precisely what you do specify in advance, and nothing more; if your specification is even slightly off, you may miss whole ranges of relevant material. You may also wind up with large numbers of irrelevant sources that happen to have the right key words in the wrong contexts.)

And it is easy to miss such relevant material because you have to guess the right words to search under, for there are no cross-references in key word searches to lead you to the right terms. There is no synonym control or "uniform heading," and no predictability of the choice between general or specific headings. The examples given in the chapter are relevant: a search that looked only for the key words "stepfamilies," "blended families," and "reconstituted families" unwittingly missed articles that used different words—"remarried families" and "reintegrated families." A search for "iron companies" missed those records with the words "iron foundry," one specifying "beef" missed "cattle," and so on.

A lot of the key word searching that is being done in the new computer indexes is thus not nearly as efficient as the Actual-Practice searchers think it is. They often believe that the databases give them "everything," regardless of which words they type in. Its failure to reveal the radical difference between two distinct methods of searching, using controlled-vocabulary subject headings on the one hand and natural language key words on the other, is one of the greatest deficiencies of the Actual-Practice model.

Nonetheless, in spite of its weaknesses, this model—just like all of the others discussed so far—does have its advantages. And the successful aspects of footnote chasing, browsing, and talking to colleagues must be integrated into any larger model that seeks to improve on such Actual Practice.

The Principle of Least Effort

The various models that we have looked at so far, especially when they are considered as structures for the actual physical arrangement of library resources, were all developed prior to the library profession's understanding of what may be called the Principle of Least Effort. This principle states that most researchers (even "serious" scholars) will tend to choose easily available information sources, even when they are objectively of low quality, and, further, will tend to be satisfied with whatever can be found easily in preference to pursuing higher-quality sources whose use would require a greater expenditure of effort. I do not mean to say that this principle cannot be discerned in prior models; but the lack of explicit emphasis on it has influenced the ways in which the models have been taught—or not taught—and their often suboptimal performance.

The Principle of Least Effort is not itself an overall model for the conceptual or physical arrangement or categorization of the materials available to researchers; but, now that librarians know as much about it as we do, it must be a design factor incorporated into any new model that would seek to go beyond the existing ones. This may seem obvious, but my experience is that it is not. What happens in the real world is that librarians are quite willing to pay lip service to the principle, but when its implications are raised (i.e., that existing arrangements and practices must actually be changed), then the principle tends to be dismissed as insignificant or insubstantial. For this reason the present chapter, and this book's bibliography, both seek to establish the reality of the Principle of Least Effort in information-seeking behavior in a way that cannot be casually ignored. Part of the reason for its neglect in practice up to
now is that the various studies and review articles documenting it have not been assembled with any cumulative force. Mere references to them are not nearly as persuasive as quoting from them (the latter entailing much more work, which explains its not having been done thus far). There are so many of these studies that the library profession truly does not need any more of them. What it does need, however, is a crystallized understanding of the information that we already have.

The point is this: if one is to create a model that makes use of what we now know about people's information-seeking behaviour, it must be a system that makes the best sources for researchers' inquiries, or at least the most promising avenues of research, easily available. In other words, if a system makes only some sources easily available—especially if those sources are very superficial or of poor quality—then it can do real damage to the quality of research, for it will encourage users simply to make do with whatever sources are readily retrievable within it, regardless of their quality or completeness.

All library systems are based on assumptions about what kinds of behavior can reasonably be expected from the system users. If these basic assumptions are wrong—if we assume that users will act in a certain way when they really will do no such thing—then any systems based on such mistaken premises will simply not succeed in connecting researchers with the information they need. What such systems will actually do instead will be to give their designers an excuse for blaming system failure on "user laziness." But shifting the blame for the problem is not at all the same thing as providing a solution. And if we are to do the latter, we cannot avoid our responsibility to learn the body of facts repeatedly established in the professional literature.

