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AUTHOR	Angell, Richard S.
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ABSTRACT

The first paper, "The Language of Term Relation Designations in Subject Access Vocabularies," contains a set of tables comparing certain features of ten thesauri and subject authority lists. The purpose of this essay is to present a kind of analysis that may have value in clarifying the language and structure of subject access vocabularies with a view to achieving maximum compatibility among them. The second paper, "The Specific-to-General See Reference in Thesaurus Construction" advances the proposition that the employment of the specific-to-general see reference is a faulty element in the structure of subject access vocabularies. The reference aknowledges the existence of a specific subject but denies the searcher direct access to material on that subject through a specific subject heading or index term. As a consequence, review of an undeterminable amount of non-relevant material is required in the retrieval process. The specific-to-general see reference should be vocabularies. See references should be limited to synonyms, antonyms, and alternative forms. (MF)

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TWO PAPERS ON THESAURUS CONSTRUCTION

a. "The language of term relation designations in subject access vocabularies"
b. "The specific-to-general see reference in thesaurus construction"

by

Richard S. Angell

Danish Centre for Documentation
Copenhagen 1968

FID/CR
Nov. 1968

EDITORIAL

The publication of this issue of the FID/CR Report Series has unfortunately been delayed by the activities of the Secretariat in arranging the *Seminar on UDC in a Mechanized Retrieval System,* Copenhagen, 2—6 September 1968. It makes available for the readers two papers which for some time have been known only within smaller groups.

Report No. 7 by Th. W. te Nuyl, former chief of the Patent Documentation Department of the Dutch Shell Company, The Hague, is a study made on behalf of the FID/CR with financial support from the FID Committee budget. The CR-Committee is greatly indebted to the author for this critical extract of the two volumes, published by Cyril Cleverdon, Jack Mills and Michael Keen on the *Factors Determining the Performance of Indexing Systems,* with special reference to the contents of the conclusions. Various suggestions for further research, based on the rich material presented in the Cranfield reports, are set forth, and to some extent later followed up by the author.

Report No. 8 by Richard S. Angell, chief of the Technical Processes Research Office, Library of Congress, Washington, D.C., contains *Two Papers on Thesaurus Construction* which date back to the Tokyo Conference in 1967. The papers have been re-edited to make a whole, and include a number of comments received from the editors of the 10 thesauri in question. The relational mechanisms of these thesauri have been studied in detail with the aim of presenting a kind of analysis that may have value in classifying the language and structure of subject access vocabularies with a view to achieving maximum compatibility among them.

It is noted that the FID/CR Report Series is being met with a growing interest as a useful means of communication between the Committee and documentalists from all parts of the world. Just because of its cheapness a considerable part of the edition is distributed without charge; this applies especially to requests received from countries with valutary difficulties.

R. M. H.

Foreword

The two papers contained in this number of the FID/CR Report Series were originally presented at the 33d Conference of the International Federation for Documentation and the International Congress on Documentation in Tokyo, September 1967; the first at a joint meeting of FID Study Committees CR (Classification Research) and RI (Research in the Theoretical Basis of Information), the second in Symposium IIIg of the Congress.

As will be observed, the first paper contains a set of tables comparing certain features of ten thesauri and subject authority lists. In these tables the characterizations of the directions and practice of the several lists were derived partly from statements in the introductions to the vocabularies and partly by drawing inferences from examination of the lists themselves. In order to correct any errors of fact or interpretation, persons responsible for each of the vocabularies were asked to review the original version. Replies were received from seven of them.

The present version incorporates all of the comments relating to a particular vocabulary. This has resulted in some cases in the noting of differences that will be incorporated in forthcoming editions. Basically, however, this version is still related to the ten vocabularies represented in the tables and cited at the end of the text. As forecast in the original study, it is intended to prepare a more definitive version to include additional thesauri, among them some whichwere in preparation in mid-1967.

The second paper, "The Specific-to-General See Reference in Thesaurus Construction," has been edited to avoid repetition of certain tables and citations given in the first and common to both. As a result several changes have been made in Table 1, particularly in the footnotes. The text, however, is essentially unchanged from that appearing in the volume of papers presented at the International Congress.

Richard S. Angell
Chief, Technical Processes Research Office
Library of Congress
Washington, D. C.

March 1968

The Language of Term Relation Designations in Subject Access Vocabularies

In the course of studying a particular aspect of the construction of thesauri and other subject access vocabularies1/, it became useful to examine in detail the several connections which representative lists2/ establish between terms and the manner in which these relations are expressed. This examination revealed even wider differences in usage than are evident from casual observation. The results of this analysis are presented in several tables and in the following commentary. It is hoped that all those interested in the construction of standard vocabularies will comment on the methodology of analysis and presentation. These comments will contribute to a more complete and definitive version of the study, which, it is hoped, will help to promote uniformity and compatibility between subject access vocabularies.

The first step in the analysis was to draw up an exhaustive list of the ways in which terms are connected in controlled vocabularies. These connections were then reduced to stylized and elliptical kernel statements from which all of the expressions used in any of the lists were excluded.

