
Changes in the Use of Literature with Time— Obsolescence Revisited

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ABSTRACT

THE 1974 ARTICLE BY Line and Sandison entitled “‘Obsolescence’ and Changes in the Use of Literature with Time” was highly critical of many assumptions about obsolescence and of the methodology and conclusions of much research on the topic. It placed emphasis on the distinction between synchronous and diachronous studies and on the need to correct for the size of the literature cited or used. Since that date, there has been a good deal more discussion of the matter, and additional light has been shed on the theory, but much research remains to be done, unwarranted statements continue to be made, and there has been little contribution to the practical applications of literature use decay. Citation studies confirm the great variation in citation decay between subjects and types of article and also show that the sources used for citations affect the results of analyses. Libraries are under greater pressure of space, but most models are too complex and time-consuming for them to use. Libraries tend not to collect data on use before weeding, and there have been few use studies. However, automated systems should now make it possible to gather relevant data. If and when the “virtual library” comes into being, remote access may make weeding easier because wrong decisions may be reversible, but several conditions have to be met before this makes much practical impact.

INTRODUCTION

In 1974, an article by Sandison and myself was published with the title “‘Obsolescence’ and Changes in the Use of Literature with

Time" (Line & Sandison, 1974). It reviewed all the literature on the subject that we could find and came to some interesting and unorthodox conclusions. It has been widely cited and has become something of a classic. This article looks selectively at subsequently published literature that deals with the issues we discussed earlier with particular reference to the practical implications for libraries. It goes on to examine the relevance of the concept of obsolescence in a possible future world where libraries are "virtual" rather than "actual."

It is useful to start by quoting extensively from our conclusions:

The study of obsolescence has been bedeviled by superficial approaches to a highly complex situation of interlocking factors. It is most important, first, to be quite clear whether changes in library use, in reference/citation, or in the value and interest of knowledge are being considered, and to ensure that conclusions about one of these are not drawn from data on another without adequate evidence for their interrelation. Secondly, great care must be taken to seek out all age-related variables that can bias the data examined, and to make suitable corrections for them all. Thirdly, full allowance must be made for the extremely high variances in all the variables concerned, and to ensure that conclusions are not being drawn from differences which lie within the experimental errors. With these provisos kept clearly in mind, studies of the relation between use and age are of considerable potential interest, even if much of this interest is theoretical.

....Most estimates of "obsolescence rates" given in the literature derive from synchronous use-frequencies in which the growth of the literature exaggerates the apparent age relation. It is not yet known...what factors determine which items in a collection will be read or cited, and the relative importance of age among them all.

What in practice library or information systems require is a method of estimating the relative probabilities that particular items will not be used. There appear to be such enormous variations between and within subjects, titles, and age groups, that only a probabilistic approach is likely to lead to useful results....

On the evidence so far available, age seems to be a rather poor criterion for discarding or relegating to less accessible storage....It may be sensible to discard either after about three years (so avoiding binding), or not at all. It also seems likely that discarding whole runs of less used serials, whether currently received or not, is more cost-effective than discarding older volumes of all serials taken. A library may therefore do best to see (a) which journals are "dead" (whether because they have ceased publication or because the library has ceased subscribing), and to consider whether they can be discarded, (b) which journals receive little use of their current issues, and to consider whether they can be cancelled and discarded, and (c) whether there are some journals that, although currently used, fall off so completely in use after three years that they need not be bound or retained after that time....

It appears then that "obsolescence" is not a concept of which librarians can make much practical use....Any librarian who attempted to weed on the basis of assumed "obsolescence", or of other studies which purported to show it, would be very unwise.

It is not known how useful references and citations may be as indicators of use probability, nor how usage patterns differ between libraries, whether of the same or of different types.

