Specialized Reference Works and Their Users. A Preliminary Study

A. BEN WAGNER* and M. CARL DROTT

The Graduate School of Library Science, Drexel University, Philadelphia, Pennsylvania 19104

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An examination of the use of three specialized reference works was made to identify users of the reference tools and the benefits from their use. The feasibility of locating and interviewing users was tested, and an attempt was made to determine the situations in which the works are used. Methods of locating users are described. Users were interviewed to determine the value of each work and alternative sources of information. The works were compared with alternative sources to test their comprehensiveness. Conclusions are: (1) identification of users and their needs is complex, and requires the combination of a number of research methods; (2) the availability and accessibility of alternate information sources varies with both the reference work and the type of user.

There are a large number of highly specialized, scientific reference works. These works are aimed at relatively small audiences, but their importance to these small groups may be great. The cost of these specialized works tends to be high, either in the form of a high purchase price or in terms of a large subsidy for their preparation. To date little work has been done to relate the costs of these reference tools to the benefits for their users. The research reported in this paper represents a preliminary step in making such an evaluation.

The two goals of our study were: (1) to test the feasibility of locating and interviewing users of specialized reference works, and (2) to determine the variety of situations in which reference works are used. This latter goal was aimed at aiding preparation of interview schedules for a more rigorous investigation. In the interests of both cost and time, we limited ourselves to the Philadelphia area and to three reference works. In selecting the reference works for study, we looked for items of value to laboratory investigators in chemical or biochemical areas. We wanted materials which might be used in both academic and industrial research laboratories, and we wanted reference works which were both governmentally subsidized and privately produced.

DESCRIPTION OF THE REFERENCE WORKS

The three works chosen were the "Atlas of Protein Sequence and Structure",[1] "A Handbook of Alkaloids and Alkaloid-Containing Plants",[2] and the "Sadtler Commercial Infrared Spectra—Monomers and Polymers".[3]

The "Atlas of Protein Sequence and Structure" is edited by Margaret Dayhoff at the National Biomedical Research Foundation in Silver Spring, Maryland; Volume One was published in 1965; Volume Two, 1966; Volume Three, 1968; Volume Four, 1969; and Volume Five, 1972. Each of these cumulated via computer compilation all previous material. Robert Eck was coeditor on the first three volumes. The 1972 volume contains 124 pages of introductory and text material, and 418 pages of data on sequences and structures available through June 1, 1971. There are 700 sequences in 438 data entries and 2500 authors cited, double the size of the 1969 volume. Multiple references to the literature are given where possible.

The growth of the Atlas reflects the tremendous growth of the field of sequencing. More sequences are determined in a quarter of a year now than were known in 1965. Automatic sequencers allowing determination in a single run of up to 50 residues have just become available. A supplement (1973) to the 1972 volume, including new material up through June 1, 1972, has an additional 515 protein entries and 16 nucleic acid entries. This area has had striking influence on such diverse fields as evolution, systematics, immunology, anthropology, crystallography, and enzymology.

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The sequences are grouped by type e.g., Cytochrome C, Immunoglobins, Fibrous proteins, and Trypsin inhibitors. Alphabetic author, taxonomic, and subject indexes are included. These are supplemented by two other tools, a key-(amino-acid)-in-context index and a deck of standard computer punch cards containing the machine-readable sequences. In addition, the 1972 volume contains 90 alignments which compare, side by side, similar proteins, and matrices showing three-dimensional structures of the molecule. The text provides a useful glossary, and an interesting applications and summary of the data section.

"A Handbook of Alkaloids and Alkaloid-Containing Plants" was compiled by Robert Raffauf, a pharmacologist, in association with Smith, Kline, and French Laboratories. Alkaloid literature through the mid-1968 is included. There are numerous indexes, an obvious advantage of computer compilation. The alkaloids, a class of basidic organic (C, H, N) compounds derived from plants and commonly used as drugs, are grouped by family in the main listing. The first two indexes are alphabetical by alkaloid name and genus of the source plant. Two indexes are given by increasing molecular formula and molecular weight. Finally, a section of structural tables matches the individual alkaloids in the main list with the last section of structural formulas where the ring structures are diagrammed. The melting point, optical rotation in a given solvent, and temperature for determination of the rotation are listed when available. The cost of the handbook for a library is about $50.00.

