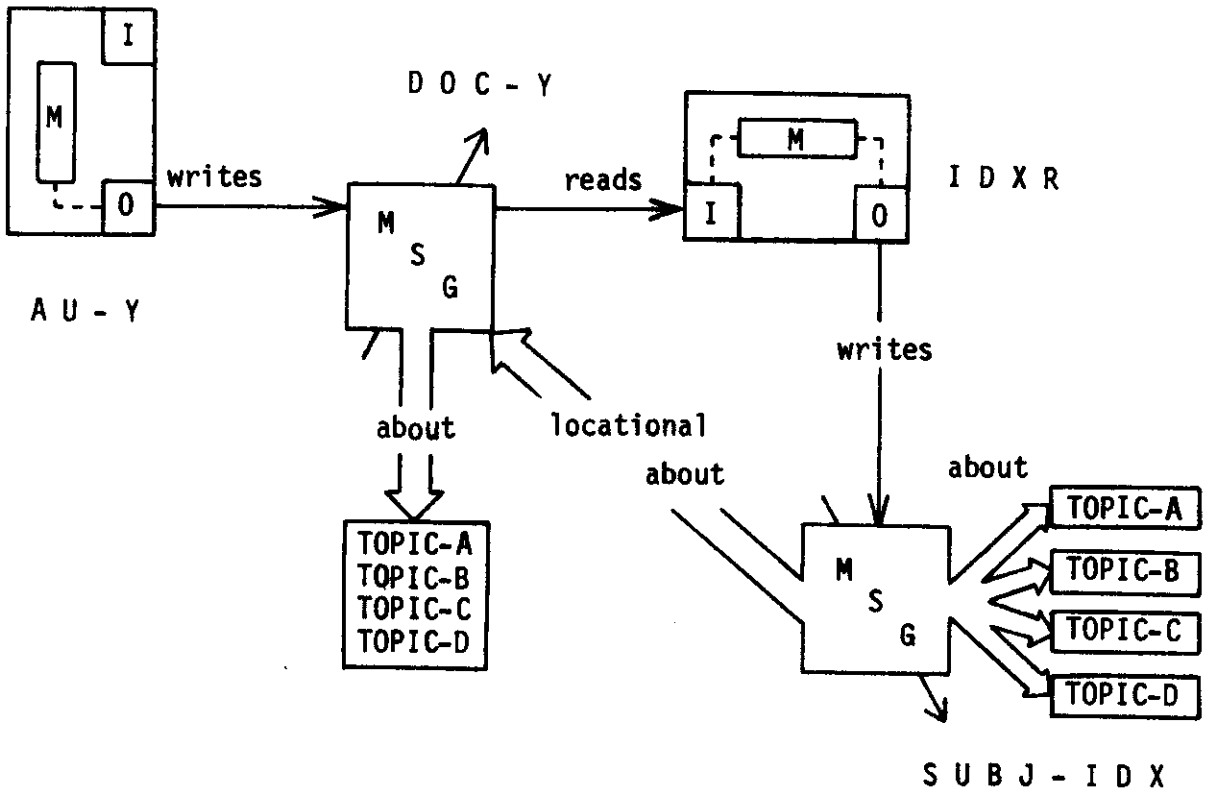


Figure 4c. Creative research path through the understanding of the indexer

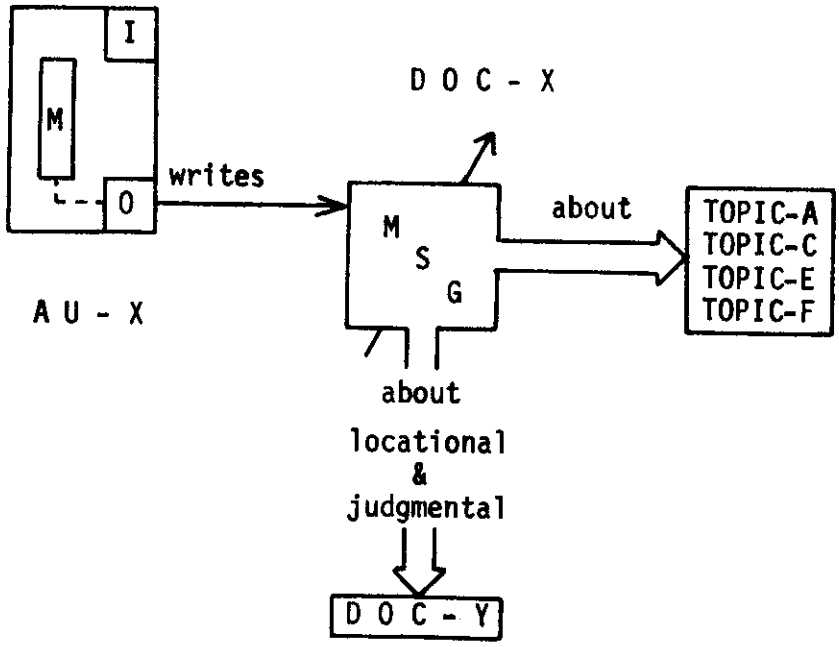


Figure 5a. Abstracted view of author creating a research document referring to an earlier document

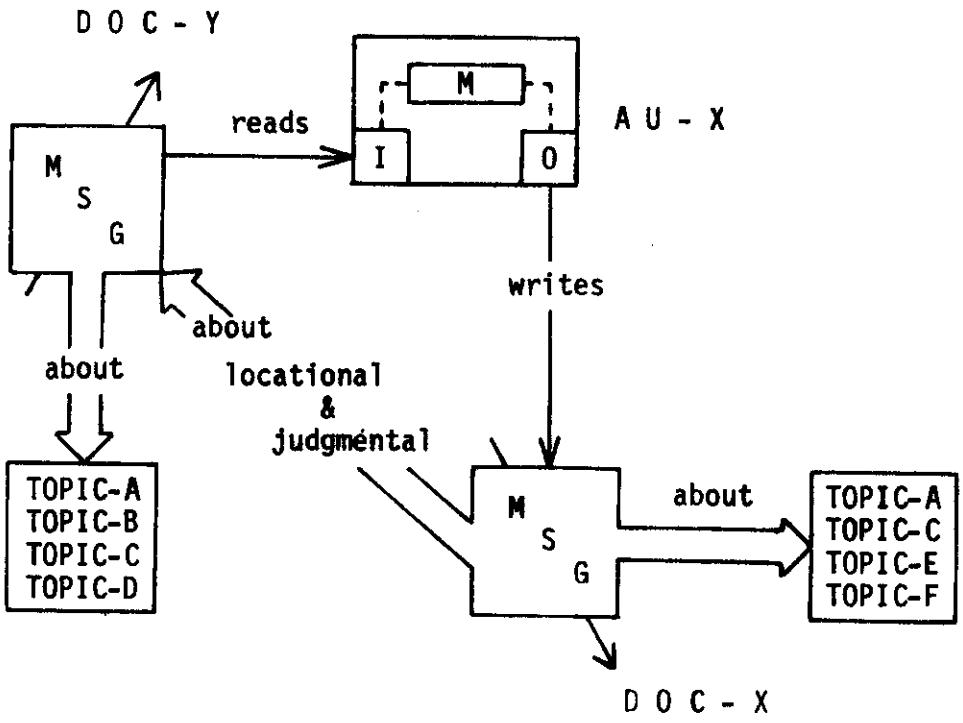


Figure 5b. More complete view of creation of a research document

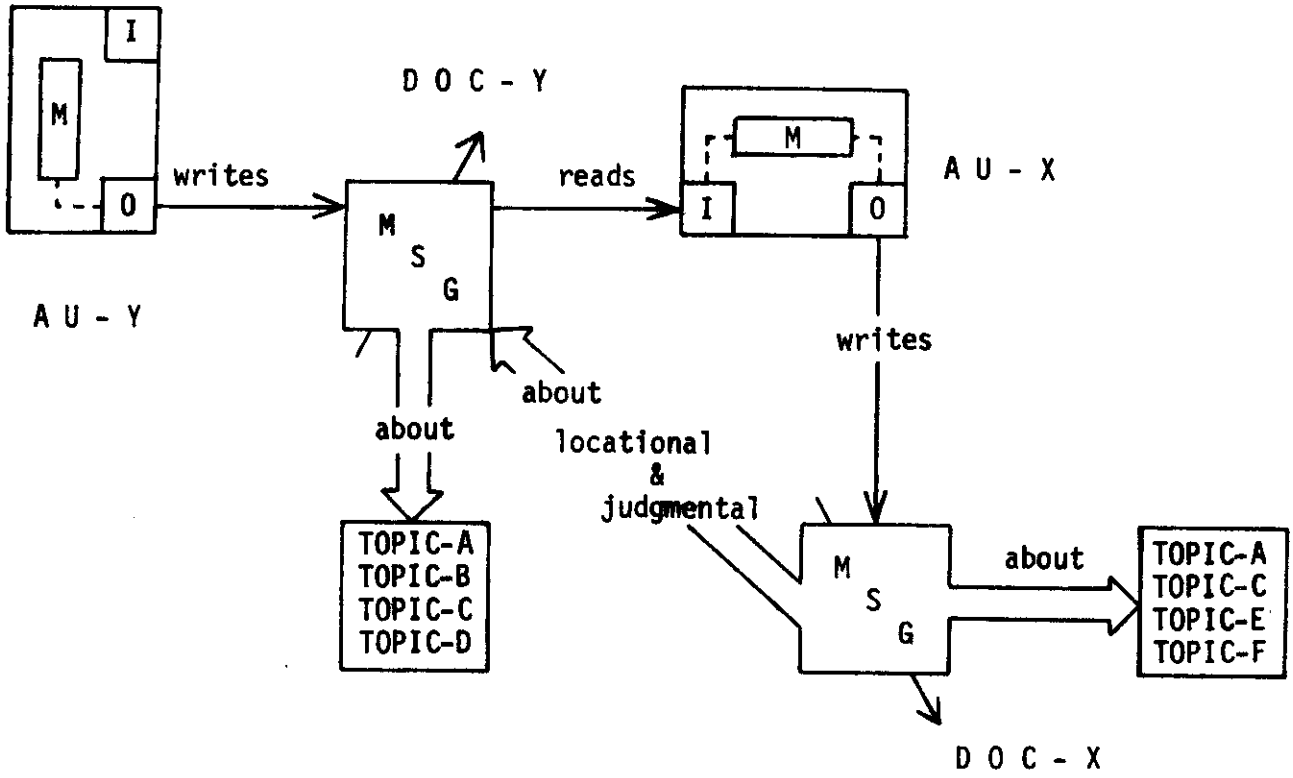


Figure 5c. Creative research path through the understanding and judgment of a research author referring to another researcher's work

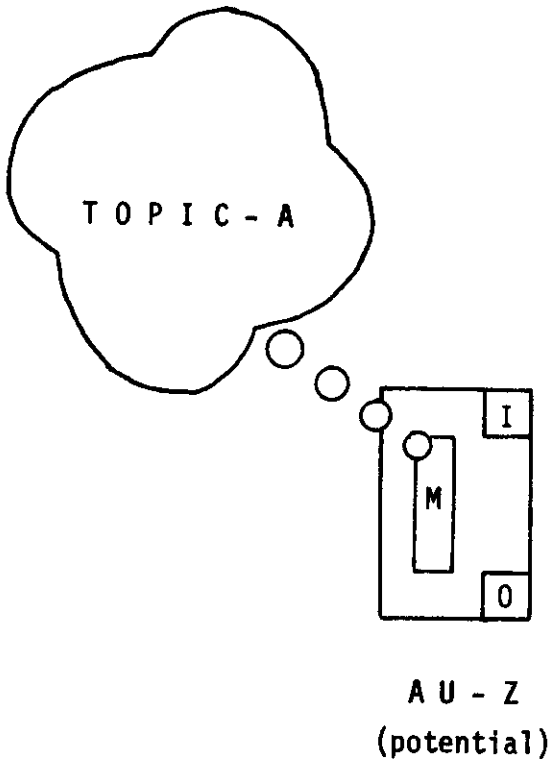


Figure 6. Searcher with a topic more or less in mind

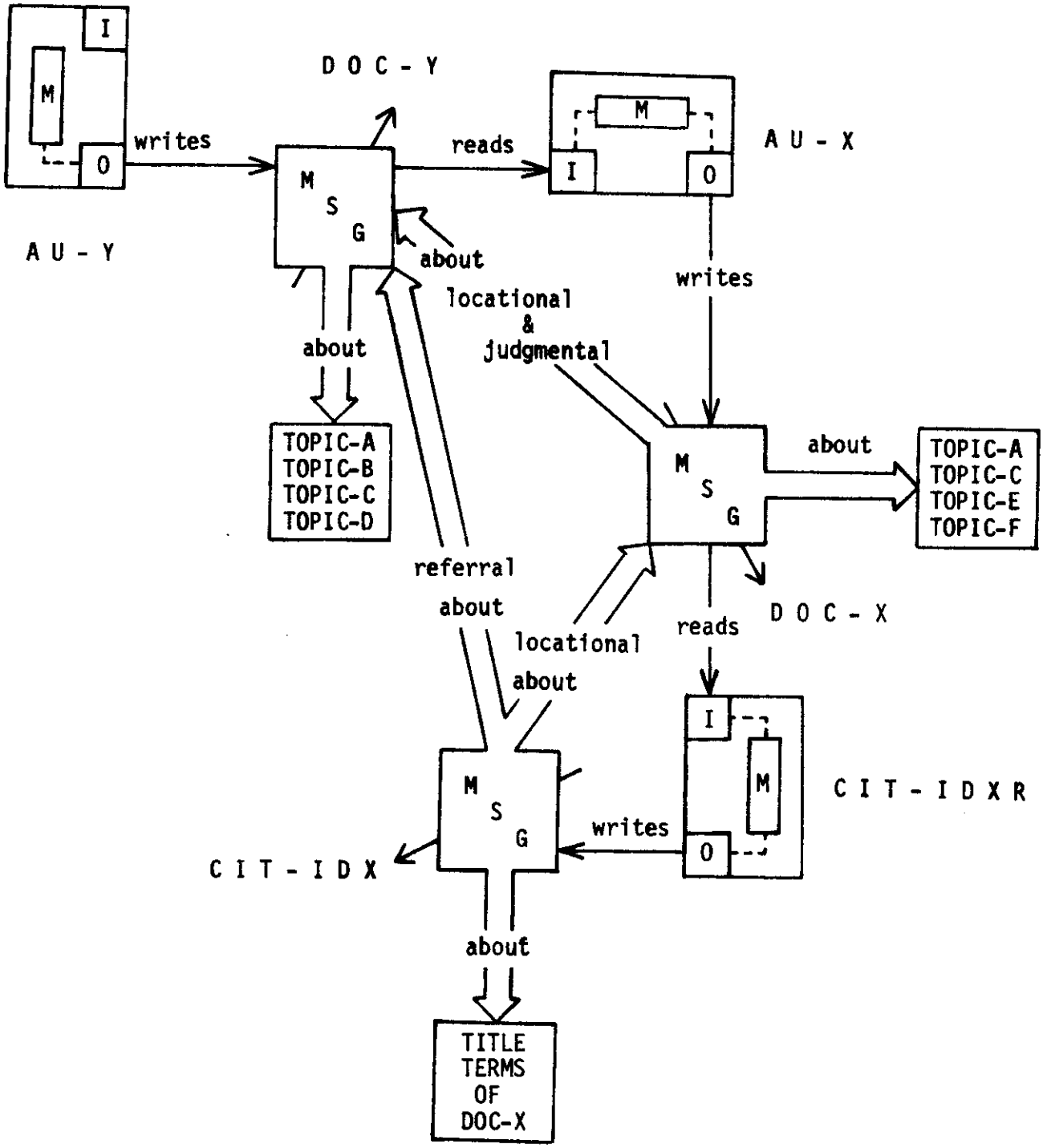


Figure 7. Connection between research documents and authors copied by citation indexers