Not only are precise measures needed of changes in use with age, but *relevant* measures. The most precise measures for each age group would be, for library uses, *uses per available item per user*, and for references, *references per citable item per potential reference*. However, these measures may be of less practical use in the decision whether to retain or retire....than *relative uses per metre*.... (pp. 318-20)

Before the conclusions, we advanced several hypotheses:

Literature may decline in use *faster* when

- (a) it deals with data of ephemeral relevance....
- (b) it is in the form of a "report", thesis, "advance communication" or preprint....
- (c) it is in a rapidly advancing technology.

Literature may decline in use *more slowly* when

- (a) it is descriptive (e.g., taxonomic botany....)
- (b) it deals with concepts (e.g., philosophy....)
- (c) it is critical (e.g., literary criticism....). (pp. 317-18)

We might have added that in the humanities and social sciences, the use of "raw" material—historical sources, literary texts, and so on—declines in use (if indeed it declines at all) more slowly than that of "secondary" literature which interprets it. Most histories written more than forty or fifty years ago are of no interest except to the historiographer, but the original sources are still used by today's historians. Similarly, most older theological works are dead to all intents and purposes, while Migne's *Patrologia Graeca* and *Latina* have recently been issued on CD-ROM.

In our earlier work, we concluded with twelve suggestions for research that would help to answer some of the outstanding questions and clarify the issues. Among them were the measurement of reliable age distributions of specific subject areas; the relationship of reference/citation patterns to library use patterns; and the difference between usage patterns of primary and review serials and between books of different intellectual levels. Hardly one of these or the other proposals has been taken up.

SUBSEQUENT WRITINGS ON OBSOLESCENCE

There appears to have been little decline in the number of writings on obsolescence in the last twenty years; it still appears to be a topic of major concern—at any rate to those who write about it (few articles in the information field are more heavily cited than those that deal with citation or other bibliometric analyses—if you want to be cited, write about citations).

One or two review articles have been published since 1974. The excellent one by Gapen and Milner (1981) concluded, as we did earlier, that the work carried out so far means little to the librarian in the field, and that: "Much basic research remains to be done on

obsolescence. Researchers have taken the concept as proven, but in fact it is still only a hypothesis" (p. 116). They go on to argue *inter alia* for more research to "be done in the humanities, if only to determine whether obsolescence is a concept which cannot be usefully applied outside of the sciences" (pp. 116-17), for studies to examine how far library circulation reflects in-house use, and on "the extent to which planned or random factors in the library [such as layout and stack arrangement] can affect obsolescence" (p. 117). They also point out that the question needs to be asked whether the time and effort required to gather data on obsolescence in libraries are justified. They propose and describe in some detail a "problem-solving management model," whose purpose "would be to allow a library to derive, review and incorporate data on obsolescence day by day" (p. 120).

A rather breathless review by Vlachý (1985)—216 references in a paper of 24 pages—lists most, if not all, of the relevant studies containing citation data. The review by Artus (1983) is restricted to the conceptual and practical validity of "obsolescence" and is highly critical of common assumptions regarding the phenomenon, pointing out that there are many causal determinants of citation decay.

The conceptual and practical confusion we criticized in 1974 seems to be still quite widely prevalent, and, while some light has been shed on theory, little has been shed on practice. Authors in the core fields of information science have become increasingly careful when addressing the subject of obsolescence (the fact that the word more often appears in quotation marks suggests growing doubt as to its use or even meaning), but others still use the term with little care or precision. It is still common to come across assumptions that literature obsolesces at an exponential rate. Apparent use or citation decay based on synchronous studies is still regarded as actual decay and interpreted as "obsolescence." The term "half-life" is also still used, although it is clearly improper in the case of synchronous studies where "median citation (or use) age" is more accurate and appropriate. Citation studies are still advocated as a major aid to libraries in making decisions on disposal or relegation often without any provisos. Use studies are still very rare.

CITATION STUDIES OF OBSOLESCENCE

One major theme of our earlier article was the distinction between *synchronous* and *diachronous obsolescence* and the need to allow for growth of the citable literature in synchronous studies; there had been a very large growth of literature in most subjects, especially the sciences and social sciences. A similar allowance has to be made in diachronous studies for changes in the size of the citing literature.