This book is a one-edition work, as opposed to the other reference works which are regularly updated.

The "Sadtler Commercial Infrared Spectra—Monomers and Polymers" are at the present a 12-volume set of grating spectra (1966–1971) and a 16-volume set of prism spectra (1966–1971). Infrared spectra are the absorption patterns of infrared radiation of organic molecules. This pattern, unique to the compound, is recorded on paper and serves as a "finger-print". Detailed structural analysis can be made, and a good match of an unknown spectrum with a reference spectrum is almost a positive identification. However, this technique is seldom used in quantitative work. As with all Sadtler publications, they are marketed in a loose-leaf three-ring binder. Included with the spectra are the trade

name, specific gravity, viscosity, corporation source, and physical state of the compound from which the infrared data were taken. Indexes provided with the collection are alphabetical by trade or chemical name; classification index, by chemical type; numerical index, by identification number; and a key-(strongest absorption band)-in-context index.

LOCATING USERS

Direct and indirect techniques were used in attempting to locate users of these reference works. In locating users directly we contacted faculty members and researchers in biology and chemistry at area universities. We asked those contacted if they used the materials or if they knew of colleagues who might be users. We were also fortunate in that the Sadtler Company made available a list of area firms who were purchasers of their series. We then contacted researchers in these companies.

We sought users indirectly by trying to locate libraries holding copies of the reference works. We used the Pennsylvania Union Catalog as a basic locating tool. In addition we contacted special libraries which might have such holdings. In particular we tried to contact companies in the areas of pharmaceuticals, biologicals, and biochemicals and selected chemical and petrochemical firms. One problem with this indirect approach was the fact that a company or university may own a book without the library necessarily knowing of its existence.

Merely finding that the library had one of the reference works we were seeking did not automatically locate any users of the work. Locating users required a number of approaches. We contacted the librarians to determine whether they knew of specific users; in other cases, library records such as purchase recommendations or circulation files led us to users. We considered observing at libraries as a means of locating users; this was rejected as infeasible because of the relatively infrequent use that such materials receive. In a longer study it might be possible to use in-book questionnaires. In several cases the books were on reserve for a specific course, and this led us to the professors who had assigned them.

Of 20 academic libraries contacted, 17 held at least one volume of the Atlas, six had the Handbook, and one had the Sadtler series. Among 14 corporate and research libraries, three held the Atlas, three the Handbook, and five the Sadtler series. In cases in which different divisions or departments of the same organization hold copies of an item, each was counted as a separate holding. It is important not to read too much into these figures since they represent informal data collection. In particular, academic institutions may be over-represented. This is because more such institutions were visited (as opposed to telephoned) and because academic researchers are somewhat easier to identify than are researchers in private industry.

USER INTERVIEWERS

Twenty users of one or more of the reference works were interviewed. These interviews were relatively unstructured. We first determined the user's familiarity with the work. This ranged from knowing of an item's existence but using it rarely, to consulting a reference on a daily basis. We proceeded to ask how the material fit with the respondent's past and present work, how easy the work was to use, and what would be done to locate the information if the work did not exist.

With one exception, all the users of the "Atlas of Protein Sequence and Structure" were quite enthusiastic. Although the work is considered comprehensive, a desire was expressed to cut down lag time which is inherent in an annual publication. The work, in general, was felt to be convenient to use and adequately indexed. The standard format and compactness are seen as great assets.

This work seems to have a comparatively broad appeal. The volumes are used by both researchers and teachers. In all, six biochemists were interviewed; some were both teachers and researchers. In research, the work gives quick access to protein sequences and structure. This is useful in planning new research involving sequencing, checking lab results on known proteins, and comparison studies of similar proteins. One biochemist, who does no sequencing himself, finds the work useful in making decisions on solvents (substrates) to use in his studies of enzyme-catalyzed reactions.