Before we get into the details of this literature, however, let me try to summarize it by means of a common-sense analogy. Let us compare doing library research to playing a pinball game. In a pinball game there are two factors, not one, that determine where the balls will wind up. The first is the skill of the players—their ability to manipulate the flippers and to shake the machine without tilting it in order to make the balls go where they want. The second factor, which is easier to overlook, is the overall slope of the gameboard itself. If the game designer were to change the slope of this surface by making it significantly steeper and also tilting it to the left side, then it would be inevitable and fully predictable that more of the balls would wind up in the lower left corner regardless of the players' skill or experience.

The Principle of Least Effort

What the professional literature on information-seeking behavior consistently tells us is that, of the two factors, the "slope" of the system is much more important in determining results than is the skill or experience of the information seeker. There are, of course, exceptions, but as a general rule of thumb, people tend to choose perceived ease of access over quality of content in selecting an information source or channel; that is, they usually follow the slope of the system regardless of whether it is leading them to the best sources. Moreover, they tend to "satisfice" (Simon, 1956), that is, to set moderate goals to begin with, and to stop searching as soon as these goals are approximated, regardless of the fact that they may be overlooking better material. This may sound irrational, but it is nonetheless true; it has been observed and verified repeatedly. Information seekers tend to follow a "principle of least effort," a "principle of least action," or a "principle of information-processing parsimony." The aggregate of literature on these points is substantial.

Victor Rosenberg (1966) concludes his investigation of information-seeking behavior by stating: "The results of the study [imply] that the ease of use of an information gathering method is more important than the information expected for information gathering methods in industrial and government environments, regardless of the research orientation [i.e., proficiency] of the users" (p. 1). And: "From the results of the experiment, it is reasonable to conclude that: (a) research and non-research professional personnel in industry and government do not differ to any appreciable extent in their evaluation of information gathering methods; and (b) the preference for a given method reflects the estimated ease of use of the method rather than the amount of information expected. These conclusions in conjunction with the results of observation studies imply further that the basic parameter of the design of any industrial information system should be the system's ease of use, rather than the amount of information provided, and that if an organization desires to have a high quality of information used, it must make ease of access [to it] of primary importance" (p. 19).

Peter Gerstberger and Thomas Allen (1968) reach similar conclusions: "A direct relationship is found between perceived accessibility of information channels and several objective measures of utilization, whereas no definite support is found for the hypothesis that the channels perceived highest in technical quality are those used most frequently" (p. 272). And: "Any assumption that engineers act in accord with a
simple instrumental learning model in which they turn most frequently to those information channels which reward them most often should now clearly be laid to rest. Engineers, in selecting among information channels, act in a manner which is intended not to maximize gain, but rather to minimize loss. The loss to be minimized is the cost in terms of effort, either physical or psychological, which must be expended in order to gain access to an information channel. Their behavior thus appears to follow a 'law of least effort' (see, e.g., Zipf, 1949). According to this law, individuals when choosing among several paths to a goal, will base their decision upon the single criterion of least average rate of probable work. . . . The implications of this finding are very important. . . . More investment in library holdings, for example, will be wasted unless at the same time this material is made more accessible to the user" (p. 277; see also Allen, 1977).

John Salasin and Toby Cedar (1985) conclude from their survey of 1,666 researchers, practitioners, and policymakers in the field of rural mental health services: "These findings are consistent with research showing that information sources tend to be chosen on the basis of perceived ease of use, rather than on the basis of the amount of information expected from the source" (p. 113).

An important review article by Saul and Mary Herner (1967) notes (citing Columbia University, 1966): "In all, descriptions of 1,036 'episodes' were collected. These were analyzed, tabulated, and types of information were correlated against the means by which obtained. The preliminary results, described in the interim report, tend to confirm the oft-observed conclusion that scientists and engineers follow those paths in seeking and obtaining information that place the smallest amount of strain and effort on them" (p. 8). Also (citing Kenney, 1966): "The sample of interviewees consisted of 75 users of International Labour Office documentation services. The interviews dealt with the mode and degree of available services, their shortcomings, and user preferences and habits in regard to card catalogs and indexes. . . . The obvious conclusion, confirming Rosenberg's findings [1966], is that people do not like to work too hard or travel to any extent for their information, even at the risk of losing some" (p. 29).