We mentioned a third type of obsolescence, *diasynchronous*, which uses synchronous studies carried out at different times. As we pointed out, nearly all studies had been based on synchronous data without allowance being made for growth. These issues appeared to arouse particular interest, and several papers attempted to examine them further. It was argued on theoretical grounds that no allowance need be made for synchronous data (Stinson & Lancaster, 1987). Some studies purported to show that there was little or no difference between the results produced by synchronous and diachronous citation studies (Oliver, 1971) while others found that there was a difference (Line & Carter, 1974). Similar differences appeared in library use studies (see later discussion). Different results emerge, not surprisingly, from different data, depending perhaps on the subject or even the journals analyzed—and the period covered (see later discussion).

Motylev (1981) has produced logical proof that the two main types of study are not equivalent. Other articles by him (1976, 1982, 1989) are, like that of Artus, highly critical of statements and assumptions about rapid aging. One of them (1976) concludes that “use frequency can be considered a function of document aging only in an ideal information system” and “information use determined from citations or requests to reference information collections is only a very approximate reflection of document aging” (p. 97). Heisey’s (1988) diasynchronous study, which was able to make accurate adjustments for changes in the number of both citable and citing papers, has a particularly useful discussion of the issues. Clark (1976) showed that “theoretically, synchronous and diachronous studies are each a restricted type of the full diasynchronous study, even though, experimentally, a diasynchronous study may consist of a sequence of synchronous ones...” (p. 33). Griffith et al. (1979) pointed out that “the ‘pure’ case, observations of all uses over time of the same items by a single unchanging literature, cannot occur” (p. 180)—both synchronous and diachronous studies are “impure” (which is why correction is needed).

Several articles (e.g., Line & Sandison, 1974; Marton, 1985) have pointed out that there are two periods in the life of an article: an early one, described by some as “immediacy” or “updating,” and a “basic” one, extending over the whole life of the article. Barnett et al. (1989), in an article that uses citation data to examine diffusion in all broad subject fields, develop a mathematical model to represent this feature (their paper, incidentally, appears to show unawareness of any information science literature). Partly because of this phenomenon, Egghe and Rao (1992) argue that the obsolescence function is not a constant but merely a function of time, and that this jeopardizes the use of aging factors.

Gupta's analysis of citations to the 1983 volume of *Physical Review* (1990), to which he applied corrections for growth, showed a decrease in citation which fitted an exponential model. He warned against assuming that this result necessarily reflects use.

There has been one big change since 1974. At that date, the literature was still growing fast. Since then, growth rates have slowed substantially; not only is the annual net increase in the number of serials quite small, but the number of articles per serial has grown very slowly in most subjects—in some not at all (Archibald & Line, 1991). The need to apply corrections to synchronous data on citations received by articles published in the last twenty years should therefore be rather less, at least in some subjects. In fact, such synchronous studies should show slower citation or use decay, another hypothesis that deserves testing.

More attention has been devoted to the social sciences in recent years. In addition to the articles already mentioned (Line & Carter, 1974; Line, 1981; Leavy, 1983) there are the papers by Rao (1974) and Oromaner (1977), the latter being an interesting, though limited, diachronous study. The humanities have received less attention; two examples (there may be others) are the studies by Longyear (1977) on musicology and Heisey (1988) on the Dead Sea Scrolls.

Highly "productive" journals (in terms of citations received) in desalination proved to have shorter active lives than unproductive journals, but journals between the extremes of productivity exhibited no pattern (Wallace, 1986). Bottle and Gong (1987) found that the content typology of articles in biochemistry affected their aging, the median citation ages ranging widely—from 2.9 (for physical and chemical properties of substances) to 9.3 (for studies on living organisms—cell or greater level). McCain and Turner (1989) analyzed eleven highly cited articles in molecular genetics, four of them aging slowly and seven quickly, and related these patterns of aging to their contents. In a wide-ranging citation study of the social sciences (Line, 1981), big differences were found between different disciplines; for example, the proportion of pre-1964 citations drawn from serials to sociology was 48 percent and to environmental planning 34 percent.