Three professors use the work in their classes. In their opinion, the introductory material, some of which is assigned reading, is a very fine summary and written at a level understandable to the students. Although some of the material can be found elsewhere, the data section gives excellent support and illustration of this review section. Many evolutionary relationships are traceable through comparative studies at a molecular level of proteins. A compilation such as this is obviously valuable to broad studies in evolution and systematics, and in the study of organic diversity.

The one researcher who felt the work is not useful is a specialist in a particular type of protein. He acquires reprints and preprints of important work in the field and maintains informal contact with many other researchers. Thus his personal files are both more detailed and more current than the Atlas.

Considerably less interest was found in "A Handbook of Alkaloids". Even at Smith, Kline, and French (originators of the work) no one contacted by phone was familar with or interested in the work. The major researchers who had worked on the project had left the company.

"A Handbook of Alkaloids" is aptly named. For "ready-reference" questions relating to simple physical data and the basic chemical structure of specific alkaloids, it should be quite handy. Unfortunately, the fact that this book provides quick reference probably means that there are few "heavy" users. Persons involved regularly with alkaloids are likely to need more detail than is provided by this book while individuals who do need information of this type are difficult to identify. We located three chemists who are interested in the chemistry and reactions of alkaloids. Little use seems to be made of the work by these chemists as none of them had done more than looked through a copy of it. One possible reason for this is the strong "competition" from four or five other excellent, comprehensive sources of much the same information. These will be discussed later.

The Sadtler collection, although being the most expensive ($1728 for the prism set and $2142 for the grating set), has in a sense proven itself by being commercially viable. The volumes are normally kept near the ir machine, often in the office of the ir chemist. This made it somewhat more difficult to trace down the set, as the library often had no record of its existence.

Researchers reported that the work is useful, though not necessarily heavily used. Users report that their work involves checking newly synthesized materials for similarity to existing ones and evaluating samples sent in from the field. One problem is a great need for breadth and currency. Most labs keep large reference files of spectra. At least two firms are experimenting with on-line computerized files.

A final point to be made is that the increasing use of a variety of newly developed analytical techniques has started to lessen the dominance which ir analysis has had in the organic field.

The sole academic user of Sadtler, an ir chemist, has a complete set of the 16-mm microfilm cassettes and a microfilm reader-printer in his office. Besides using it in analyti-

cal laboratory work, he makes overhead transparencies and copies for instructional and examination purposes.

ALTERNATIVE SOURCES

In considering the value of a reference source it is necessary to consider how else the information might be obtained. To this end we asked our respondents the question, "If you did not have access to this source, what would you use to find the same information?" Our goal was not to construct a comprehensive bibliography, but to reflect the alternatives as perceived by persons working in these fields. Many of the alternative sources mentioned proved difficult to locate. In a more comprehensive study users of these sources would have been located, and we could have tested whether source preference was based on special needs or on source availability.

The "Atlas of Protein Sequence and Structure" seems to have the fewest substitutes. Beyond using standard abstracting and indexing sources to access original papers, personal files and annual reviews of various subfields in sequencing were mentioned most frequently. The *Journal of Molecular Evolution*[4] gives new sequences, but no holdings were located in the Philadelphia area.

A number of sources were found in the field of alkaloid chemistry. Perhaps the best single source is one by Manske and Holmes, "The Alkaloids: Chemistry and Physiology",[5] in 13 volumes. The material by Boit, "Ergebnisse der Alkaloid-Chemie bis 1960",[6] is comprehensive and well referenced. The Specialist Periodical Reports from the American Chemical Society are valuable for their currency. Again, personal files and abstracting and indexing services are also used.

There is one very fine alternative to the Sadtler series, Hummer and Scholl's "Infrared Analysis of Polymers, Resins, and Additives; an Atlas".[7] The two-volume, German-produced set costs about $150.00 for a total of 2924 spectra. Both the chemical and trade names, the molecular formula, preparation, molecular weight, and manufacturer are given. The material is considered highly reliable. The Sadtler Monomers and Polymers Set has the advantage of sheer numbers of spectra and being somewhat more oriented to American corporations. A very fine, general index to ir spectra is the American Society for Testing and Materials' "Molecular Formula List of Compounds, Names, and References to Published Infrared Spectra; an Index to 92,000 Published Infrared Spectra" (1969). A companion volume is the "Alphabetic List of Compounds . . . .