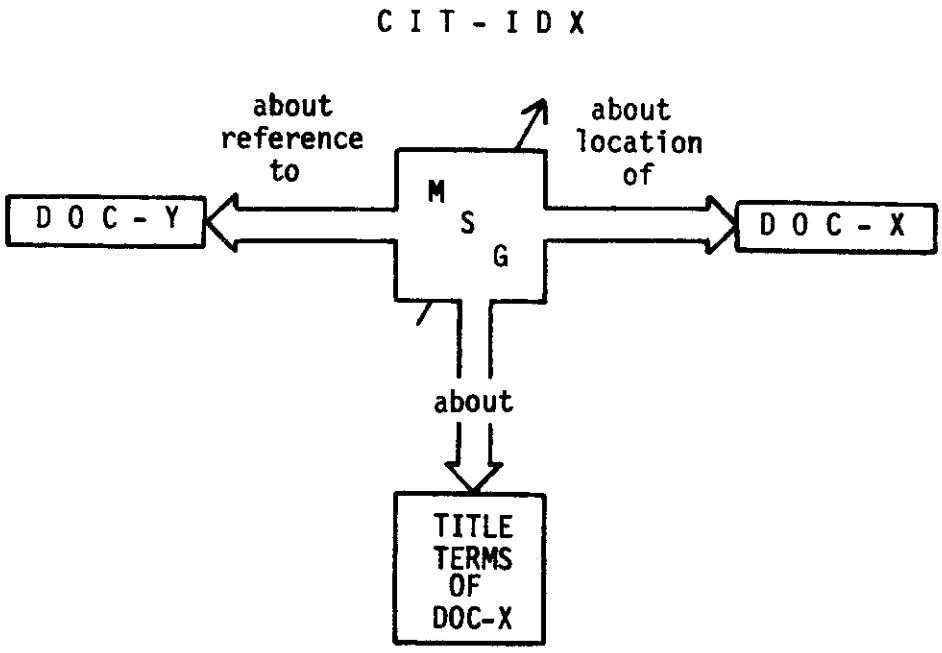


Figure 8. Static view of citation index

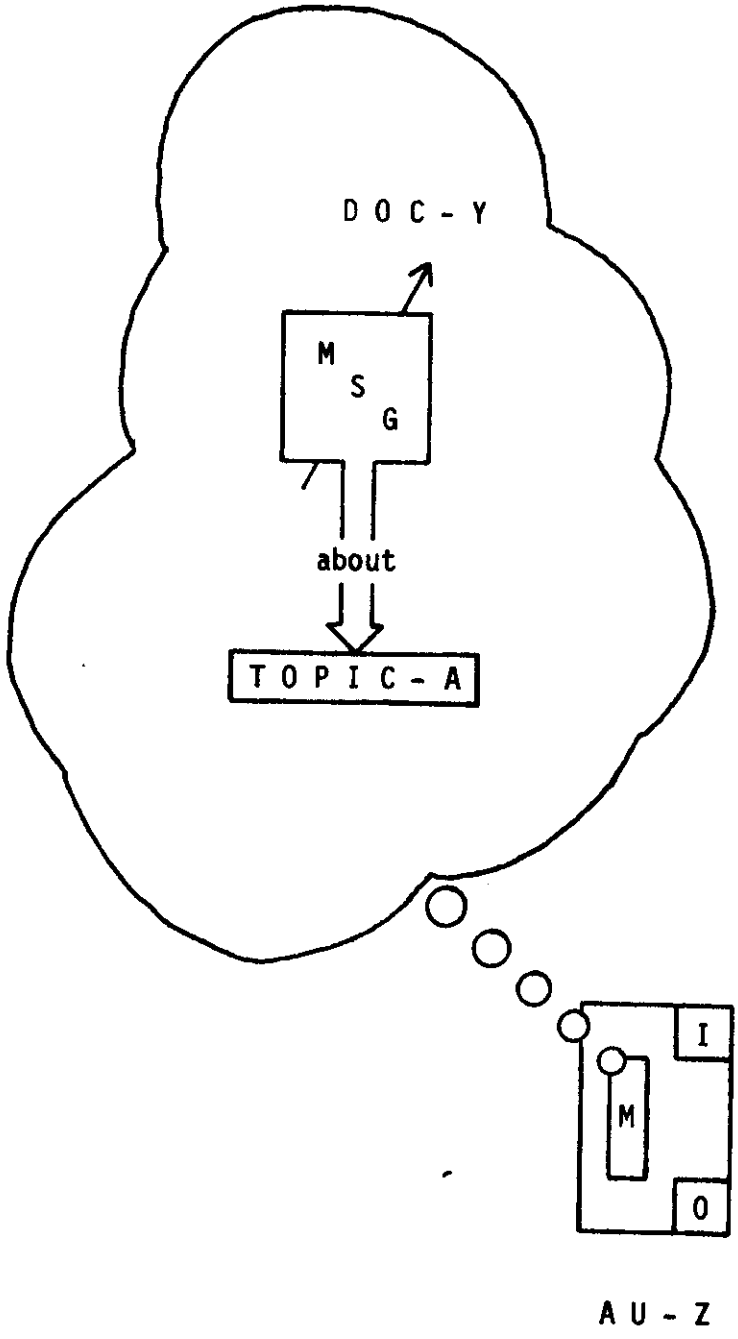


Figure 9a. Researcher remembering a document about a topic

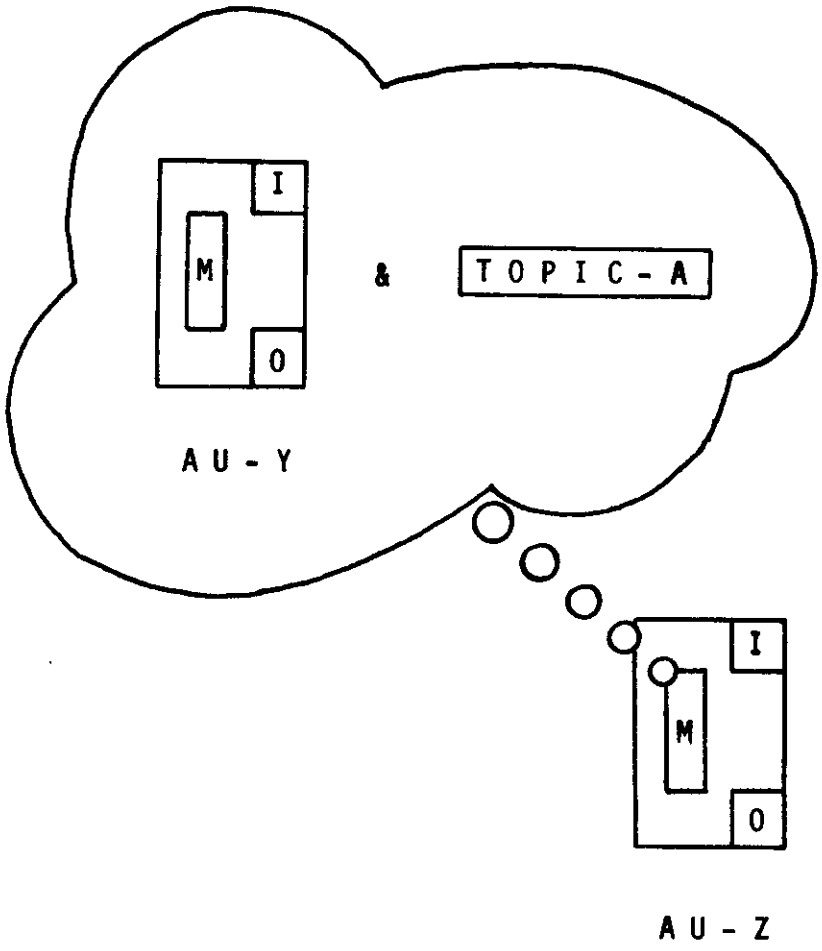


Figure 9b. Researcher associating a topic with another researcher

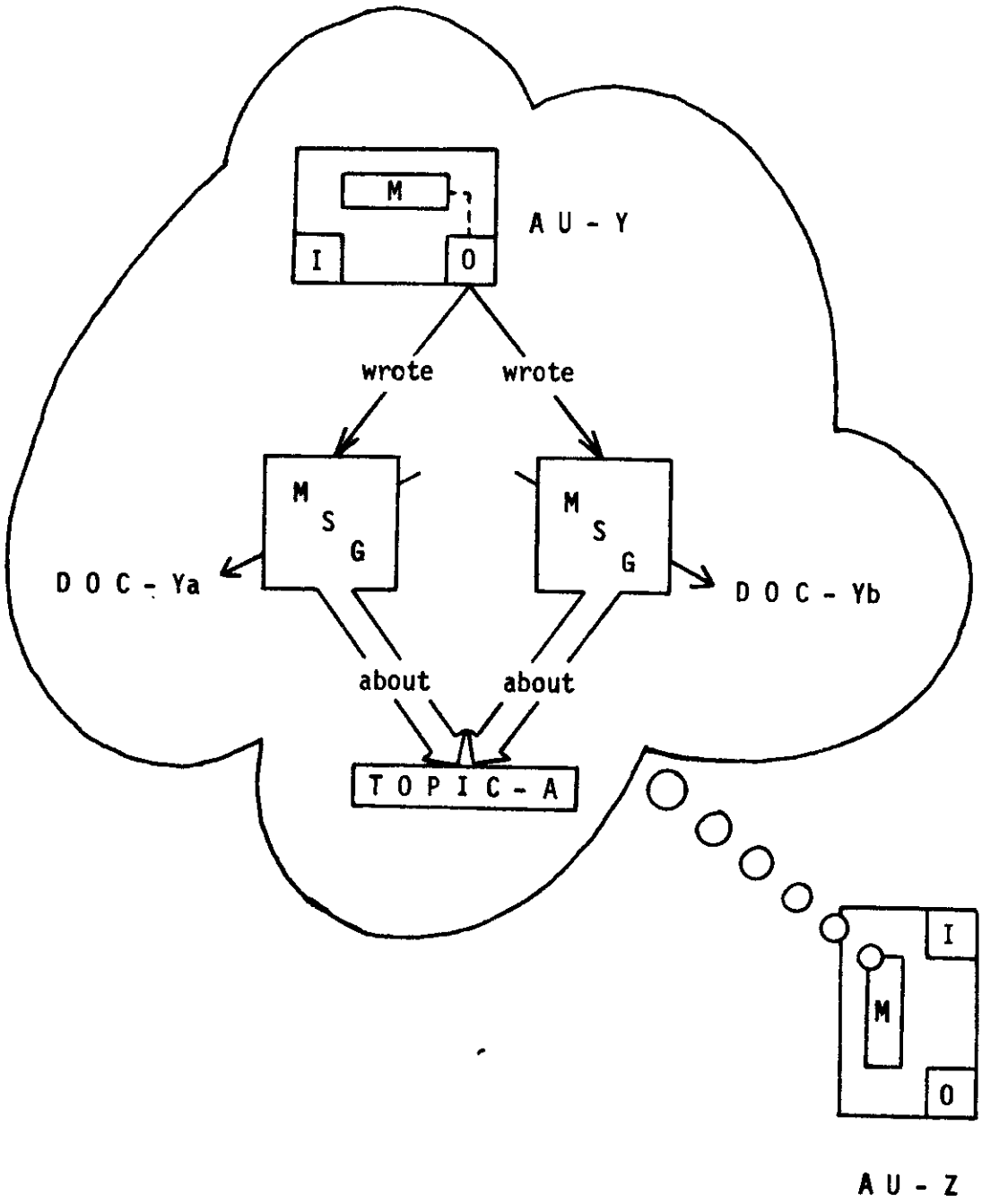
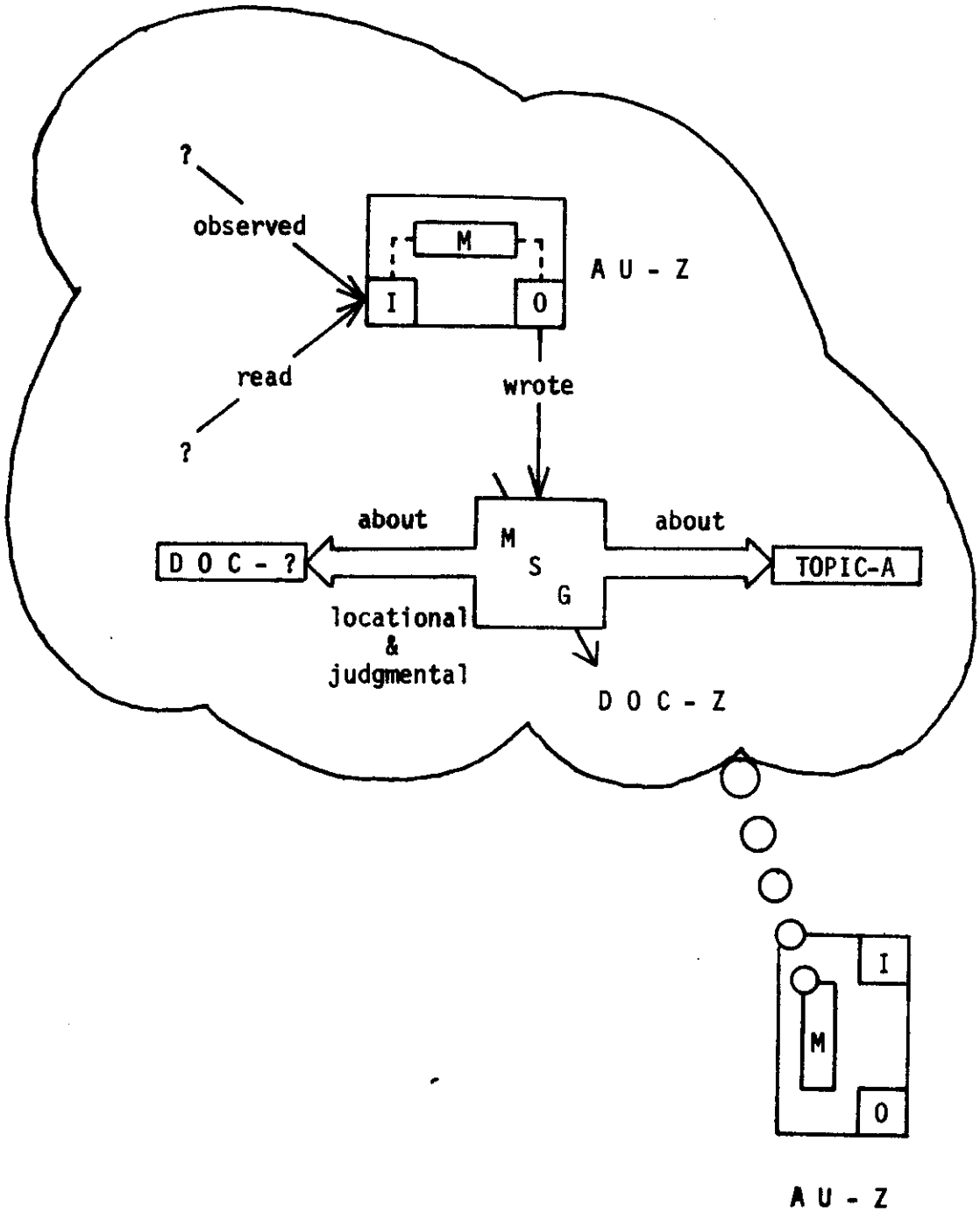