Citations to journals show a faster decay rate than citations to books, both in the social sciences (Line, 1981) and at least in some science subjects (e.g., phycology [Musib, 1988]). It is highly probable that this is a general phenomenon. It is certainly to be expected since, in general, articles are intended to report research at the frontiers and therefore date more rapidly than books, which consolidate knowledge.

Several studies have looked at the use of articles rather than journals over time. There are possible practical applications of this

kind of study (see later discussion), but it is also of some theoretical interest, not least because it qualifies ideas that journals obsolesce in some regular sort of way. Walsh's (1977) dissertation on articles in physics followed up on a much larger scale two small studies (Line et al., 1972; Line, 1974), which showed that articles that were least cited in the first three years became less and less cited, while the most cited, far from "obsolescing," attracted more and more citations. Walsh found an increasing concentration of citations on a limited number of articles as time passed. A further study (Line, 1984), also in physics, provided additional confirmation. Aversa (1985) studied 400 very highly cited papers in science and discovered that they fell into two groups: one group declined in citedness after the first two or three years, the other after the sixth or seventh year. For patents, however, Noma and Olivastro (1985) found that highly and lowly cited papers "obsolesced" at the same rate.

Several articles have been published that, like our own and those by Artus and Motylev, are highly critical of previous literature on obsolescence. These include two by Száva-Kováts (1973, 1976) who has made some major contributions to the topic based on large citation analyses of his own. Leavy (1983), reviewing previous literature and drawing from his own research, concluded that median citation ages in the sciences and social sciences differ little; he speculates as to the reason for this finding, which conflicts with Kuhn's view of the social sciences.

One potentially serious problem with citation studies was suspected but not known about in 1974. This is that the results of analyses can differ quite dramatically according to the sources used for gathering references. The aforementioned study in the social sciences showed that analyses of references drawn from journals and monographs produced big differences in date distributions (Line, 1979); 47 percent of references in serials were to pre-1964 material, compared with 62 percent of references in monographs. References drawn from high use and randomly selected journals yielded much smaller differences. In science and technology, the gap between high- and low-status journals is rather larger, and differences might be larger in these fields (another study is called for here); it may be reasonable to use only journals (i.e., not monographs) as sources of references for citation studies in science and technology, but it may be dangerous to use only high status journals.

Finally, in this section of the article, Kuch (1982) attempts to apply the concept of thematic analysis to literature obsolescence. He uses Sandison as an example of "antithematic" and Rouse as an example of "thematic"—a position challenged by Sandison (1983).

Kuch's advocacy of thematic analysis as an important part of the understanding of science is barely convincing.

The more citation studies appear, the more apparent have become differences between subjects and types of articles as well as between studies in what appear to be the same or similar fields. The great dangers of generalization are confirmed. Some studies seem to have been conducted with no clear purpose; even their curiosity value is limited. This will probably continue to be a problem with citation analyses; ISI's citation databases have put the opportunity for manipulation of huge numbers of citations within almost every student's reach, and it is tempting to carry out analyses in order to produce a dissertation or a publishable article. If we are not to be in danger of being buried under citation analyses, a new statement of what we need to know and why, and what might be done with the information gathered, is called for.

OBSOLESCENCE AND LIBRARY PROBLEMS

Few libraries are now growing at an exponential rate, but any relief this might have provided has been more than cancelled out by increased pressures on space as a result of a shortage of money for new buildings. More and more libraries are reaching, if they have not already reached, a crisis point in accommodation, though in North America libraries seem to have less difficulty in obtaining new buildings than in Europe. A report of the University Grants Committee (UGC) (Great Britain, 1976) recognized that libraries could not keep on growing at the rate then prevailing without soon consuming the entire capital expenditure budget of the UGC. It did not advocate the use of citation data or even detailed use studies. Rather, it proposed an empirical approach, with candidates for relegation moved to a low-cost store and reviewed after five years to see if they had been used during that time; this was thought likely to reduce the resistance of academics to disposal. The report caused a storm of protest among academic librarians and some users, but reality has since increasingly forced libraries into discarding material.