A COMPARISON OF SOURCES

The final part of our study was a comparison of the comprehensiveness and ease of use of the works under study with alternative sources. In keeping with the informal nature of our investigation, only a small number of sample cases were examined. Since the test of a spectra collection is its ability to identify unknown spectra and since unknown spectra were not available, this part of the study did not involve the Sadtler Infrared Collection.

Our procedure was twofold; to test the uniqueness of a work under study we selected entries from the work and attempted to find the same information in other sources. The comprehensiveness of a source was tested by picking appropriate entries from alternative sources and searching for them in the work under study.

Eight proteins and their respective biological sources were chosen out of the "Atlas of Protein Sequence and Structure" and sought in *Chemical Abstracts*. Of the eight proteins, only three were located. The search time was lengthy owing to the necessity of using the broad subject of "proteins" or the biological source (e.g., "swine"). The abstracts often did not give the complete sequence, which would then require going to the original paper. The hits that did occur were on references listed in the Atlas.

Twenty-one protein names and biological sources were picked out of *Biological Abstracts* and the citations were recorded. Both the taxonomic and the subject index of the Atlas quickly (2 min per search) found the sequence and the identical references in all but three cases. Despite the small sample sizes, these results are decidedly favorable to the Atlas.

"A Handbook of Alkaloids" was compared with Pelletier's "Chemistry of the Alkaloids",[8] Manske's 13-volume set, and *Chemical Abstracts*. Twelve alkaloids and respective plant family sources were chosen from the Handbook. Rapid location (7 min per search) of all but one was made under either the family or alkaloid name in the *Chemical Abstracts'* five-year cummulative indexes. However, the molecular formula index did not seem effective in finding the alkaloids. Both the keyword-in-context index to *Biological Abstracts* and the thesaurus scheme of *Index Medicus* were not suited to this type of search. Four alkaloids out of the same twelve were located in Pelletier; eight in the 13-volume Manske set. In Pelletier the description of the alkaloid was brief but set in the context of research done on similar alkaloids. The Manske volumes were particularly well referenced and gave good summaries of research including spectral data and synthesis.

Going the other direction, five out of eight alkaloid names picked from *Chemical Abstracts* were found using the alkaloid name index in the Handbook. *Chemical Abstracts* appears to be as good at locating alkaloids as the Handbook is, although more time is involved. Manske, although not as comprehensive, gives much more information about the alkaloids.

CONCLUSIONS

This study, while exploratory in nature and nonrigorous in sampling and survey techniques, has led us to a number of general conclusions. First, the question of who uses specialized reference works and for what purposes is highly complex. Users and uses cannot be deduced simply from the subject matter of a work. Further, normal survey and interview techniques are only partially successful in identifying users or potential users of these materials.

A second conclusion is that the availability of similar information from other reference works or literature search techniques may vary widely for different works. Comparison to other works must also depend on the ease of use of the respective materials. In addition, the evaluation of coverage should separate the aspects of uniqueness and comprehensiveness.

Finally we believe that it is both desirable and feasible to undertake a more extensive examination of this literature. We believe that users and uses can be identified and classified; that information from users and comparison with alternative sources will prove valuable to both funders and publishers; and, finally, that a successful reference work must be acutely "tuned" to the intellectual needs of users and to existing information sources.

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Reference Literature to the Critical Properties of Aqueous Electrolyte Solutions

A. L. HORVATH

18 Harlow Close, Thelwall, Warrington, WA4 2HD, England

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A comprehensive review is compiled of the published literature sources for the critical properties of aqueous electrolyte solutions.