Figure 9c. Researcher recollecting another researcher and his documents about a topic



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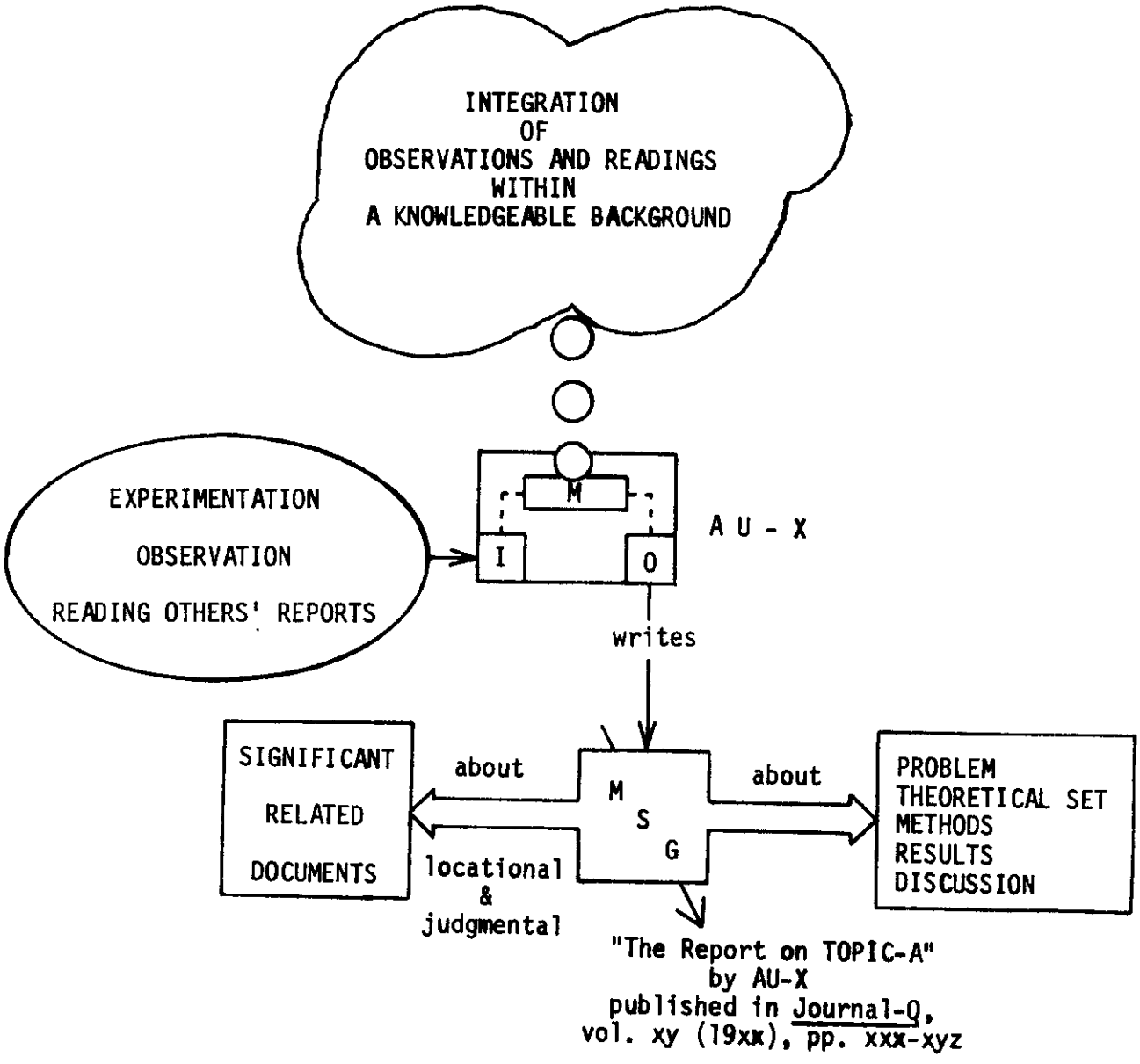

Figure 11. Report of research within a certain tradition

Scholarly Research in the Academy

-- A View from Inside

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Introduction

Information science may not be well defined as a discipline, but some fundamental concerns of those persons claiming to be information scientists are pretty clear. Such persons are largely concerned with the transfer and storage of knowledge. This makes information science a human science, but the human is often forgotten in research and applications fostered by information scientists.

The human factor is fundamental in discussing knowledge in that, although the transfer and storage of symbols can take place external to the human, to speak of knowledge requires an assumption of human processing.

Societies that have not developed external storage methods must depend for the maintenance of culture on the development of elaborate skills of highly personal storage and transmission, e.g. the griot of West African radical fame, a phenomenon found generally in pre-literate cultures, as in the oral tradition that may be the basis for Homer's poetic works. In modern societies which have developed more or less elaborate external symbol storing devices, it is easy to forget that the individual human possesses an elaborate internal device for storage and that most if not all persons make use of that internal device, called the memory, in their daily work, be they laborers or scholars.

The longest standing tradition of external storage is that which transfers knowledge into a written representation on an external, smooth surface. The transfer of knowledge from one human to representation on an external surface and then back from that surface to another human has traditionally been called writing and reading. In the beginning it is clear which came first; something had to be written before anything could be read. The general beginnings of writing and reading are so remote, however, that for most people who read and sometimes, if at all, write, it undoubtedly is axiomatic that reading should come before writing. An elite group of persons, research scholars and literary artists, knows, however, that the sources of inspiration for creating written texts are not necessarily other written texts. The creative process is an internal process not very open to external observation and evaluation. Only its products, in the case of writing, composed texts, are generally open for close inspection.

Academic libraries serve the scholarly tradition by providing storage and assisting in the transfer of knowledge, and have done so for many years. With this long tradition, librarianship ought to be able to provide a basis for the development of a more comprehensive discipline concerned with transfer and storage also in less traditional forms, i.e. an all-encompassing information science. However, modern librarianship appears not capable of articulating its own tradition well enough to be able to contribute in a general way. Librarianship seems to be looking too much to outside sources to explain its own behavior.

Modern librarianship does have a good understanding of the storage of knowledge, especially in the traditional written form, and seems to be

finding it easy to apply this understanding to storage in non-traditional forms. Traditional librarianship also understands apparently fairly well half of the transfer of knowledge, from storage to recipient. But the other half of the transfer, from creator to storage, appears to be almost totally misunderstood and in large part misconstrued by traditional librarianship, at least in the more modern representatives of it.

In a general critique of librarianship, Paul Wasserman sees a general inadequacy in research in the discipline and attributes it to librarianship's pragmatic basis:

> [R]esearch in librarianship is viewed largely as the gathering of facts to support political decisions in individual situations. The intrinsic resistance, symptomatic of the entrenched professional preference for its own tradition, relates perhaps to a view that research may threaten the existing order. If pragmatic librarianship rests on certain assumptions and if the consequence of research may be to cast doubt about these very tenets, here is where risk lies. To encourage, to support, or to believe in research is to tolerate ambiguity -- the possibility that there may be other viable alternatives, that existing practice is not divinely inspired. The net effect is a profession which is not only uncomfortable with the idea of research, but fundamentally hostile to it. [1, p. 142]

The discomfort or hostility that Wasserman perceives may extend to research generally, thus contributing to librarians' misapprehension of the creative scholars and artists who produce and use the knowledge stored symbolically in libraries.

Further below I make clearer some of my own specific criticisms, but I wish, first of all, to profess my belief in the value of service provided by modern librarianship to the academic scholarly community and to express my optimism about the role librarianship might play in guiding information science into becoming an academic discipline. If its practioners, who should have a lot of valuable experience, would only look at librarianship more carefully and state clearly and forcefully what it does and does not do, they could, I feel, create the basis for a discipline of information science.

Introspecting and scrutinizing about librarianship is a rather large and difficult task if one is trying to make sense of the entire picture. I will not attempt here to give a description of the whole scene or to provide fundamental definitions, code words, keywords, etc. as a basis of a theory of library and/or information science. I will try, in a rather limited way, to account for a few aspects of academic library and document use with which I am personally familiar but which seem not to be well understood by many who have written about them from within the library world. For my purposes I make use of an explanatory model proposed generally for information science. In another article I have used this model, with slight modification, to help account for an aspect of library work which I felt I understood from the moment I first encountered it, but which was incomprehensible to most librarians, or so it seemed from the library literature I read about the phenomenon. [2]

The information science model I have used and use here is based on one developed by Laurence Heilprin in references [3], [4], [5], [6], [7], [8], and [9]. The choice of models is a personal one, since I was influenced directly in its study by Heilprin himself. My applications of it, however, depend on its usefulness in explaining certain things. The model and

the theory behind it have been built very carefully over a period of years and depend on general physical and psychological theories for support.

One test for any theoretical model for a discipline is how well that model accounts for aspects of that discipline. This paper is meant as a partial test of Heilprin's model. If it convinces others, I hope that they might test this model in other ways. If nothing else, I hope my discussion here will cause others from within librarianship to think about our discipline in a new way.

Narrowing the Problem

One aspect of scholarly research that appears to be very puzzling to librarians is the meaning, nature, relevance, and further usability of bibliographic citations found in, under, and after the text of reports of research, published in journals, technical reports, books, and various other forms of documents. One mistaken view I find common to librarians is that such citations are somehow separate from the rest of the document in which they are found. This view often comes out in discussions of citation indexing and citation analysis and is especially revealed when someone questions the applicability of citation studies or statistics to some practical aspect of librarianship. For example, one eminent practitioner of the art of applying the computer to library processes speaks of "bibliographies attached to published papers." [10, p. 146]

As a researcher, I usually find that a list of publications at the end of any report I read can be very useful. I often will make a copy of such a bibliography without necessarily copying the whole work, but usually only after I have found that the publication in which it is contained says something important to me as a researcher. I even find that later I may

make a completely different use of the list than was my original intent, so that such a list can have separate existence and use. Saul Herner [11, p. 33] reports a similar phenomenon in the reaction of someone else to the references in a study he had prepared. Most of the time such a list is most useful to me, however, in conjunction with the text of the document in which it is found. In this regard it is the references made in the text, or the footnotes to the text, citing those works which may be found listed at the end of the text, that make the citation of those works and the works themselves useful in my research -- neither the text alone nor the references alone but all together.

Another aspect of the research use of bibliographic references apparently not well understood among librarians is the seriousness of intent behind their inclusion in a research publication. This may be just a variation of the mistaken view that separates the references from the text. Nonetheless, it does appear also as a direct question in discussions of the use of citation analysis in supplying library services to the academic community.

In a fairly recent review of some of the literature of citation analysis, the reviewer, a library school faculty member, comes to the conclusion, "References (citations) do mean a great deal. Fears that they are made carelessly or for ulterior motives are not justified by evidence presently available." [12, p. 328] These 'fears' were apparently the basis for some of the studies reviewed by Broadus and logically must still exist for many librarians, since Broadus attempts to lay them to rest with these concluding statements. His next statement, following the one cited above, has practical implications for librarians, "A high proportion of readers depend on references as leads to other publications -- more, apparently, than make use of indexing and abstracting journals."

One of the implications, especially for more general libraries, such as those found at universities and colleges, is that it is a "proportion of readers", perhaps even a majority, but at least not all readers, who use references as their primary way of getting into the literature. This means that one vehicle cannot be made to serve everybody. Nonetheless, Broadus' proportion does include me as a reader and, I believe, many other academic researchers to a very high degree. Herner also notes this phenomenon and makes an even finer distinction, commenting on an older study in which he was involved, "Pure scientists, who spent the most time in libraries and made the most use of published literature, made much less use of library reference and bibliographic services than applied scientists, who made less physical use of libraries and of published materials than pure scientists." [11, p. 33]

Reports of research, especially the more valuable ones, are creative in what they report. The difference in what is created makes a difference in the two types of document usage and style of retrieval noted by Herner. Michael Polanyi comments on the creative difference insightfully:

> The beauty of an invention differs . . . from the beauty of a scientific discovery. Originality is appreciated in both, but in science originality lies in the power of seeing more deeply than others into the nature of things, while in technology it consists in the ingenuity of the artificer in turning known facts to a surprising advantage. [13, p. 178]

Because the pure scientist, to use Herner's terms, is concerned with deep penetration of nature within a community of scholars with a specific tradition, he must not only observe the natural things around him and

reflect on them but must also read the reports from others in order to make a claim to originality in his own reports. Obviously, it benefits both the pure and the applied scientist to read reports and gain from the experiences of others, but the orientation of the applied scientist, or technician, can account for his seeming lighter regard for the primary literature and heavier use of fact-finding vehicles. Polanyi goes on to make the point:

> The heuristic passion of the technician centres therefore on his own distinctive focus. He follows the intimations, not of a natural order, but of a possibility for making things work in a new way for an acceptable purpose, and cheaply enough to show a profit. In feeling his way towards new problems, in collecting clues and pondering perspectives, the technologist must keep in mind a whole panorama of advantages and disadvantages which the scientist ignores. He must be keenly susceptible to people's wants and able to assess the price at which they would be prepared to satisfy them. A passionate interest in such momentary constellations is foreign to the scientist, whose eye is fixed on the inner law of nature. [13, p. 178]

The pure scientist's heuristic passion may be towards the inner law of nature, but he also has a distinctive focus, very personal to him, but also very cognizant of other scholars in his discipline. There are also momentary constellations in pure science, usually of a discipline's superstar researchers and their associates and the reported findings of such groups. These constellations guide others in their fields far beyond their personal knowledge. The research stars may be productive, influential, and gleam brightly for a long time, or they may burn out quickly after an initial flash or warm glow.