There is a substantial literature on weeding of collections (e.g., Slote, 1982), but this tends to deal with principles and techniques; little of it deals in any depth at all with obsolescence.

One significant point about library use we might well have made in 1974 was that use decay will vary according to the library. In fact, it will vary according to the *clientele*, which does not remain static in a single library; this not only makes the application to one library of data obtained in another library dangerous, it also makes the use of data collected a few years ago in the same library highly dubious. For example, a change of direction in the research interests

of a department, perhaps as a result of the advent of a new professor, can swiftly lead to some of the stock becoming "obsolete" and lead to heavy demand for other stock that has been little used. "Obsolescence" is not an objective thing independent of circumstances; it is, almost by definition, in the mind, or rather the uses, of the user. It has also been shown by Sandison (1975) and Brønmo (1978) that accessibility can affect use substantially; so "obsolescence" is also partially under the control of the library. All these factors should lead to great caution in disposing of stock.

Little research has been carried out in real library situations. Most citation studies have been of journal obsolescence, largely because the citation indexes have made it much easier to study. With libraries it is different. In many, journals cannot be borrowed, and, in any case, most of their use is in-house and by means of photocopies; the use of books, on the other hand, can be studied by analyzing automated loan records, although these do not reveal in-house use. Nevertheless, journals occupy a great deal of space in most libraries, and the process of withdrawal is simpler because few records have to be changed; it may thus be more cost effective to study the use of journals.

While citation analyses are still advocated by some as a guide to disposal of library stock (e.g., Gupta, 1984; Longyear, 1977; Pan, 1978; Todorow, 1980), there seems to be increasing agreement that their value is small. No one has yet successfully studied how far citation reflects use, even on a global scale. It seems likely that citations show faster—perhaps substantially faster—decay than uses. This was found in a study by Guitard (1985) which compared the "half-lives" of photocopy requests in the Spanish Institute of Scientific and Technical Information with SCI data. Given the variability of results of different citation studies in the same field, and the much greater variation in use patterns of different libraries, it is difficult to see what use could safely be made of citation analyses in a particular library. The most one can say is that heavy citation of older volumes may well suggest that they should be kept; low citation however does not necessarily indicate that they should be weeded. There is no substitute for use studies in each library (Line, 1978).

When making rational decisions on weeding, libraries need not only collect data on use of material of different dates but must relate it to the space occupied by the material. It needs to be ascertained, for example, whether the 1950 volume of a journal which receives only a quarter of the use received by the 1975 volume occupies the same shelf space or only a quarter as much. If the latter, there is no more reason to discard the earlier volume than the later one. A reworking by Sandison (1974) of data on the use of physics journals

at Massachusetts Institute of Technology analyzed by Chen (1972) showed that an apparent rapid decrease in use disappeared when allowance was made for the space occupied by the volumes of different dates. Brønmo (1978) came to similar conclusions from a study of the use of works on literary criticism in Tromsø University Library. Another study of biochemical journals gave different results (Sullivan et al., 1980-81); this led the authors to claim in the title of their article that obsolescence was "not an artifact of literature growth." But obviously different studies in different subjects and different libraries are going to yield different results; all that Sullivan et al. showed was that use decayed in the circumstances they studied. There is, in fact, little doubt that material does become less used with time in most libraries, but this cannot be assumed and it varies greatly between not only subjects but volumes.

It needs to be borne in mind that the *rate* of use decay is of no practical importance; for example, heavy use of a volume soon after acquisition may be followed by quite a sharp decline, but its use after several years may still be high relative to other volumes whose use has decayed little because it was never heavy.