Esther Bierbaum (1990) reports: "In an extensive examination and content analysis of journal articles about the information behavior of scientists, Herbert Poole [1985] found that 43 of 51 studies (84%) directly exemplified least effort and pain avoidance" (p. 18).
scholars attach to convenience" (p. 41) in doing research in all fields (sciences, social sciences, and humanities). Dierdre Sturm (1984) reports similar results in a study of the information-seeking practices of art historians. Maureen Pastine (1987) notes the same practices among other humanities scholars.

Mary Ellen Soper's article "Characteristics and Use of Personal Collections (1976) observes, regarding scholars' behavior: "Both evidence and informed opinion support the assumption that ease of accessibility to information affects its use, quite apart from the value of the information. . . . [A] seeker of information, for whatever purpose, will go first to a source he perceives to be the most accessible to him. In spite of the possibility that the information he needs may exist in a more authoritative form elsewhere. . . . he will tend to be satisfied with what he finds nearest and not search further. The cost to the user of going beyond his immediate environment may outweigh the cost of using sources that are judged inferior by other knowledgeable people." (p. 401).

The National Enquiry into Scholarly Communication's landmark 1979 study Scholarly Communication (described as the "[r]eport of a comprehensive three-year research effort conducted under the auspices of the American Council of Learned Societies") points out an extremely important fact (confirming Soper): most scholars try to avoid using libraries in the first place, preferring by a large majority to use their personal collections instead (pp. 133, 135). This finding is endorsed by many librarians, among them one quoted by William Paisley (1968): "The levels of frustration in using libraries are awfully high for most people. . . . [Y]ou are conditioned to feeling that the library is a place you almost have to drag something out of" (p. 18). Paisley also notes the "obvious solution": "make high-quality channels more accessible and easy to use" (p. 9; emphasis added).

Charles O'Reilly (1982) confirms the point that even professionals are not exempt from the Principle of Least Effort. In a review of the literature prior to presenting the results of his own study, he notes that "decision makers may choose information sources based on criteria other than quality of information. Corroboration of this fact is available from a number of studies. For example, in a now classic study Menzel and Katz (1955) demonstrated that physicians often learned of innovations in drugs, not from the most qualified sources such as reputable medical journalists, but from accessible sources such as drug salesmen. In a study of research and development scientists, Gerstberger and Allen (1968) also found channel accessibility to be an important determinant of use. Similar findings have been reported in studies of education, rural sociology, and the diffusion of technical innovations (Rogers & Shoemaker, 1971). Studies of this type have revealed that often the information source is chosen for reasons other than factors associated with quality. . . . It is important to note, however, that it is the accessibility, not the quality, of the source that often is the critical determinant of its use." (p. 758). And later, in discussing the results of his own study, he states: "It is important to note that accessibility predicts frequency of use independent of a set of other variables that might affect information usage, such as uncertainty in the task, education, and tenure in the job. These factors are significant determinants of use in some instances, but it is accessibility of the source that consistently determines usage." (p. 767).

Richard Miller (1986) writes: "Moreover, there is a limit to the lengths faculty will go to obtain information, even when the information is known to be highly important to research. The principle of least effort has been shown to have a major influence on faculty research techniques and attitudes toward using libraries. Briefly stated, the principle of least effort says that in any problem situation that admits of more than one possible solution, people will tend to choose the solution that produces a minimally acceptable result with the least expenditure of effort." (p. 463).

Edwin Parker and William Paisley (1966) point out: "Accumulating data have not been kind to normative assumptions of ways in which scientists ought to use information. We have been forced to broaden our investigations to include. . . . 'inefficient' and 'irrational' information-seeking, and so on" (p. 1061).

Further discussion and extensive documentation of the validity of the Principle of Least Effort may be found in the bibliography at the end of this book.