Wasserman's point about the pragmatic basis of library research can be accommodated in the distinction between pure and applied scientists, or scientist and technician, except that Wasserman makes the stronger claim that librarians are afraid to invent new applications. Indeed, there are more and less creative applied scientists, just as there are more and less creative pure scientists.

The creative applied scientist who wishes to profit directly from his discovery must pay careful attention to the literature of his field in at least one way similar to a way that the creative pure scientist does. The patent literature search, as is well known, desires most strongly a truly negative finding, i.e. that the idea does not exist in the literature. Part of the motivation for the pure scientist to read as much as he can in his field is to find a similar negative result in the scientific literature about some idea of his. The staking out of claims within science has been discussed before [14], but I would caution anyone from attributing it as the sole motivation of pure research. The territorial imperative is only one possible explanation for the publishing of significant research findings. Some humans like to share territory, ideas, and many other things also.

Broadus' study is a fine example of research for applied library science. The rest of the text in his summary and conclusions following the paragraph I have strung out above is devoted to a discussion of the implications of the results of his findings for the applications indicated in his title. His report affords the opportunity for occurrence of one of the phenomena I described earlier. The references listed at the end of Broadus' report make a great jumping off point into the literature of citation analysis. Especially valuable are Broadus' evaluative comments within his text on each individual item when laid alongside the original item. The works

Broadus cites and discusses themselves can lead into other works found cited in them, and an ever expanding network can be built up which can be cycled into the future through the established citation indexes. One could probably go on forever reading material related in some way to citation analyses and studies of citation behavior.

In the library world, pragmatic as it is, constructing theories of library use that are predictive of events to come should be one important goal of library research. It is my impression that there has been a burgeoning of studies of library use that have revealed a multitude of findings about the behavior of humans in libraries. Theory beyond the immediate applicability of these findings even sometimes creeps into the reports of those studies. It is at such times that the attitudes that underlie library practice are often most revealing.

There is one stimulating study of the use of subject catalogs which started out as a library school doctoral dissertation [15] and which has been reported on more recently in two journals [16, 17]. The conclusions reported in the dissertation include the betrayal of an assumption about the nature of academic research that I think is common among librarians but which conflicts with my understanding and practice of it. The study is based on a survey of some of the literature of catalog use and on a laboratory study done by the author in a state university system. The assumption with which I disagree lies behind the following statements:

> It appears . . . that knowledge of the subject content of a field does not improve one's success rate [in the use of pre-coordinate subject headings for retrieval of books]. Apparently, variations in knowledge level of a subject do not affect success. This seems unjust, somehow. It is not proposed that a system be designed where users are penalized

> for ignorance, but on the other hand, experts should have their searches eased by their knowledge. In the chapter 1 review of other studies in this area it was noted that subject catalog use appears to slack off as the user rises on the academic ladder. It was surmised that this decline in use might be due to the increasing dissatisfaction of the user with a system not geared to the expert. There is nothing wrong with serving the novice in a field, but the expert (including the undergraduate major) working in his own field should not be badly served. He is, after all, the primary client of a university or research library. [15, pp. 227-228]

In the summary and conclusions of one of her articles [16], Bates shows that she has thought more about this assumption; there she poses a few valuable, provocative questions that should be considered within librarianship. Nonetheless, this article still includes a general assumption about the use of the library catalog which views it as the one vehicle through which users get into the literature stored in the library. The assumption is stated most directly in the introduction [16, p. 161], "In one sense, the catalog is the crossroads of an information facility. It is where the user starts searches of all kinds . . . . The catalog is where . . . the user interfaces with the information store", and is restated in the second article [17, p. 367], "The catalog is the principal information access device in most libraries and information centers."

The searches of 'experts', at least of the scholarly researchers of my acquaintance, do not ordinarily begin with the subject catalog. Indeed, it is hard to tell where and when scholarly searches as a part of research begin, or where they end, for that matter. The simple search probably started far back in time for the advanced researcher and was no doubt part of a general search

for a subject to major in as an undergraduate, a status from which he was next lured into graduate research for very personal reasons of interest.

In an excellent introduction to the study of anthropology, which has advice that graduate students in any academic field would do well to heed, Morton Fried, in discussing undergraduate training in his discipline, says,

> [T]he student begins to perform research functions when he follows an author's work (or a small portion of that work) to its sources as revealed in the author's footnotes and bibliography. At the same time, the student should be looking for the critical reviews that were published about the book, or, if it is an article he is examining, he must try to find out if it struck some response which would usually appear in a later issue of the same journal, or might be revealed in one or another bibliographical index. [18, p. 116]

It is my belief that 'experts' do have their searches eased by their knowledge. For a very good reason not having to do with inadequacy of the vehicle, academic researchers rarely use the subject catalog or the simpler forms of subject guides as the starting point to the literature in their narrower fields. The reason is largely, I believe, that most scholarly researchers have a personal history of a longtime habit of reading as much as they can, no matter where or how they find it, on rather narrow subject areas. Their reading habits may extend to doing a lot of reading outside their fields also, but their most intense disciplinary knowledge is well defined, in <u>their minds</u> at least.

Part of this personal knowledge of a field is a memory of what is written where and when and by whom. There is an intense attachment to names and dates within their areas of interest. Researchers come to

associate certain names, certain journals, certain publishing companies, certain academic and other research institutions, rightly or wrongly, as the case may be, with certain topics and subtopics within their narrower or broader ranges of interest.

When such researchers want to find something they have seen before, they either know where to look or have other ways than just through the subject catalog to go about finding it. When they are looking for something new, they know which journals might publish something thought provoking to stir new interests. They also know which publishers are putting out which new books about the subjects they like, in part through advance advertisements, which may be in the journals or on dust covers of the books they buy and read, or which may come to them through a system of select dissemination of information by means of the professional junk mail coming from those publishers or other bookdealers who have pulled their names off one or another elite list, usually the membership lists of professional societies or subscription lists to professional journals.

Academic researchers usually know which shelves in their favorite libraries are likely to have new books of their liking appear on them occasionally because they have probably visited those shelves quite frequently, especially in open-shelf, self service systems. They also know how to recognize a new book on an old familiar shelf. These abilities to recognize new items in familiar display areas and to know which areas to look in to find fond items may be viewed as an extension of general human abilities as in the ability for shoppers to recognize items among the products on display in a favorite shopping area and the ability to know which shops to look into for the kind of item desired. Many a scholarly researcher can be found passionately stalking the shelves of libraries and bookstores.

The scholarly researcher also knows there are more ways than one to skim a catalog. He may even go to the subject catalogs and indexes on occasion, especially if he is starting off into a new field of interest or going back to one he has not looked at for some time and for which he has forgotten the layout. But I firmly believe that librarians should not see as a failing on their part the fact that 'experts' do not use their subject catalogs all that extensively.

Subject catalogs do have failings in form, as I have experienced intensely in attempts as a neophyte general reference librarian to help undergraduates get started into the literature of fields I am not personally familiar with. But I think it would be a mistake to gear the efforts of correcting whatever failings there may be to an attempt to make subject retrieval devices more useful to all experts. Scholarly experts will use those devices only occasionally.

Even if it can be shown to the researcher that his research does not yield all the possible documents he might use, he will probably reject any outside attempts to force more material on him. He knows what he likes and where to get what he likes. If he does not know precisely where to look, he knows he can experience again the fun part of research that comes from uncovering something himself. Gerard Salton hits on the attitude of scholarly resentment to outside intrusion in his description of reactions to the selective dissemination of information:

> By far the most common complaint of SDI users appears to relate to the large volume of output continually delivered by the services. Even if the proportion of relevant items is fairly high, users receiving 30 or 40 citations every week will soon tire of the system and will revert to on-demand searches which furnish output only when a specific request for service is actually on hand. [10, p. 147]

It is a truism of American society that many people dislike too much junk mail, even if sometimes it may prove interesting and useful.

In the review of user studies in one of her articles, Bates [16, p. 162] reports again, "There is considerable evidence that as users go up the academic ladder, they tend to use the subject catalog less and less relative to the author-title catalog," a conclusion with which I obviously agree. She goes on to assert, "No user studies were found that investigated why this trend exists." I have already offered informal remarks meant to help explain the trend Bates perceives. I will proceed now to attempt to account more formally for the academic researcher's use of scholarly references.

In my attempt I use the model mentioned in my introduction. My discussion is not based on controlled laboratory observation of overt behavior. It is directed at fostering an understanding of behavior evident through Broadus' and Bates' reviews and which I know is a part of the nature of academic research as I have practiced it -- and have observed others practice it -- in my experiences over the years as a graduate student at three major universities, dissertation writer, teacher of undergraduates at two campuses, author of journal articles, independent researcher, and part-time university general reference librarian.

The Theoretical Model

As stated in the introduction, the theoretical model I use is based on a model found in the various writings of Laurence Heilprin. His most concise presentation is in [9, pp. 25-29, plus figures 4 and 5]. Versions publicly more accessible are in [3, pp. 298-302], [6, pp. 23-29], and [7, pp. 120-128].

Heilprin's statement of theory is based in part on communication theory that has been developing for some time and uses an iconic model of the process of

communication much like those that communication theoreticians have been using since at least the time of Shannon and Weaver. There are two ends to the communication model, one end sending, the other receiving. In between is a channel for communication. To connect the two ends there must be some means of encoding and decoding the message to be sent and received through the channel.

One of Heilprin's contributions to the discussion which makes his theory and models important in the library world is his emphasis on the individual at either end. Libraries are very personal means of communication. Users usually approach quite individually and personally the messages that libraries assist in transmitting. The symbolization of an individual at each end of the communication channel intensifies this assumption in the applications to which the model can be put.

A second and, I believe, very important contribution Heilprin makes with his theory is a distinction between long and short duration messages. The most obvious short duration type occurs in face to face or electromagnetically assisted interpersonal real-time situations. This type, the length of duration of which is a function of the medium, usually sound, light, and/or electromagnetic waves, and of the distance between originator and recipient, has been the concern of most of the communication theoreticians who have developed similar models to explain communication behavior. This type message of short duration is important in a library, especially to public service librarians who must facilitate information transfer to individual recipients, e.g. in reference negotiation. In reference [2] I have used Heilprin's model as part of an analysis of interpersonal short duration messages occurring at the beginning of library reference encounters.

The long duration message is the kind that is stored in some body-external medium, resulting in what is commonly referred to as a document. The long duration messages that a library assists most in transmitting have their origin in what is commonly called an author and are stored in book, journal, manuscript, film, record, and various other forms. By this theory also, some of the body-external tools in the library that aid in the search for certain stored messages are themselves stored messages that started with someone authoring them, e.g. a cataloger or indexer, and resulted in inclusion in a body-external documentary form, i. e. a catalog or index.

In this analysis, as Heilprin goes into in some detail, the stored document's message can be read only by an individual at the receiving end of the communication model and then only when the application of some external energy is appropriate for the conversion of the markings of the stored message into similarly patterned short duration messages. That is, pages must have light shine on them, films must have light through them, and vinyl disc records must have power to rotate them for the groove-tracking stylus to do its symbolic dance of minute proportions, so that the messages symbolized on the pages, films, and discs can be discerned by the person wishing to use them. At the storage stage, the energy has gone into preparing a message for long duration, normally involving short duration movements in fixing the storage medium.

The symbol for the individual at either end of Heilprin's model includes three body-internal parts, one for receiving messages, one for sending them, and, between these afferent and efferent organs, a center to process them, which in some philosophical and psychological traditions is called the mind. I believe Heilprin's symbolization of the integral individual communicator with internal processing is very important, because

it has the effect of saying that not all of the activity important in understanding the human use of libraries is behavior which is externally observable or which can be derived just from the observations of external behavior without some very strong assumptions about the internal character of the individual producing the behavior. It is a methodological assumption which is quite different from the behavioristic assumptions behind many of the user studies reported in the library literature. Behaviorist psychology has had a strong challenge to its assumptions from linguistics and other cognitive based research in the last twenty years. I believe it is time for shining the light of cognition on library and information science research. I agree to a great degree with Victor Rosenberg's opinions about the premises of information science, [19] and [20], and I believe Heilprin's insightful model can provide the necessary starting point for new vision in our field.

Modifying the Model

For this paper I confine the discussion to long duration messages, that is, those found stored in documents of one form or another, with the assumption that these must be converted into short duration messages for sensing to take place. For my purposes I have made a few modifications of Heilprin's model of the communication process.

My basic model is presented in figure 1. The rectangles at either end represent individual humans. The areas marked I, O, and M stand for the bodily internal IN-organs, OUT-organs, and MIND, respectively. The IN-organs are any sensor or set of sensors humans possess. For the purposes of this paper they will be mostly the eyes used in ordinary reading, though they could be the ears for listening to sound recordings, the fingers for Braille reading, or whatever other body parts for whatever other means humans have

of sensing externally stored messages. The OUT-organs would be mostly the fingers using pencils, typewriters, etc. for written documents but could be whatever other organs that might be used in controlling body-external, medium-fixing instruments. The MIND is the mind and for the purposes of this paper will be assumed. Any attempts at describing it here could lead into a lengthy and discursive philosophical, psychological, and physiological sideshow using lots of other Greek-based words and symbols. Its assumption is useful in what follows; its assumption is valid in many circles of the Western tradition of cultural analysis. Neural connection between the mind and the mind's body-internal tools is acknowledged by the broken line from the MIND portion to or from one of the organs at the extremities.

The originating body in my model is marked AU in a traditional library abbreviation for author. The person at the other end of the process of transferring the stored message is marked here in a general form as RDR, standing for reader, but it should be understood to represent anyone distinguishing, recognizing, and making sense of the patterns emanating from the message stored in the document, which in general form in figure 1 is marked DOC. The lines of communication symbolized by the single line arrows marked writes and reads and connecting DOC to both AU and RDR can be interpreted most generally to stand for the creation and understanding of externally stored messages by humans, whatever the means used.