Metz (1979) reports a particularly valuable study of the use of material in the general collection of the Library of Congress. Its special value arises from the comprehensive nature of the collection (uses are not likely to be constrained by expectations, as they are in most other libraries), and from the fact that it relates data on use to data on holdings, including figures on the size of the collection for different dates of publication in different subjects. Use per volume figures are presented. The study thus well satisfies the criteria for use studies of obsolescence set out by Sandison and myself. For example, 1940s use per volume is calculated as a proportion of 1970s use; this statistic ranges from .11 in class *R* and .13 in class *T* to .63 in class *N* and 1.67 in class *C*. Serials did decline in use more than monographs but the differences are small.

Taylor (1976-77) takes a pragmatic approach to weeding, using research at the University of Newcastle upon Tyne, England. He compares subjective with objective criteria and points out the deficiencies of most readily collectible data on use. A study of journal use in a hospital library (Kamenoff, 1977) found many uses of older volumes and concluded that it was "vitally important to evaluate the use of each journal title before making a decision about length of retention or purchase of microform; the study also suggests that, for some titles initially purchased in the 1970s, back runs on microform might be worth obtaining" (p. 447). Parker (1982) discovered that decline in use was multifactored and pointed out that this made decisions to discard more difficult.

One major study that might appear to be highly relevant is the University of Pittsburgh study (Bulick et al., 1976; Kent et al., 1979), which incidentally provoked a great deal of controversy, not least in the institution where it was conducted. This study collected, over a period of seven years, a great deal of data on library circulation and in-house use. One of the findings was that a high proportion (40 percent) of books acquired in 1969 had not circulated by 1975, and of those that had, nearly three-quarters were borrowed in the year of acquisition or the following year. However, the study does not demonstrate obsolescence so much as (1) an immediacy effect, and (2) selection decisions that proved to be inaccurate in terms of subsequent use.

A study reported by Hodowanec (1983) is of decay in the use of books by subject area in a university library. He found very large differences between subjects, foreign languages having the lowest use decay rate and business the highest. Rouse and Rouse (1979) also studied decay in the use of monographs, but by examining interlibrary loan demand rather than use in a library. They corrected the data for literature growth and duly found that this increased the median use age. They also found that demand at the regional level decayed faster than statewide demand.

Hindle (1979) advocated the use of Markov models of book obsolescence in libraries using two studies as examples. Sinha and Clelland (1976a, 1976b) presented a complex model for acquisition and disposal, claiming that data obtained in two scientific libraries confirmed that a negative exponential function fitted the relation between average use and age. Sandison (1977a, 1977b) disputed the methods and conclusions of both articles, was duly answered (Sinha & Clelland, 1977, 1978), and, in one case, made a further response (Sandison, 1979). At the other extreme to complex articles, a simple introduction to obsolescence and weeding by Lancaster (1988) should be mentioned.

A theoretical paper by Verhoeven (1986) seems to be a good example of pointless and inapplicable theory. His attempt to apply an expectation of life formula to collection management is not unlaudable in itself, but he looked at *average* life expectancy in a *stationary* population. The great variation between items makes averages quite useless, while in no library in the world, except a dead one, is the book population stationary.

Perhaps the most important issue amid all the technical discussion of models and statistics is the practical one. It is assumed that libraries want to make rational decisions, but can any library be expected to collect the necessary data and carry out the necessary analyses? And are they much better off if they do? There is little

evidence that librarians have attempted to use any scientific approach to discarding; rather, they have employed whatever crude methods can be used quickly. Not only have librarians—rightly, though perhaps not for the best reasons—made no use of citation data; they have not generally attempted to gather much data on use in their own libraries, largely because of the time and effort involved. After all, they might argue, selection is far from an exact science; why should disposal be? One answer to that might be that just because there is a hit-and-miss approach about selection of new material, it is all the more desirable to compensate for at least the errors of commission by a firmly based disposal program.

Public libraries have less interest in obsolescence, although they dispose of material much more than academic libraries, since they do not need to use much precision in disposal decisions. Relatively few public library users want specific items; more often they want up-to-date material on a subject or books by a favorite author. Public libraries regularly dispose of books that have become worn out and of stock that is no longer used. There is thus a high degree of substitutability; if one book is not there, others will often do as well. It is not surprising that the literature on disposal from public libraries is very small.