The critical properties of binary and multicomponent systems have been extensively studied during the last 20 years; however, these investigations paid little attention to the critical phenomena in aqueous electrolyte solutions (see, e.g., ref 8, 18, 35, 50, 55, and 65). Particularly, the properties of the saturated solutions were omitted from the studies, despite the fact that scientists and engineers often require these properties in their work.

This article tabulates the references on these data. The references were obtained by searching the following:

Chemical Abstracts
Chemisches Zentralblatt
Citation Index
Dissertation Abstracts
Nuclear Science Abstracts
Physical Abstracts
Referativnyi Zhurnal

Furthermore, the listed references in several articles were examined for additional sources of relevant information.

The critical phenomena or the disappearance of the liquid–vapor meniscus has been measured experimentally for most pure compounds; however, the techniques for aqueous electrolyte solutions are more cumbersome. The difficulties arise from several sources: there are great differences between the critical properties of pure water and the pure inorganic salts, e.g., NaCl, Na_2SO_4, $CaCl_2$, etc; the apparatus has to be designed to tolerate high temperatures and pressures in addition to the corrosion resistance of the vessel; the critical temperature of these inorganic solids is in the range of 2500–3000°C; and the reliability of the calculated values (using the construction of rectilinear diameter in most cases) is fair, owing to the discrepancies between the derived values by various investigators.[52,53] This uncertainty justifies the belief that further studies are required for the establishment of more reliable data. How-

Table I. Bibliography of the Critical Properties of Inorganic Compounds–H_2O Systems

System:	Ref	System:	Ref	System:	Ref	System:	Ref
H_2O–	...	H_2CrO_4	30,34,40	H_2O–		NaI	21
$Al(OH)_3$	30,34,40	H_2MoO_4	30,33,34,40	Li_2SO_4	49,51,57,58,60	NaOH	30,34,37,40
$Al(ONa)_3$	30,34,40	H_2SO_4	47	Li_2SiO_3	30,40	$Na_2B_4O_7$	30,40,51
Ar	12,13,44,68,69	H_3BO_3	30,34,40,47	$MgCl_2$	47	Na_2CO_3	21,30,40,51,57, 58,63
B_2O_3	21	H_3PO_4	47	$Mg(OH)_2$	34		
CH_3COOH	47	KBr	40,47,71,72	$Mg(NO_3)_2$	47	$Na_2Cr_2O_7$	30,34,40
CO_2	1,3,11–13,16, 38–40,44, 67–70,79–81	KCl	20,21,26,27,31, 40,47,51,71,72	$MgSO_4$	73	Na_2MoO_4	30,34,40
				NH_3	1,12,44,45, 68–70,82	Na_2SO_4	21,29,51,57–59, 61,78,85
		KF	51				
$CaCl_2$	47	KI	21,40,47,71,72	NH_4Cl	47	Na_2SiO_3	30,31,34
$Ca(NO_3)_2$	21	$KLiSO_4$	57,58	NH_4HCO_3	47	$Na_4P_2O_7$	51
$CaSO_4$	78	K_2CO_3	30,40,51	$(NH_4)_2CO_3$	47	$NiSO_4$	48
$Cr_2(SO_4)_3$	32,40	$KHSO_4$	47	$(NH_4)_2SO_4$	47	$PbCl_2$	51
CsCl	51	K_2SO_4	51,57,58,62	N_2	1,11,13,56, 67–70,80,83	RbCl	40,51,71
$CsNO_3$	47	$K_2SO_4 \cdot Li_2SO_4$	84			SO_3	17,40,76,77
Cs_2SO_4	51			NaBr	21	SiO_2	3,10,12,22,30, 34,36,57,58, 66,78
D_2O	40,64	K_2SiO_3	30,40	NaCl	1,3–7,9,10,12, 15,21,23–29		
$Fe(OH)_3$	34	$K_2Si_2O_5$	21				
HCl	47	$K_4P_2O_4$	51		40–43,47,51,54, 57,69–72,74, 75,78,80	Tl_2SO_4	51
$HClO_4$	47	LiCl	47			UO_2SO_4	46,48
HNO_3	2,47	LiF	51			Xe	13,14
				NaF	51		