The single line arrows outside the bodies show the direction of the external flow of the message. The use of the slanted arrow within the DOC symbol is an adaptation of Heilprin's symbol for indicating a variable time delay from creation to understanding through the deferred sensing that is possible with messages of long duration. The text of the message is symbolized inside the document as MSG. I mean by this symbolization to assert that the

document is to be distinguished from the message text, even though in the stored form they may appear to be nearly the same thing.

Just as a document contains a message, so does a message have contents. Although a message and its contents also may appear to be the same thing, they must be kept distinct. The contents of the message are symbolized in my model by another unit outside the DOC symbol. The contents, however, do not exist inside or outside the message except through the minds of the AU and the RDR. Grasping this aspect of symbolic communication has been a stumbling block for some communications researchers. I symbolize the connection here by means of a double line arrow which is meant not to imply that it is leaving the message but to show that the message in some way relates to its contents. Including the label about with the double-lined contents arrow is intended to help symbolize the indirectness of this relationship. The addition of an about arrow comes from another model of the communication process by Geoffrey Leech [21], whose analysis is based in part on the functional analysis of Roman Jakobson [22]. It is the only structural change I have made to Heilprin's basic model, the rest of my modifications being essentially changes in labels.

Documents and Indexes

In figures 2a and 2b I have abstracted two views of a document from the stored communication model of figure 1. The view as in 2a is easy to arrive at from the point of view of a library or other information storage area. The book, the journal, the film, the sound recording, even the computer tape, is an object that lies or stands on a shelf or in a drawer, or otherwise takes up space, and is quite tangible. With a little reflection, however, the next figure, 2b, is not hard to keep in mind, especially with books

that emblazen their creator's name in gold or other pretty decoration on their spines, or with the journal article whose author's designation is displayed in generous white space just below its own name, the article's title. The Anglo-American cataloging tradition has canonized the practice of author recognition in its general principles for catalog entry [23, pp. 9-10].

Both figures 2a and 2b disregard the contribution of editors and publishers to the form of the document, but the documents themselves, and in part the rules for documentation, do make more or less explicit recognition of at least the publisher responsible for the form of the document. Researchers usually recognize the processes that stand between the creation of a message and the storing of it in documentary form. They cannot but have become acquainted with the processes as producers of some of the documents that have come to be stored.

Perhaps this is the first part of the definition of a researcher, someone who has created a message stored somewhere in a document, as contrasted to searchers, persons who may have handled documents extensively but have never gotten a message stored in documentary form. The American Ph.D. tradition canonizes this distinction by making the granting of the research degree dependent on the depositing of a documented message, the dissertation, in at least one storage facility, the degree-granting institution's library, then often to be made more generally available through on-demand reproduction, a process with which the dissertation's author may be personally familiar because of degree requirements to provide a copy for microfilming, to pay a microfilming fee, and to produce an abstract of the dissertation to be used in advertising the work to other researchers. Whatever other documents a researcher produces--books, journal articles, and various other forms of research reports--usually go through several stages of editing, printing,

and publishing, which themselves become very apparent to the researcher transmitting messages through those processes.

Because researchers generally understand that there is often a great deal of work that must be done between the time an intellectual work first gains physical form as a manuscript by an author and then gets stored in a library as a document, I have subsumed all the intervening processes under the single arrow marked writes. This is not intended to discredit editing and publishing, but only to draw attention to the creative aspect of authoring, an aspect of research which, I believe, is not generally understood by librarians.

Librarians may have a personal acquaintance with some of the publishing aspects of the preparation of a message for storage through their contact with publishers and their wholesalers at the selection and acquisition stage of document storage. The processes of library selection and acquisition may not be well known to researchers, but the purpose of this exposition is to explain researchers to librarians, not librarians to researchers.

One potentially misleading aspect of my model is the delineation of TOPIC's in the contents portion of the stored message. In documents of free text, e.g. typical books and journal articles resulting from scholarly research, the topics discussed in the messages of those documents are usually not so easily delineated as my symbols might suggest. I intend to use a single enclosure around all the topics in a stored message as in figures 2a and 2b to indicate that the topics are included within free text. Some documentalists use the term 'natural language' for this distinction, but my attachment to that compound's designation in the traditions of philosophy and linguistics disallows my use of it here. The term 'free text' as I use it is potentially misleading also. I hope the distinctions I am trying to make here will become clearer in the later portions of the present text.

The various topics in free text may be more or less separately discernible by a reader. The reports emanating from different traditions may lend themselves more or less readily to mechanical elucidation of topics through the calculation of occurrences of words. Those disciplines with rather rigid jargon and quite stern, even ossified traditions of style in communication, e.g. jurisprudence, secret military correspondence, may lend themselves more easily to mechanistic text analysis, but a general method of such abstraction of topics by keywords seems not readily realizable for the purposes of scholarly research. The hard part of using a document for research comes in reading its message, discerning the intended meaning, and fitting the understanding gained from that reading into whatever else is going on in the mind of the reader. Librarians who may or may not do a lot of reading of separate texts may be misled on this point of topic analysis because of the forms of messages that they deal with a great deal, i.e. indexes, abstracts, and other condensed and/or simplified subject statements.

In figure 3 I have represented a static view of an index. The two-fold array of double-lined about arrows attempts to capture the functioning of a subject index, here meant to include many types of subject indicating devices, e.g. the subject portion of a library's card catalog or the various subject indexes with which the many reference librarians are more familiar than I am. A subject index typically lists a series of short statements each made up of a word or word group or other symbolization of a series of topics more or less precisely selected, depending on the characteristics of the index, and then gives clues to the location of documents whose messages contain something about the topics so represented.

Even though I have symbolized the topics referred to by the index's message as individual items in figure 3, i.e. TOPIC-A, etc., it should not

be forgotten that this is not meant to indicate that this is the form in which a reference to TOPIC-A, etc., is necessarily found in the index's text, but rather that a portion of the text of the index's message is about TOPIC-A, etc. Nonetheless, indexes, with their typical unitary symbolization tend to give the impression that TOPIC-A is the words or other symbols standing for TOPIC-A.

To understand why this is not the case, think of the very general topic 'water'. In an index, I could symbolize this with the English word water, or the German word Wasser, or the chemical notation H_2O , or even some non-standard, arbitrary notation such as Kg78*-444. As long as the reader of those symbols understood the system of notation, be it common language or special symbols, the topic would be understood to be the same. It is, however, quite easy to forget that the reference to topics is through symbols if you use quite frequently an index that has as its notation words from the common language.

Despite the potentially misleading character of my unitary symbolization for topics in an index, I prefer to use it as in figure 3 for the aboutness representation of an index's message, because enclosing each topic separately makes a convenient, and, I believe, revealing contrast with the free text representation I have symbolized in figure 2. It should not be forgotten, however, that the form of the symbols for TOPIC-A, etc., is within the text of the messages about the topics, and that the text, whether created by an author or an indexer, only represents TOPIC-A, etc. Recognition of the problem of fitting words or other symbols to concepts is rather basic to the use of reference tools. Devices to aid solution of this problem include thesauri and other means of vocabulary control.

Indexes have creators, something that readers, even librarians, too easily forget or do not even realize. It is easy to look at the entry in a card catalog or other standardized index and forget that some person has,

at some point in time in the past, created a message contained in that entry. A more complete view of the index, in the sense that 2b is a more complete view of any document than is 2a, is contained in figure 4a.

Here I have included, for simplification of the diagram, locational reference to only one document. With figures 3 and 4 it should not be forgotten that an index may include locational reference to many more than one document with each reference to TOPIC-A, etc. The simplification incorporated in figure 4a is due to the representation in the next figure, 4b, which is intended to symbolize the process by which an indexer creates a message for storage in an index about the topics of a single given document, which, if I understand the human process of indexing, is the way its progress is measured, document by document, even though the indexer may be working on more than one at any one time and in the end summarizes the process by collecting together all the documentary references to TOPIC-A, etc.

Figure 4a might have left the suggestion that the indexer just makes up indexes out of his head, but in fact, except perhaps for spurious examples, indexing requires some effort at examining the document being indexed, symbolized in 4b by the reads arrow. To make the communication process from original author through the indexer to the stored index even more complete, I have added the AU symbol and his writes arrow to get figure 4c, much as I added the personal and creative symbols to get 2b from 2a and 4a from something like 3.

I think 4c is a better way to symbolize subject indexes, not only because it is a completer statement of the processes behind their creation, but also because it symbolizes elements related to a document that are usually found in indexes used in libraries. Not always, but usually there

is indication of the author along with the locational information of a given document. Other information, especially usually the document's title, is included with the locational information. All of this documentary information about the message being indexed could be specified more explicitly along with the cover term locational, which labels the double-lined about arrow connecting the index message to the original document. I wish, however, to subsume all that documentary information under the one term, and I believe it will not be too misleading to do so. Generally, indexes are pretty clear in references to documents and their locations, although the actual practice varies and can be confusing, e.g. in the use of abbreviations for 'well-known' journals.

In figures 4b and 4c the contrast between the message texts of researched documents and the simpler texts of indexes referring to them, utilizing the symbolic variations for the representation of TOPIC-A, etc. as discussed above, becomes important. Say that a person is searching for material on TOPIC-A and has stumbled onto or been guided by a librarian or other resourceful person to an appropriate subject index symbolized as in figure 3 or one of the variations of figure 4. Suppose that such a searcher has correctly discerned that the message of the subject index contains reference to TOPIC-A as being located in DOC-Y. Following from this there is a naive view that when our searching person gets to DOC-Y he should quite easily locate the portion of DOC-Y that refers to TOPIC-A, and, most naively, should also find there in the text of DOC-Y the words which the searcher found in the text of the index's message used for describing TOPIC-A.

I think what I have described as a naive assumption about message texts is quite common among persons not having much experience in scholarly research, which may be another way of saying not having read a lot of free

text in depth about a topic, a possible step in defining a scholarly researcher, by saying what he is not. It may well be that certain texts or types of texts allow for a simpler minded searching approach. Such may especially be the case with documents meant to serve fact finding. Fact-finding information gatherers may look at their index map and go into the library woods to gather their information berries, but that is hardly an adequate way to describe a vast portion of scholarly research.

Scholarly research does include writing and reading, but it also demands thinking. Subject indexing meant to serve scholarly research must also include some thinking. This aspect of indexing is symbolized as a potential of the MIND portion for the IDXR in the variations of figure 4.

Research through References

Finding reference to DOC-Y in a subject index is only one way of getting to DOC-Y. Another way to get there is to come across DOC-Y directly, which may appear to be harder to do than to go through the subject index, especially if the reason for getting to DOC-Y is to find something about TOPIC-A. However, knowledgeable researchers do have other means, a large number of which involve indexing of some kind, although it may not be the kind that results in a stored message of the type found in a subject index.

Shelf arrangement is a well known device for indexing and retrieving documents by means of general classification. Browsing is a well discussed topic and is also a functioning part of my method of research. However, browsing, in its most productive form, which I would prefer to call shelf searching, is an active process that depends on the searcher having done a lot of reading before going to the shelves, although not necessarily immediately before, and also some careful reading while at the shelves.

Thinking is also very much involved, and so may be writing, to the extent at least of making small notes if, for example, the active shelf-searcher comes across a document he cannot take along at the moment.

In addition to external classification devices, an active researcher has categorized in his mind the journals, publishers, books, etc., that are likely to have material about TOPIC-A, if indeed the researcher is familiar with that topic as a part of his discipline. As the reading, thinking, and writing of a researcher intensifies, and perhaps also broadens, the researcher becomes very expert, not just about TOPIC-A, but also about the forms of documents, and, most importantly, about specific documents that have discussion of TOPIC-A from several points of view.

Different researchers may employ very different and very idiosyncratic methods of keeping this documentary information in their files and/or minds, but it is generally true that an advanced researcher has well developed means of keeping tabs on what is published or being published about the topics in which he is interested.

I do not intend here to describe elite groups of highly paid researchers, such as those in medical, space, and secret intelligence fields, who are given what seems to an outsider as unlimited funds, part of which they can spend to develop elaborate electromagnetically interconnected retrieval devices using gross operations of mindless machines. Those researchers have their own methods, including a lot of yes-men-and-women to carry out factory-like information assembling tasks. With large numbers of people and machines between researcher and message store, different things happen than with a more or less independent researcher who goes more or less directly to the stored message.

I intend to describe here also more than just the elite groups of researchers commonly known as 'invisible colleges'. What is designated by that phrase, which has been used as an appellation in English speaking areas for more than three centuries, is the very personal way that rather select groups of individuals have of keeping each other informed of what they and the other 'important' people are doing. Members of an 'invisible college' are usually highly visible to anyone who has followed a particular discipline that can be said to have an 'invisible college'. Only their privy secrets remain unseen beyond the fold until someone decides to display them in public. Usually there is enough leakage to enable anyone exerting a little effort to figure out generally what is going on within the group.

I mean, in addition to members of the visibly elite, to include among scholarly researchers the common garden variety Ph.D. holder who reads a lot, thinks too, and writes, although maybe he does not get what he writes into 'documentary' form very often. Such people abound in colleges and universities across the United States. The largest portion of their writing may be in the form of lecture preparation notes and as advisory notes to term papers and/or tests from students in classes they teach. These people are not so highly visible on a national scale as are the members of the 'invisible colleges', but they can be observed in lots of places, essentially, or hopefully, wherever there is an institution that considers itself one of the academies of higher education. The names and credentials of some of them can be found listed in the various volumes published under the Jacques Cattell imprimatur, e.g. Directory of American Scholars, American Men and Women of Science.

In a way, this very large group of certified researchers provides, through the courses they give and the relationships they develop with students,

a very valuable link to the research that goes on nationally. These academic leaders form the final funnel for much of the information of a 'higher' nature that trickles down to the students in such academies. This is especially so if, as I think to be the case, many undergraduates read very little, and then only what has been assigned by their instructors. Because this group is readily perceptible, if one only looks in the right place, but also because the individuals in this group are not so clearly distinguished, a designation for them as a whole may well be 'the translucent college'.

These very important people do read a lot and arrive at documents through other means than through subject indexes supplied by librarians and other information handlers. The kind of independent researcher I have in mind may well get to a document through reference to it in another primary document. As many user studies have shown, this is quite commonly the way an experienced reader follows a topic through documents, especially, I believe, the reader conducting research, hence doing a lot of reading.

In the three figures of 5, I symbolize the writing, reading, and referring research processes once again based on the Heilprin-Eichman model of stored communication. As before, I show the various states of completeness of view of the processes of reading and writing. Figure 5a already has an author symbol attached to a new DOC-X, which contains reference to DOC-Y. Figure 5b adds the reading that AU-X must do to be able to make reference to DOC-Y, and 5c completes the picture by designating as AU-Y the originator of the message contained in DOC-Y and used by AU-X.