Where other types of library are concerned, all the evidence suggests that any decision on disposal must be made with a great deal of caution. Every item should ideally be considered in its own right, and any general model is useless. Even when the use of individual items can be identified, analyses at one point in time show only what is used then not what might be used at some future time; as noted, clienteles and interests change. Also, political pressures cannot be ignored; a powerful dean can resist even the most rational decision. The empirical solution proposed by the University Grants Committee (Great Britain, 1976) avoids some of the possible pitfalls by identifying candidates for disposal and testing what happens to them, but the candidates still have to be identified.

Wallace (1987), at the end of an article which calls bibliometrics “a solution in search of a problem,” states:

The literature of scatter and obsolescence is fairly large, but the practical uses proposed for the two concepts are limited and repetitious. The questions of whether and how studies of obsolescence and scatter can be of use to the librarian or information system manager interested in efficient collection management remain largely unanswered. (p. 47)

He goes on to advocate a number of conditions that have to be met: “a set of consistent, easily applied formulae for measuring scatter and obsolescence in a working environment”; the testing of these formulae in a variety of settings, and the consolidation of the results;

and an exploration of "the relationship between quantitative bibliometric methods and more traditional qualitative methods...in order to determine which techniques are most efficient, most effective, and most cost effective....It is not clear," he adds, "whether the cost and effort of [meeting this set of conditions] would justify the result" (p. 47). To these suggestions might be added one for strictly comparable studies of use in libraries of similar type, size, and age; and of studies in the same library at intervals of, say, four or five years.

Wallace's proposals are eminently commendable, but it is not easy to see how the results of any testing would be judged, since once material is disposed of or relegated to a store, whether the method of selection used is crude or sophisticated, quantitative or qualitative, use is at once affected; a decision to weed becomes a self-justifying one in the case of most materials (back runs of scientific and technical journals may be an exception, since much demand on these arises for pursuing references in other works or searches of databases). A "half-way" store, separate but easily accessible, might go some way toward solving this particular problem.

At this point, the librarian might be tempted to give up and make quick and crude decisions without even consultation, let alone studies of use. This would be wrong and unfair to users. Analyses of the best data obtainable will not provide "the answer," since there is no definitive answer that is valid for all time. What they can do is to indicate probabilities, and they can thus reduce the area of uncertainty and make better decisions possible. With good automated systems, it is possible to make much better informed decisions than many libraries make now. Their failure to collect data on use is understandable at the actual point in time when decisions have to be made, but a little foresight and planning could ensure the provision of relevant data from well designed management information systems. There is now the opportunity for libraries to provide themselves with data on the circulation of all their stock and also on photocopies made of library material, and to relate this data to entries in the catalog. Something like Gapen and Milner's (1981) "problem-solving management model" is now capable of realization. Automated catalogs also make the process of disposal much simpler.

It was mentioned earlier that studies of journal articles might have a practical application. If it can be shown that a small percentage of articles within a journal account for a high proportion of use, if these same articles continue to be used over a long period, and if, moreover, they can be identified in the first two or three years after publication, the possibility arises of republishing them as a package (e.g., "Key articles from *Journal of ... 1976-85*"), which could be acquired either by libraries that did not have the back volumes

or by libraries that did but wished to replace them in order to save space. The conditions above seem to be fulfilled for physics journals (which for some reason seem to have attracted most of the attention in this respect), to judge from the research by Line (1974, 1984; Line et al., 1972) and Walsh (1977). The economic and practical viability of this could easily be tested by the publisher of a journal such as *Physical Review*; both publisher and libraries might gain.

OBSCULESCENCE AND THE "VIRTUAL LIBRARY"

Whatever the difficulties of selecting material for disposal and actually disposing of it, most libraries nevertheless have to dispose of some stock from time to time. Does it actually matter very much what is discarded if it can be quickly and cheaply obtained from elsewhere? Does even cheapness matter very much, since occasional access is cheaper than holding materials locally, except when uses exceed some seven or eight a year for the average book or twenty or more for the average serial?