What are we to make of the mass of this literature? In brief, there are two conclusions that we cannot responsibly avoid. First, given a choice between a system of access to information that is perceived as easy to use and one that is perceived as difficult, most researchers will choose the easy path alone, regardless of the fact that it may offer lower-quality content. And second, even experienced researchers and senior scholars tend to follow the slope of a system that makes some channels easy and
The Principle of Least Effort

It is necessary to belabor the reality of the Principle of Least Effort for a specific reason, namely, that system designers who ignore it—apparently in favor of what they regard as their own unchallengeable “common sense”—often assert that it is not their fault when their systems fail to deliver the best information. Rather, they say, the system is good; the problem is that its users are lazy, and this is a factor for which they cannot be held responsible. It is acceptable, in other words, for the problem to remain unsolved as long as the blame can be shifted.

If, however, it can be demonstrated that we already know that most researchers will not expend much effort in seeking information, then this is something that information professionals and library designers must take into account in creating any overall system. It is irresponsible to view the creation of information systems as merely a technological problem, for to do so is to ignore a great deal of information that we have about the people who must use the systems. Ironically, disregarding the Principle of Least Effort is itself a result of the same principle at work: it is easier for many library managers and information scientists to concentrate on “hard” problems of technology than to do the difficult library research on “soft” human behavior. As Robert Fairthorne (1969) has noted: “The unwillingness, or inability of information retrieval specialists to retrieve information about information retrieval is notorious. It is also extremely expensive” (p. 338).

Still, although the requisite awareness may be lacking in individual cases, the library literature indicates a widespread recognition of the need for change.

James Dwyer (1979), referring to an unpublished paper by Marcia Bates, “User Studies: What Are They Good For?” notes: “Bates proposes that we reconsider assumptions about our clients and reformulate our service patterns accordingly: ‘[The traditional] model is the industrious searcher who does for him or herself, and if not willing to is considered ‘lazy’ and not deserving of our attention. I’m not suggesting that we turn library service inside out and do everyone’s searching for them. But I do suggest that it is our responsibility as information professionals to know and understand people’s search behavior and to design services to optimize the likelihood for people getting the information they need given their patterns of behavior’” (p. 137).

James Bettman and Pradeep Kakaar (1977) make the point emphatic-
predicated on the assumption that its customers will exert minimal effort in order to receive its benefits. Furthermore they won’t bother at all if the necessary minimum is higher than some fairly low threshold” (p. 9).

Herner an Herner (1967) provide a succinct statement of the professional responsibility involved: “While the user can furnish insights as to how he get his information and how he prefers to get it, it falls ultimately to the information specialist to devise the best and most efficient means of supplying it” (p. 3).

James Leisener (1984) concludes: “It is high time that this profession confront these issues and redesign library media instruction and services in the light of our primitive but growing understanding of information seeking behavior... It is also clear that we need to reconsider the concept of self sufficiency in information seeking activities...” (pp. 85-86).

With the development of the library profession’s understanding of the realities of actual information-seeking behavior, it will no longer be wise to assume that researchers’ failure to find necessary information is simply the result of their own laziness. If we truly hope to solve the problem of overlooked information, we must take into account library system design in addition to researchers’ skills. We must consciously manipulate the “slope of the gameboard” to make the best channels easier for researchers to perceive.

One distinction is important here, however: while we cannot know in advance the information content of particular books, journal articles, or other sources, we can know in advance that some methods of searching are clearly superior to others for given inquiries. Thus, subject heading category searching is usually more effective than natural language key word searching, provided that appropriate subject headings exist. If they do not exist, then key word search sources are preferable as the first avenue of attack. In some instances citation searching will be a preferable first point of attack rather than either LCSH or key word approaches. At other times, the use of published bibliographies rather than computer-generated lists will be the best first step; and so on. How the readers can search in the first place is a function of the configurations of the “gameboard” that the librarians have waiting for them. It is necessary that the full range of search options be embodied in distinct groups of sources that will allow the different search methods to be readily perceptive (and distinguishable), with any one of them then being easily available as the first option for a given inquiry. Such a configuration is the system-design responsibility of the librarians, not of the researchers themselves. These are points that need to be kept in mind, especially in any attempt to integrate computerized-access resources into a model of library research in the future.