Notice the outward similarities between the models of the indexing process in 4a, b, and c, and that of the process of authoring in 5a, b, and c. Notice that both in indexing and authoring a person writes a new message that refers to his reading of DOC-Y. The referral to the location

of DOC-Y within the text of each type of document, in the index and in the second document, DOC-X,will be fairly similar in form, since participants in search and research processes, indexers and authors, more or less agree on style of documentary reference. However, the message of DOC-X will often differ in its reference to DOC-Y in a way very fundamental to the research process from the standpoint of a person wishing to read DOC-Y for further research. As indicated with the inclusion of the phrase judgmental along with locational on the double-line about arrow connecting DOC-X to DOC-Y, there is, more often than not, I believe, either an implicit or explicit value judgment made about an original document in the message of another original one citing it.

Another important difference between a subject index and a referring document as with DOC-X is the manner in which TOPIC-A is dealt with in the text of each. As we have seen before in discussing the representation of the references to topics found in indexes, it is easy to view TOPIC-A as the words that stand for it in the message text of the subject index. In whatever way it is that an indexer decides that DOC-Y contains something about TOPIC-A, he will generally symbolize it with a concise symbol or group of symbols. When one looks at the text of DOC-Y, one may or may not find the symbol or group of symbols the indexer has used to symbolize TOPIC-A. If the indexer has done a good job, then other people reading DOC-Y will agree that it contains something about TOPIC-A. To prove the thoroughness of the indexing of DOC-Y, one has to find agreement that in addition to something about TOPIC-A there is also material about TOPIC-B, TOPIC-C, and TOPIC-D in DOC-Y, i.e. all the subject statements the indexer has assigned in indexing the document.

A simple-minded searcher coming to DOC-Y looking for something about TOPIC-A and coming across material that is about the other topics as well

may think that the indexer has done a sloppy job of categorizing the text of DOC-Y, a trap I often find myself falling into on those few occasions when I use a back-of-the-book subject index in a book in one of my specialty fields. A less simple-minded view would acknowledge that TOPIC-A is included in DOC-Y along with the other things found discussed there and would assume, or at least would probably hope, that the indexer had seen the total picture also and had captured the essence of the document with the topic statements he chose. I believe that a lot of people who use subject indexes as their main tool for access to research literature do hold a more simple-minded view similar to the naive view of representation I have described above.

In figure 5c (and 5a and b also) I have symbolized the contents of DOC-X with different topic statements than those for DOC-Y, oversimplifying again the aboutness relation of the text thereby, but also hopefully stressing the difference between a second, referring document and an index. The difference in form between topic statements in the document's text and the index's text is indicated by enclosing the topics of the second document within one rectangle as a message unit as opposed to the separate rectangle for each topic statement of an index as in figure 4c. It might be good to recall at this point the static view of the subject index as in figure 3. A subject index covering both DOC-X and DOC-Y would list all the topics in both documents and make references to the appropriate documents with each topic reference. In the case where there is sharing of topics, e.g. TOPIC-A, TOPIC-C, the index will make reference to both DOC-X and DOC-Y with each shared topic.

In figure 5c I have indicated that DOC-X contains text about TOPIC-A, TOPIC-C, TOPIC-E, and TOPIC-F. I could have shown an example with the

same topic list for DOC-X as in DOC-Y. Indeed, different authors sometimes write about the same kinds of things in much the same way, perhaps making just some fine distinction between them, a distinction unimportant to general subject indexing but perhaps very important to the researcher. However, authors also write their own messages about the world and often include only some of the same topics that someone else has covered in a document they have read. The resulting dispersal of topics may cause scatter headaches for the librarian who likes to keep every topic neatly filed, but such a state of affairs cannot be avoided without a stifling regimentation of research.

I symbolize different topics for the two documents in 5a, b, and c, as I believe that case is more typical than completely co-extensive documents, or at least so it might seem to a researcher who is not required -- as is the indexer as part of his job -- to say in a few short statements what the topic of a given document is. What the researcher does when he authors a document is say what he wants to say about whatever topics he is currently writing up. In doing so he may make reference to previous work in the same area, more or less well defined.

When a reader uses DOC-X, he will not necessarily find TOPIC-A covered first, then TOPIC-C, next TOPIC-E and finally TOPIC-F. He will no doubt find a coherent text that might or might not be separable into sections relating to those topics. Nonetheless, if DOC-X is related to DOC-Y through inclusion of material about TOPIC-A, then when the portion of the message of DOC-X is more or less about TOPIC-A, there might well be explicit locational reference to DOC-Y, and not just to ways of finding the general location of the document, but also, in many professional scholarly styles, to the specific portions of DOC-Y that refer to TOPIC-A, although the style

and extensiveness of citation varies from author to author, from academic discipline to academic discipline, from journal to journal, and from publisher to publisher.

Primary document reference can be more valuable than the usual general subject index reference for someone interested in reading about TOPIC-A because it includes textual reference to TOPIC-A in two documents that include discussion of the topic in and among discussion, on the one hand, in DOC-X of figure 5c, of TOPIC-C, TOPIC-E, and TOPIC-F, and on the other hand, in DOC-Y, among discussion of TOPIC-B, TOPIC-C again, and TOPIC-D. Because of the nature of the texts of researched academic messages, all of these topics are probably well related in one way or another. Finding topics discussed this way in at least two documents will probably help the researching reader zero in on TOPIC-A from a wider standpoint than the simpler-minded, 'What are the facts about TOPIC-A?'

Furthermore, because researched articles usually contain reference to more than one other document, a whole network of citations related in some way to TOPIC-A may open up to the reader who stumbles upon or is directed to at least one such document. Such a network of citations is what makes the citation indexes from Philadelphia work for the researcher, about which topic more below. Citations only work, however, for the document user who is interested in following up on and reading whatever references are made by the document's author. Not all other works cited will be directly useful, but they will at least help provide an understanding of what point the author doing the citing is trying to make. Understanding the background of an author's claims so that an evaluative judgment can be made is a key aspect of critical research. Critical research involves much more than the fact finding that a popular view of science seems to hold as representative of scientific research.

Critical Research

Now suppose again that we have a person searching for some material on TOPIC-A. We can symbolize this person as in figure 6, where I have tried to indicate through use of a conventional cartoon device that this person has TOPIC-A more or less in mind. How he got to that hazy condition is a fact of his life. This person is now wanting to find something he can read about TOPIC-A, that is, he wants to make connection to his IN-sensors that will bring some information to process inside his mind along with his foggy notion about TOPIC-A. I assume further that this person, after reading about TOPIC-A, intends to, or is required to, if possible, control his OUT-organs and create a message potentially for storage, which will come to be known as DOC-Z. It is for this reason that I have labelled the personal symbol in figure 6 AU-Z (potential).

If this person is unfamiliar with the primary literature concerning TOPIC-A, he may go to a subject index, which he perhaps views at this point as a static device as in figure 3, scan its list of subject statement entries, and, assuming he can match his more or less foggy notion of TOPIC-A with some entry on the list, be led by the index to DOC-Y. When this searcher gets to DOC-Y, he will then have the problem of finding relevant discussion of TOPIC-A, which, depending on the topic and the document, may be more or less easy to do, as discussed above.

This same person symbolized in figure 6 may have come across DOC-X, perhaps by accident in the current periodicals section of a library, in which case it may well not be indexed in a standard index yet, or he may get to DOC-X through other means, conventional or non-conventional, including even perhaps through a subject index in the manner described above, if enough time has elapsed since DOC-X was published, if it was published.

No matter how he gets to DOC-X, as symbolized in figure 5c, there he will find a citation to DOC-Y much like what he found also in the subject index, i.e. with indication as to where to locate DOC-Y. He will also probably find in DOC-X a wider discussion than what might be narrowly associated with TOPIC-A (as discussed in the previous section in connection with figure 5c).

Now if potential AU-Z is conducting research, which may include fact finding but also requires more thinking, he will probably appreciate and benefit from the discussion of TOPIC-A that he finds in DOC-X. He may disagree or agree with AU-X, but at any rate he should appreciate having reference to another text created by another author concerned with TOPIC-A. Indeed, if this person were conducting only a fact finding search, he may be satisfied with what he finds in DOC-X and not wish to look further into DOC-Y except perhaps to see whether AU-Y agrees with AU-X, something he may already know from having read DOC-X's judgmental reference to DOC-Y.

Checking back on cited sources is a rather basic aspect of research which graduate students are normally expected to know about. Again Morton Fried's guide to the study of anthropology states this aspect well. In a discussion of the evaluation of papers written by prospective graduate students, Fried says,

> . . . there is increased expectation that statements will not be taken as fact simply because they appear in print. Graduate papers should display a critical attitude toward the information used; they should reveal the interest of the student in the methods used to obtain the original data, and some curiosity about the logical tools employed in manipulating them. One expects to find an awareness of theoretical sets, whether apparent or latent. In other words, graduate students, much more than undergraduates, must show sophistication in assessing

> the biases that produced the work on which their papers rely. [Fried digresses briefly to assert that undergraduates also can make critical judgments, and then he continues.] One way of accomplishing this, as suggested earlier [cited above], is to do research [emphasis Fried's] on the critical statements found in the work of others that supplies the main basis of the paper in question. This means digging into learned journals to find reviews or critiques of that work, checking out the author's sources, trying to find other accounts of the same phenomenon. Even if the student lacks the expertise needed to make an authoritative decision about truth, it is possible to indicate the basis for acceptance or rejection of the statements in concern. [18, pp. 196-197]

What Fried is describing is partly the rites of passage from student to researcher, perhaps also from searcher to researcher. It is no linguistic coincidence that one way a person can come to be considered an authority is to author something. To become a published author, one has to accept careful scrutiny of the text of a message one wishes to send to the world. Part of this scrutiny one does himself as a part of the research in preparation for formulation of the final text. The checking and verifying described by Fried is an essential part of that research. Researchers may use a subject index as a guide to that research, but usually, I believe, only, if at all, in the early stages of research for getting started and perhaps then later to do some looking anew at the topic of research in an attempt, as Fried says, "to find other accounts of the same phenomenon" after already having formulated a definite opinion.

Both the researcher and the indexer must read and understand the message of a document they are dealing with in order to be able to fulfill their professional tasks, allowing, of course, for the normal misunderstanding that occurs in the course of human events. But what the researcher and the indexer each does with the understanding of a text are quite different things. This difference is stated well in a philosophical tradition concerning the understanding of what philosophers like to call the proposition of a statement, what we might call the 'aboutness' of the message texts in our context. The philosopher G. E. Moore made a three way distinction in what a person can do after understanding a proposition -- believe it; disbelieve it; or neither believe nor disbelieve but simply understand it. [24, p. 56]

The researcher in the present analysis has at least the first two options and may even exercise the third, suspending judgment until further research can allow him to make an evaluation.

The indexer's professional role allows him only the third option. His task is to construct a device to point accurately and meaningfully to whatever document he is indexing. As a critical person, the indexer may exercise either of the belief options, but his professional duty requires him to create a simple message that fairly represents the contents of the document's message text through his understanding of that message.

It may well be that an indexer with a less personally committed view of a text can perform a more efficient job of simply understanding the text and representing it with general subject statement indicators than can a committed researcher. That is to say, subject experts may not be detached enough from a field to make the simple understanding required in indexing. I do not mean simple here in any perjorative sense, because having to do a

quick read of a long or short, more or less dense text and then come up with a short statement or series of statements giving good indication of the contents of that text is not a simple task. The simplicity is even less apparent when one realizes that an indexer performs such a task on several texts each working day for perhaps many years. The individual task with each text is just less complex for the indexer than for the researcher who must make that text and its contents fit into everything else he knows about the perhaps very narrow TOPIC-A. The latter requirement is the critical review which is a part of the research process.

Librarians who deal with documents as individual items are less aware of the internal connections because of the lack of a requirement to deal professionally as believing or disbelieving whatever is contained in the text of the document's message. Such detachment from the contents of a text leads, I feel, to the view of the inherent separability of text and references that I criticized at the outset. The uncritical attitude is carried to an extreme when librarians and other information handlers worry that citations may be to other works that an author wishes to refute, thus, I guess, making the information handler's analysis of citation practices less than an ever upward, positive and progressive view of the development of knowledge. [12, p. 309]

I sense among librarians an attitude toward written works that is reminiscent again of Fried's description of the undergraduate student who has not as yet developed critical abilities, and perhaps never will:

> Students sometimes take the position that a paper deserves the optimum grade if it does not contain factual errors. Further, it is felt that such errors are unlikely if the paper was based on many seemingly

> highly regarded books. Viewed that way, the main point of a research paper is missed or distorted. [18, p. 116]

Fried describes an attitude I also have found in papers of many of the undergraduates I have taught. I believe that underlying this attitude, and the uncritical attitude I find in many librarians, is some kind of belief in the existence of an independent authority that deems whatever is in print to be the God's or gods' truth. In truth, the research gods are the mere mortals who are creating the message texts that get published. The veracity and validity of their statements are ascertained only by the continual close and critical scrutiny of those texts.

It is because of the interconnection between texts that is revealed through citations that citation indexing can provide a means of finding documents on specific topics. It is because of the lack of understanding of the nature of research going into the preparation of scholarly academic texts that the importance of citations to a researcher is often misunderstood, primarily, I believe, by librarians and others uninitiated in the critical attitude required for research. Viewing citation indexing through the model that I have used in analyzing the processes of subject indexing and authoring in figures 4 and 5 should help explain also how citation indexing can produce a product useful to the researcher.

Citation Indexing

With figure 7 I have added the representation of a citation indexer and his processing and product to the model from figure 5c. I have not taken it through stages, as with 4a, b, and c and 5a, b, and c, for two reasons. First, my reader by now should be able to follow the diagram in figure 7 based on his having plowed through my material up to this point.

Second, citation indexing is not a very creative process in itself. The reading and writing required for it are much more elementary than those processes required for authoring and perhaps for subject indexing.

Citation indexing lends itself much more readily to mechanical processing than subject indexing because it mostly, if not entirely, copies and/or systematically reduces the citational and title information of the work being processed. Whatever reduction is possible depends on the redundancy that is a very important feature of the communicative potential of language. This kind of indexing is essentially a parasitic process that depends for its simple success on the creative activity of an original author in selecting a title for his own document and in making careful reference notation, including locational information, to other documents. Citation indexing's parasitic nature is revealed quite directly in a suggestion made by Eugene Garfield of a project for library school students. [25, p. 399]

The three types of indexes to research literature provided in the series from the Institute for Scientific Information, the source index, the citation index, and the permuted title term, or quasi-subject index, are produced by ripping off and redisplaying the externally appearing components of an author's text, the title and the reference citations. These portions of the document's text, when their connections to other texts are shown as they are in citation indexing, can be very useful to a person initiated in doing research, especially to one who is familiar with the topics covered in those texts and with the authors and/or works of the authors doing the citing and being cited.