Many short items can already be obtained very quickly—within a few hours—from elsewhere with the aid of online catalogs, automated requesting systems, and facsimile (which will become much cheaper and faster with ISDN and Group 4 machines or even with enhanced Group 3). As more and more journals become available online, searching, identifying, requesting, and receiving will become an integrated process. (It is necessary to comment that if some journals cease to be printed altogether the cost of access may become very high indeed.) This will not, however, apply to most journals for some years, and perhaps never to all journals, particularly those from less developed countries.

It is hard to see how very fast access to longer items—mainly books—that are not held locally can ever be achieved on any scale. However, it will increasingly be possible for books to be printed on demand in libraries or bookshops; and this means that a disposal decision that proves to be wrong may not be irretrievable as it is today, since most books more than a year or two old are out of print. This happy state will not be realized for some years, if then, because the great majority of older books will not be in the necessary form for transmission. In principle, printing on demand is already possible, since most books published over the last ten or twelve years are produced from word processed text; however, that does not prevent them from going out of print because the mechanisms for printing in response to demand on any scale are not in place.

The virtual library would, of course, affect library acquisitions as much as, if not more than, weeding. There might be no point in buying large amounts of material, which has to be selected, if

any material could be obtained cost-effectively from remote sources, and, if material is not acquired, the question of disposing of it becomes irrelevant. As mentioned earlier, much of it can be obtained in this manner already; in this sense the virtual library is already with us, and further developments in technology and its application will merely accelerate the process. Yet libraries continue to acquire as much as they reasonably can, in spite of the proven cost-efficiency of the alternative for most material. If and when more journals and other materials are made available only in electronic form, there will be no choice, but, while a choice remains, librarians—and most users—will choose to have material on the spot.

There are very good reasons for this ready availability. Much library use is generated by the physical presence of items on shelves. It has been shown again and again that much material, even in science, is picked up by browsing (which has an element of purpose about it) or serendipity (which is happy accident). Some of this use is important in extending the user's frame of reference or by enabling him to make connections that would otherwise not have been made. Most of this material would never have been identified by even the most superior indexing system.

Some kind of surrogate browsing is needed, but it is difficult to see how the kind of exposure offered by the display of new books and current issues of journals in a library can be provided by even the best electronic system; scanning issues of journals online is much slower than scanning printed text. Indexing is a partial solution, but no more than a partial one. Where a specific search is called for, scientific journal articles and reports are generally well indexed and easily retrievable since they deal with one narrow topic. Existing indexes and abstracts should therefore satisfy most retrospective needs, but a sophisticated expert system would be required to provide the browsing element in current awareness, not to mention serendipity. And if other types of material, such as books and many humanities and social science articles, are to be accessed remotely rather than being physically present, there will have to be immense improvements in indexing.

This author has outlined elsewhere (Line, 1990) the sort of system that might be developed for books in the future. This involves the construction of a (preferably international) combined subject database on the same lines as the large machine-readable indexes for scientific journals, using abstracts with controlled vocabulary which can be searched online, and a supporting file on microform of the title pages, contents pages, and possibly actual indexes of books, which could be called up automatically if users wanted further information on particular books; it would be coded and linked with the bibliographic

file. Such a system is technically entirely possible now and requires only the will and the money to implement; there seems to be no reason why it should not be viable as a commercial product. Unless and until such improvements take place, libraries will not only wish to hold physical materials but will need to do so in order to serve their users; if they hold these materials, they will from time to time need to dispose of some of them.

The "virtual library," then, if and when it appears, is a concept that will not apply to more than a (growing) proportion of current intake, and a much smaller proportion of older material. The problem of weeding will therefore still be with us, though less intensely because less and less space will be needed for new materials. This should ease the pressure on libraries to dispose of material and make the issue of which methods to use for selecting material for disposal of less moment.

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