Once again contrasting a static view with the view presented in figure 7 may help clarify the difference in attitude that librarians and researchers

might have toward citation indexes. A view as in figure 8 is what people uninitiated in research may very well have and may be a quite common and understandable way for any user to approach citation indexes.

Each time I go and pick up one or the other volume of the ISI series I have to stop and think about what I am doing in trying to find something there. I have trouble remembering, if I have not used them for a while, whether the source or the citation volume is where I want to look. Trying to remember by attaching the label 'source' vs. 'citation' in my mind does not always help, because my experiences with these valuable tools have shown me that I can find leads for my research in any of them. Once I get started in one, my knowledge of research processes and of the subject field I am working in allows me to thread my way to useful references through all three of them. The permuted title index is probably the least confusing of the three, because titles are used quite widely as clues to the contents of documents. The older central European cataloging tradition known as the Prussian Instructions made use of rules for the selection and control of content words of titles as a means of subject access a long time before the incorporation of the institute in Philadelphia.

The potential confusion between source and citation is well symbolized, I believe, in the static view of figure 8. The connections between the text of the citation index's message and both of the documents that are internally connected to each other are of the same character. That is to say, the message that the citation index conveys is that located in DOC-X, itself located at such and such a place, is reference to DOC-Y, which itself is located at such and such another place. The message of the citation index simply interconnects locations of texts which the author of the most recently produced one of them thought were somehow related. There is no

attempt by the citation indexer, beyond repeating and in part juggling around the titles of the interconnected documents, to tell a potential reader of the citation index's message what the processed documents' topics are.

The processes of citation indexing contrast greatly, from the standpoint of the intellectual processing required, with the service the subject indexer provides when he reads portions of the text of a document and, in addition to repeating locational and title information, makes an independent decision about the topic content of the document's message and represents that content, as he views it, with a new subject statement, in effect writing another symbol or string of symbols, or even several, much like what the author has written as a title. In fact, the author may also have written other such subject statements as headings of sections and sub-sections of his document. The clever subject indexer may even take advantage of these sub-headings in writing subject headings as part of the indexing process and thus also be more or less parasitic like the citation indexer.

The differences that do exist in the requirements for processing of subject vs. citation indexing may be well understood by librarians, but the value of citation indexing to researchers is underrated by librarians, partly, I believe, because of the intellectual commitment subject indexers have to subject indexing and partly because of the librarians' failure to grasp the intellectual commitment that researchers have to their research. Perhaps hypothesizing a potential user of citation indexes, as I did above with figure 6 for a potential user of subject indexes, will help provide an understanding of the usefulness of citations to experienced researchers.

The Knowledgeable Researcher

For the hypothesized potential user of citation indexes I use the personal symbol I have used before but this time label him AU-Z. For these examples I assume that this is an experienced researcher, most obviously a person who has authored at least one researched document, e.g. the holder of a Ph.D. for which the person has produced a dissertation. This is not intended to suggest that all researchers must have Ph.D.'s. A researcher should be understood to understand what Fried says a graduate student must understand.

A researcher who is committed to a more or less narrow field can approach indexes with more in mind than the foggy notion of TOPIC-A as symbolized in figure 6. Indeed, researchers have probably categorized in their minds lots of rather hardened notions about certain topics. But our symbolic researcher will be assumed to be coming to an index with something open in his mind about TOPIC-A.

In his mind the researcher might have associated with TOPIC-A a certain document in which he has read about that topic. Figure 9a represents what AU-Z may thus have in mind where DOC-Y is the document he remembers having something about TOPIC-A in it. He may go to the citation index, viewing it as in either figure 7 or figure 8, and find there that DOC-Y is referred to in DOC-X, which we know is the result of AU-X having read DOC-Y and having referred to it within the text of the message he has written for DOC-X. The citation index tells AU-Z where to find DOC-X, or at least gives him a start on that path, and, if he does not remember, how to get back to DOC-Y also.

I believe that the situation described in connection with figure 9a is, however, less typical than the way a researcher would usually approach

topics through a citation index. More typical, I believe would be either of the situations represented in figures 9b and 9c.

Figure 9b represents the association in a researcher's mind between a certain topic and another researcher, whom he may know personally, whom he may have met as a graduate student or later at disciplinary conferences and/or other colloquiums, or however it may be that researchers come to know personally the other researchers interested in their narrower fields and with whom they may eventually form their own 'invisible colleges', by which means they keep their interpersonal communication private for a period of time.

A less directly personal, though equally strong attachment in an independent researcher's mind may build up just from having read a lot of the documents that a like-minded researcher has authored, in whatever form they might be, overt or covert. Such practice may even lead the researcher to imagining what the person being read must be like. In the field of linguistics there is a well-known anecdote demonstrating mistaken assumptions scholarly researchers can make about others whom they know only formally through reading their documents. In this instance, an older colleague had vastly overestimated the age of a younger man, whom he asked, when they met, if by chance the younger man were related to the famous scholar, himself, in fact. [26, pp. 2-3]

The more formal, though also quite personal association in the mind of one researcher for a connection between another researcher and a topic through documents the second researcher has authored may be better represented by figure 9c. I have included here more than one document for the remembered author, AU-Y, as I believe that this is the more typical situation in the formal kind of personal relationship to researchers and their documents

that I am talking about here. AU-Z in figure 9c has two definite places to start from in a citation index, which, if AU-Y has written two actually different documents dealing with TOPIC-A, might lead AU-Z into a somewhat overlapping but potentially very finely discriminating analysis in the literature of TOPIC-A. The references within the references lead to still other references, and AU-Z becomes faced with the old familiar problem of when to stop looking at references.

AU-Z probably knows the territory of TOPIC-A, because he is probably somewhat of an authority in it himself. The knowledgeable researcher can fill in from his prior research some or all of the things about the original documents he has read, which could be symbolized as in figure 5c, and beyond even what the citation indexer copies, as symbolized in figure 7. Because of this research knowledge, figure 8's view of the citation index fails to represent what the researcher can read into the information he finds in the citation index. In fact, it is a distortion to leave figure 9c in isolation as representing what the researcher knows about TOPIC-A.

Assuming that AU-Z is a published authority on TOPIC-A, he probably has in his memory some kind of representation of at least the elements I have symbolized in figure 10. The question marks at the end of the observed and read arrows leading into the memory's representation of AU-Z's production of DOC-Z have the potential of leading back to all the experiences that have gone into AU-Z's development leading up to the document. The question mark at the end of the locational and judgmental about arrow represents all the documents which AU-Z actually referred to in the document he produced, two of which might have been DOC-Ya and DOC-Yb of figure 9c, though it does not necessarily represent all that AU-Z has read, only those documents he cites.

I leave what is represented by the question marks in figure 10 unspecified because trying to symbolize a typical example of a research article in this display could result in a diagram for AU-Z's memory even more complex than those diagrams in citation analyses that merely show the general interconnection of journals in a discipline resulting from calculating the actual references that research authors of the discipline have made, e.g. [27]. In addition, the researcher's memory for the experiences and documents may be more or less clear, depending on closeness in time and interest and other factors affecting individual memories, and the question marks are meant to suggest also the possible haziness of memory.

The Memory of Research

Human memory is thought to involve structures that are somehow associated or interrelated to each other in rather startling but somewhat predictable ways. This is not the place to go into all the details of the controversies in those disciplines concerned with human memory, but a couple of lines of research in the field seem fruitful as lines of inquiry for the explanation of memory operations of the scholarly researcher.

In the areas called human information processing and, more recently, cognitive science there are working hypotheses concerning a two-fold principle to the structure and operation of human memory. These two aspects have been labelled by one researcher, Endel Tulving, episodic memory vs. semantic memory. In the work where he put forth his hypothesis, and which can serve as the starting point for anyone wishing to cycle into the literature on the subject, Tulving defines these two aspects of memory as follows, "Episodic memory refers to memory for personal experiences and their temporal relations, while semantic memory is a system for receiving, retaining, and transmitting

information about meaning of words, concepts, and classification of concepts." [28, pp. 401-402]

There is not agreement among researchers on human memory about Tulving's hypothesis. For example, one author finds it "questionable whether a distinction based on anything as subjective and phenomenological as personal reference is either viable or appropriate," and claims further that because "all memory is surely based ultimately on personal experience, it is hard to see what is gained by assuming different memory stores depending on whether the personal reference is or is not recalled." [29, pp. 317-318] Another researcher reports thinking

> . . .that semantic memory really is a misnomer and furthermore that the distinction between semantic memory and episodic memory is wrong. Once lexical memory is separated out, the resulting conceptual memory is basically episodic in nature. Definitions of words are part of lexical memory. Consequences of events involving concepts are part of episodic conceptual memory. Associations between concepts are limited to the way concepts can relate within complete action-based conceptualizations. Supersets are mostly artificial constructs with definitions in lexical memory and without a place in the episodic conceptual memory. [30, pp. 263-264]

Despite the lack of consensus on the structure of human memory, Tulving's view is useful in discussing the memory of the scholarly researcher.

Traditional documentation with its two way split of subject vs. descriptive cataloging or indexing may reflect the hypothesized two part storage principle in human memory structure. The contents of the message of a document, the topic, the subject, the semantic interpretation --

whatever you want to call it -- carries the meaning of the message that the author has created. The externals of the document, e.g. its publication date -- a temporal notation -- its location, and especially the reference citations, carry traces of some of the episodes in the researcher's life as he went about creating for himself, by means of reading, observing, and talking to others of a like mind, the knowledge stored in his mind and which stands behind the authoritative documents the researcher produces.

A seemingly simple external bit of locational information, e.g. the journal in which an article is published, the conference where a published paper was read, or the publishing company which has put out a book, can be a trace to the author's memory of writing, getting into pretty form, submitting, receiving back from an editor, rewriting, resubmitting, proofing, quickly mailing back corrected proofs even though feeling he could still change a paragraph here and there, finally proudly seeing the intellectual work in print, and distributing preprints and reprints therefrom to like-minded colleagues, perhaps with accompanying notes explaining his more recent thoughts, which might be the basis for more communication and further publication. With a conference paper, the author may have had the opportunity to discuss it immediately with other 'authorities' present listening to him. An author might be reminded of these processes, in addition to the semantic contents of his published messages, each time he lists the simple externals of title, location, and date of his works on a résumé or grant proposal or each time he sees such a citation to a document of his made by someone else in one of their documents. The processes of creating intellectual products through scholarly research are not simple. They are also often very lonely processes, visible to no more than a few of the author's inner circle of acquaintances, formal or informal.

The memory for and critical attitude toward one's own carefully constructed creative works are not unique to the scholar; they are shared by skilled

craftsmen. In an interview taped and transcribed by Studs Terkel [31], a stonemason reports his attitude towards external structures he has built:

> There's not a house in this country that I haven't built that I don't look at every time I go by. (Laughs.) I can set here now and actually in my mind see so many you wouldn't believe. If there's one stone in there crooked, I know where it's at and I'll never forget it. Maybe thirty years, I'll know a place where I should have took that stone out and redone it but I didn't. I still notice it. The people who live there might not notice it, but I notice it. I never pass that house that I don't think of it. I've got one house in mind right now. (Laughs.) That's the work of my hands. 'Cause you see, stone, you don't prepaint it, you don't camouflage it. It's there, just like I left it forty years ago.

The modern scholar's writ is not set in stone, but what he has committed to printed publication is quite permanently set in type and correctable only with later publication, if at all. The scholar's published products are also always on public display much like the stonemason's products are:

> My work, I can see what I did the first day I started. All my work is set right out there in the open and I can look at it as I go by. It's something I can see the rest of my life. Forty years ago, the first blocks I ever laid in my life, when I was seventeen years old. I never go through Eureka -- a little town down there on the river -- that I don't look thataway. It's always there.

When I go into a library I have never been in before, I find it hard to keep from 'looking thataway' -- looking to see if the library carries the journals in which my first public pieces of scholarly work are printed and perhaps to look at the actual works with pride once again even though I know there are some small things I might change in them.

I can well imagine that a librarian doing original cataloging cannot come across one of the cards in the catalog which he has prepared and which represents the end product of a solution to a particularly difficult cataloging problem without remembering some of the details of that problem and its solution and reflecting with pride on the card as it exists as a trace of those intellectual processes, even though few people, if anyone else, will know who is responsible for it and what all stands behind its production.

Individual human memories vary, and the ability to recall the things and processes I symbolize for the scholar in figure 10 is not always easy to tap. Societies without external storage devices usually have an oral tradition of cultural transmission conducted by a limited number of persons, chosen perhaps because of their memory abilities, whose main function in society is to recall and help preserve the society's tradition. The next step in cultural development includes using some external device to record the knowledge that is so hard to recall from internal storage. Societies that develop writing also usually develop an elite class, sometimes called scribes, whose main duty is to record the received wisdom and/or knowledge of the society. The tradition of recording knowledge externally has been developed over a long period of time in and among various cultural and sub-cultural traditions. One of these traditions is the scholarly research tradition, which itself has many subtraditions in the manner of recording knowledge.

With figure 11 I have attempted to symbolize a research author creating a message reporting an experiment and other observations within a tradition that calls for the message to be laid out in a topical format to include discussion of the problem, the theoretical set of the researcher, the method of experimentation and/or observation used, the results of applying

those methods, and a summarizing discussion with indication of possible implications and further applications. The formatting of research reports may be an informal, though well practiced tradition in some scholarly disciplines, or such a format may be canonized in individual journals as part of the code of instructions to contributors, e.g. "Organization: In general, the background and purpose of the study should be stated first, followed by details of the methods, materials, procedures, and equipment used. Findings, discussion, and conclusions should follow in that order. Appendices may be employed where appropriate." [32]

One of the reasons for structuring reports of research within a certain tradition is to allow like-minded researchers interested in the research being reported on to be able to judge the report through reconstruction of its background in their minds from reading the report and relating it to whatever else may be in their minds. Thus one of the author's reasons for structuring his report as he does is to attempt to communicate his findings most meaningfully to others. Another reason for structuring a research report may be so that the author can organize his own thoughts and record them for his own future use by applying them to an explicit recognizable structure. There may be various other reasons for researchers authoring and transmitting messages, but the result of these efforts is an external record of traces of some of the internal human processes of scholarly research within a tradition of long duration.

The memory traces that are part of a published research report are not by any means a complete inventory of clues to all that an author has experienced, read, and believes, even about the confined topic of the report. The author has selected the things he wants to report from his entire background and reports them within the tradition of his discipline.

A more complete record may be found elsewhere, in his personal memory, or in his lab notes and other preliminary works behind his published reports, but at least traces of those events and concepts important to understanding the author's point of view are on the public record for other persons to process.

The librarian or other information handler unacquainted personally with a tradition of research from the inside may have some difficulty understanding such a tradition because of its highly personal nature. Creative persons from within the information handling field may pick up certain aspects of traditional research processes and build their own productive structures based on the scholarly traditions, as did Eugene Garfield, whose citation indexing apparatus is a grand testimony to the usefulness of even minimal traces of the collective episodic memory of published researchers. In order to put the products of a collective memory to work, however, there must be individual humans, either experienced or neophyte researchers, reading, evaluating, and further using the documentary traces of the collective episodic and semantic memory recorded within the published works of other creative researchers.

It is difficult to replace human experiences and human memory structures for the processing of information. Those creative researchers in the field of artificial intelligence who have achieved a modicum of success in getting their machines to look somewhat smart, e.g. Winograd [33], Schank [34], have had to forcefeed human-like experiences and concepts into the programs in the form of scripts, frames, schemata, and other recipes.

Research Comfort

It has been reported that there is continued interest in question answering devices as one possible successful application of information machines. [35, p. 136] Such a machine is intended to retrieve facts in response to questions posed to it, sometimes after making inferences based on the machine's program and data files. These devices have obvious uses but are limited to answering questions to which the answers are 'known', i.e. acceptable to persons using the machines. Such machines are logical devices of the first order, but there are other possible worlds in the minds of men beyond those that can be agreed upon by all men.

To those persons uninitiated in pure research it might seem astounding that a great deal of joy can come from figuring out the areas of agreement and disagreement that lie beyond the field of facts and which may in part determine what are to be counted as facts to be marshalled in support of one theoretical position or another. Indeed, rational disagreement, as noted by one philosopher of science, Dudley Shapere, can be viewed as playing an important role in the development of science. [36, pp. 546-548]

There are various kinds of uses of documents in information systems. A Soviet information scientist,Y. A. Shreider, speaks of the task of an information retrieval system as providing comfort for the users of the system. Comfort is a pragmatic judgment and relates to the type of user making demands on a system. Shreider uses a term, translated as 'metainformation', to refer to the sum of devices and vehicles -- e.g. headings, abstracts, classification, etc. -- which "provides information about the position occupied by a document in the system of scientific and technical documents, i.e., information about information, or metainformation." [37, p. 2]

The translation of Shreider goes on to describe two possible but quite different uses of information systems:

> Different information users have different ideas of the comfort provided them by metainformation. There are two juxtaposed user situations. In one the best metainformation is the information that most completely and precisely describes the particular user's specific information need. Such a user experiences comfort from the fact that the metainformation he receives has taken away the burden of deciding the usefulness of some secondary information. The student obtains the textbook suggested in the program; the designer obtains the suggested list of the literature; the supervisor obtains a reference about the latest achievements in science and technology and in the field for which he is responsible, etc.
>
> The opposite situation is when the user feels comfort as the possibility of himself trying to comprehend the information. For this user useful metainformation is not that which defines the sphere of his needs but that which is a good guide to scientific information fairly removed from the area of his immediate interests. For such a user the comfortable information environment is the library with open shelves, it is a group of scholars in allied fields, it is a dialog information system with the capacity to make remote semantic associations, etc. [37, p. 2]

The second type of user, for whom the possibility of becoming acquainted with other, perhaps remote, semantic worlds seems most comfortable, is, in the scholarly tradition, the knowledgeable researcher.

The scholarly researcher happens often to work in an information environment in the academic library which must try to serve his comfort while at the same time serving the comfort needs of a different type, those of the student who is satisfied with finding the required or suggested textbook -- or something close to it -- or other items on a reading list for the course or courses he is taking. An ironic condition for the scholarly researcher is that he is often caught in the web of both types of comfort demands. He is desirous of comfort of the second type but also necessarily provides some of the comfort of the first type through the reading lists and textbooks he may assign and/or even write for use by some of the students under his influence.

Librarians who think they can become the master information comfort providers for all possible users must not make too universal an assumption about the nature of any one user's demands. Most fundamentally, academic librarians must realize that creative researchers using their libraries are not seeking just answers to questions but also may be looking for holes in the system of knowledge which they can fill themselves or may be looking for unique ways to interpret what is 'known'. Creative researchers are elegant question posing devices. Through their research efforts they provide many of the answers that seekers of comfort of Shreider's first type would find acceptable.

At least some people within the field of information science in the United States must be in on the secret of knowledgeable research. In his prize-winning book, Michael Arbib introduces his section of references and suggestions for further reading with the following advice:

> Before giving a detailed bibliography, we devote a paragraph to each chapter of the book, suggesting material which may

> interest the reader who wishes to read further the themes of that chapter. No attempt has been made at completeness, and readers wishing to pursue the matter even further should go to a good college or university library and browse through books on the shelves adjacent to books cited here, and look at other issues of journals containing cited articles. To follow up a book or article of exceptional interest, the reader should refer to Science Citation Index, a quarterly that lists, under the title of a paper, all those papers which have been published in the previous three months and in which it is cited. The list of references [in Arbib's book] also contains numerous papers not cited in the text which will provide useful leads for further reading. [38, p. 223]

No better advice could I give anyone wishing to begin emulating the outwardly observable information seeking behavior of a scholarly researcher in the academy than the way Arbib suggests following up on leads. The challenging side of research begins when the researcher must read, evaluate, and assimulate information -- processes not very observable or mechanical. Research information processing is not even usually so segmentable, since the gathering process continues throughout as leads to be followed up on are found in the midst of reading, evaluating, and assimulating other texts. Tentative evaluations might also be reevaluated as new views are found in the leads followed up on. And so on.

Academic research comfort comes not from getting done with intellectual problems but from being able to continue with them. The challenge of scholarly research in the academy is not suited to every person's tastes.

Conclusions

In my attempt to explain some aspects of scholarly research which I think are important for academic librarians to understand, I have used an iconic model whose simplicity has allowed me to draw attention to some of the intellectual processes shared by indexers and authors and to ways in which the individual tasks of such persons are different. It is more than just the lines in the model, however, that allow me to use it for my purposes. I have found it necessary to label the parts of my model, and behind my labels lie certain assumptions which I have tried to make clear above in the discussion and applications of my model.

The particular model I have adapted for my use was designed by a man trained in physics whose work has led him into a deep interest in communication and information processing. His is not the only iconic model proposed for the fields of library and information science and will not be the last. There are, for example, two other authors who use models which, much like Heilprin's, are based more or less on the Shannon-Weaver model. A look at these models will help bring out the points I think make the model I have used better suited for understanding some of the library behavior of academic researchers.

One very elaborate model of the processes of communication is presented by Gernot Wersig [39, p. 109]. This model has symbols for separate bodies for communicator and recipient, but it also includes symbols external to the body for the mostly psychological processes involved in creating and understanding messages, i.e. intention, world-view, selection, pragmatic considerations, language encoding and decoding, etc., connected by a rectilinear progression of diagrammatic arrows. This diagram lays out many of the areas of interesting study for a total understanding of human communication, but the domains of

inquiry thereby implied lie far beyond what is necessary for understanding library use. Caution must be applied in the use of such models, the kind of caution Robert Fairthorne advised in his criticism of a model used by Harold Borko. [40, p. 91] Fairthorne's comments about the implied flow of arrows could apply also to Wersig's model, since recent psychological theorizing will hardly support a step-by-step rectilinear flow through the processes Wersig indicates with the labels of his model.

A simpler model which is closer to the one I use, in that it does not try to picture the psychological processes in any way except as controlling origination and use of documentary communication, is another one by Wersig [39, p. 182]. This model is segmented into processes of pre-documentation, documentation, and post-documentation, and as such could be useful for defining individual areas of concern for certain assembly-line type information processing. However, insisting on that segmentation for the complete process of the creation and use of documents would make it difficult to account for what a scholarly researcher knows about documentation, since there is no diagrammatic connection between the communicator who fixes a document at one end and who may then show up as a user using a document at the other end.

Another model meant to account specifically for the communication between authors and readers in an academic library shares the fault of oversegmentation that can lead to disregarding what a scholarly researcher knows about documents. This model, by Alan Taylor [41, p. 27], also ~~makes the~~ makes the mistake of symbolizing the processes of verbalization and encoding through writing as separate units outside the body of the author, though one would have to share my view of language to consider that a mistake.

There is little to which I would object in Taylor's model as a diagrammatic analysis of the system of editing, publishing, distribution, and selection of

materials that end up in his symbol for a library, to be used there by a reader. What is hard to make explicit using this model is the fact that the scholarly researcher knows a lot about most if not all of the processes. One can infer from Taylor's model that the symbolized author knows something about editing and publishing, since Taylor symbolizes him submitting a manuscript to an editorial publisher, and also that the faculty member knows something about selection in the library, since Taylor represents faculty in that process, but the possibility of connection between author and reader in the research process is not all that clear from this model that has all readers come to the library on an equal footing regarding the documents in storage there.

Taylor's model, with an added symbol for the catalog at the receiving end, would serve well for representation of the assumption I attributed as common to librarians in my discussion of Bates' reports above. When Taylor abstracts from the total picture and puts in the taxonomic detail of an academic library subsystem and its processes of selection, acquisition, cataloging, classification, circulation and reference, with the products of reference books, books and monographs, pamphlets, periodicals and magazines, newspapers, rare books, government publications, theses, and microforms, he describes fairly well the outward appearances of an academic library [41, p. 28]. Readers wanting to use the academic library so symbolized might then all be lumped together as persons who know about the various parts of this taxonomy in proportion to the visibility of the parts as determined by the library.

In fact, in his discussion, Taylor makes explicit the assumption that researchers have this general view of a library's collection mediated through the reference and circulation end of his model to the various genre channels backed up by the various technical services. Although this differs

slightly from Bates' claim that users interface primarily with the catalog, it nevertheless shares her mistake of putting all readers, for guidance into the literature, entirely at the mercy of the librarians who create and operate the structure. Taylor's assumption is stated most baldly when he conjures up an image of the library use of a research scholar, whom he had defined as "a graduate student conducting research for his dissertation or a faculty member pursuing postdoctoral research":

> [I]t is possible to imagine the researcher poised on the right-hand side of the model faced with the task of obtaining the knowledge he needs from the reservoir, which we postulate as lying behind the author, at the extreme left of the model. The channels in the model are rather like a maze, and, like a laboratory rat, the researcher has to make his way through the maze to the other side by the shortest possible route, avoiding dead ends wherever possible. [41, p. 18]

A little reflection by Taylor on his own model should have kept him from such an absurd image of the research scholar. Surely faculty who have helped select books for a library ought to be able to make their way back to at least a few books in the library quite easily.

Taylor's discussion [41, pp. 16-20] of the total communication system, of invisible colleges, and of the necessity of academic librarians to understand the total research process beyond the bibliographical research process in order to be able to render good bibliographic research service reveals that he knows more than what is implied by his model, but his model, pushing author and reader to extreme ends of the research process, ill serves such an understanding. Taylor may or may not know much about the research process, but his adaptation of the Shannon-Weaver model of communication for the academic library

accomplishes not much more than to present a little of the library world's received wisdom about its physical structure and some of its internal processes and a very limited view of the use of libraries, fortified in its imagery by behaviorist psychology's laboratory experiments with rats and in many of its assumptions by those of strict behaviorism.

I believe, despite the recently reported finding of a lack in interest in research and publication among a large number of the holders of library doctorates, a finding based on an attitudinal survey of such persons [42], the results of which lend to confirming Wasserman's critique, that nonetheless there is much potential wisdom in the library world. I hope I may have contributed to public display of library wisdom through my discussion and use of a slightly modified version of Heilprin's model for information science in a few aspects of academic scholarly research.

Heilprin's model fits in with the current of cognition now running more generally through parts of the world of intellect and has the added virtue of having been developed independently and intentionally to account for aspects of information use. His theoretical model has the further virtue of being simple and confined in its domain while at the same time being backed up by writings that make explicit the assumptions behind his theory. Heilprin's work, like that of many other physicists, is philosophically very pleasing. I believe it also has possibilities for greater application to the library and information worlds than I have made in this and in my previously published excursion [2].

The message unit standing for stored symbols in my figures does not have to be confined to the traditional book, journal article, index, or other printed form, but can be used to represent the storage device of a computerized information storage and retrieval system. In my adaptation of Heilprin's

model the reads designation would then need to include whatever skills and tools are necessary to get at the messages stored in such devices, just as one must have the traditional reading skill and tools, e.g. eyeglasses for many people, in order to use books and other printed devices. Intermediaries crop up necessarily to provide the skills and/or tools and to teach the skills, no matter what kind of reading is involved.

A possible advantage of applying the Heilprin-Eichman model to computerized systems is that insisting on symbolizing a person with a mind and body as integral for the operations of a system draws attention to the fact that what comes out of the receiving end of a system is based on and takes reliability from what some person has put in at the originating end, a truism which goes under the computer world's maxim as 'garbage in -- garbage out' and which I have known from earliest childhood as an oft-delivered maxim of my working-class father, 'Figures don't lie -- but liars do figure.'

This model, however, also could draw attention to the personal involvement in any mediating process along the way, as it does in the indexing symbolized in some of my figures. As applied to computerized operations, the symbolization in the model I use could draw attention to the programmers, systems designers, even the old-time key punch operators, and other persons involved in the transfer and reshaping of data through such devices. Any relativity in the reliance of users on the data supplied by such systems may be a result of the relative sophistication of users toward the data-creating end of the system. Just as academic researchers tend to rely on the recommendations of other original researchers for guidance in their research more than they do on the traditional subject indexers, my theory should predict that business and governmental managers probably rely more on their colleagues for guidance in making decisions than on the data that comes out of their management information systems, unless

the managers themselves have been actively involved in the process to which the data refer and/or in the shaping of that data in the information system. I do not have much experience as a government or business manager, however, and I feel I should at least read up on the reported experiences of persons of those traditions in order to begin to judge the accuracy of my prediction. That can be the project of another piece of speculative research that I wish not to pursue at the present time. My present text is done. Research goes on.

Acknowledgement

I wish to dedicate this paper to Laurence B. Heilprin, for reasons that should be obvious to anyone processing my text -- or even just my list of references -- and to express my love and gratitude to Alice Agler Eichman, who has supplied the other comforts -- not the greatest of which was typing most of the pretty copy -- that afforded me the research comfort necessary to complete it. I hope I have not done too much damage to his work or to her sanity.

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