Figure 1, Classification of Term Relations, is an attempt to draw up such an exhaustive list in abstract terms. "A" in each case represents a term referred from; "B", "C", "...N" represent the term or terms referred to. It will be noted that A is either (1) a forbidden term, i.e., one that is excluded from the vocabulary and not used as an index heading; or (2) a permitted term, i.e., one that is admitted to the vocabulary and used as an index heading. It goes without saying that B, C, ...N are permitted terms. It may occasionally be convenient to refer to them as "target" terms3/.

Section I of Figure 1 comprises the cases in which A is a forbidden term. One or more terms are presented for assignment instead. In Section II, A is a permitted term and there is a requirement that one or more terms be assigned also. Section III provides for the relationship in which one or more terms are listed for optional assignment in addition to A. None of the vocabularies now establishes this relation explicitly. In Section IV one or more terms are offered for optional assignment as alternatives to A. As will appear, this part of the study is only sketched out in the present essay.

FIGURE 1

Classification of Term Relations

Statement number	Formula statement
	I. A forbidden, B ... instead
1	a. B
2	b. B and C
3	c. B and C and ... N
4	d. B or C or ... N
	II. A permitted, B ... also required
5	a. B
6	b. B and C
7	c. B and C and ... N
	III. A permitted, consider B ... also
8	a. B
9	b. B or C or ... N
	IV. A permitted, consider B ... instead
10	a. B
11	b. B or C or ... N

The formula statements of Figure 1 have been cast in the form they have as instructions to the indexer or subject cataloger. Naturally these directions are essential to the user or searcher also, but it should be noted that several of them would be expressed differently if addressed to the searcher. This point will be amplified later.

The next step in the analysis was to prepare for each of the subdivisions of Figure 1 a table showing the manner in which the term relation statement is expressed in each of the vocabularies; whether or not the relation is recorded under the target term or terms, and if so, in what manner; and the kind of relation the target terms bear to the A term. These tables permit comparison of the different expressions used for the same reference.

A final table displays the references of Section I of the outline (A forbidden) in a manner which brings together the different ways in which "see" and "use" are employed in the several vocabularies and within the same vocabulary.

While it is hoped that these tables will be largely self-explanatory, a few words of comment may be helpful.

Table 1 exhibits the term-to-single-term reference. It is the only term connection used in all of the ten vocabularies. With one exception it is used in all of them to connect synonyms, although the strictness with which synonymy is regarded varies considerably. Seven of the lists employ this reference from a specific to a more general term, a feature which is dealt with in the accompanying paper, "The Specific-to-General See Reference in Thesaurus Construction."

The Euratom thesaurus gives a count of the number of assignments of permitted terms. Forbidden terms are designated by a dash. Terms with neither indication are in the process of being introduced as accepted terms.

Table 2 shows that the instruction to assign B and C instead of A is employed only in lists designed for post-coordinate systems. Moreover, the relation of B and C to A is uniform in the five lists, namely two more general terms which together constitute a synonym for A; for example, "Pulmonary embolism, use Embolism and Lungs." (DDC page 356).

As shown in Table 3, the same reference extended to more than two terms is employed only in the EJC and Euratom lists. An example (Euratom page 17) is:

- Congestive heart failure Use Blood circulation

+ Diseases

+ Heart

Table 4 shows the term connection known as the "multiple see" reference. It is used in subject heading lists for an enumeration of the permitted headings under which works dealing with the subject matter of the excluded heading are entered. An example (LC page 774) is:

Space of more than three dimensions

See Fourth dimension

Hyperspace

Space and time

As indicated in statement 4, this kind of reference directs the indexer to assign term B or C or N according to the content of the document in hand. To the searcher, however, the reference means, "For all material on A, search in this system under B and C and N." In general it can be said that an "or" instruction to the indexer is an "and" message to the searcher.

Table 5-7 reveals the fact that only two of the vocabularies associate with an A term the required assignment of additional terms. These are API and Euratom, both of which assign terms at more than one hierarchical level. API also employs the looser "Related term" connection.

Table 8-9 provides for statement 8-9 (Section III) of Figure 1; that is, optional additional assignment of one or more terms, although no examples are shown. One of the vocabularies formerly made explicit provision for this kind of relationship.

As previously indicated, Section IV of the outline in Figure 1 has not been reduced to tabular form. This is the connection which provides for optional assignment of alternative terms. It is expressed in subject heading lists by the see also reference to terms for subordinate and coordinate topics; in many thesauri by entries for broader terms, narrower terms, and related terms*. In addition, several vocabularies

*It is recognized that in any given application of a thesaurus the terms so listed may be used for optional additional assignment, but this is a matter of usage rather than of construction. For purposes of the kind of analysis proposed here, it is considered important to maintain the distinction between additional and alternative term assignments.

display their terms in groups and fields, hierarchical arrangements, or other means of associating terms according to their subject area; for example, the graphic display in the first edition of the Euratom thesaurus (Brussels, 1964)+). In some vocabularies hierarchical relationships are strictly conceived; in others, looser relations are allowed. The "Related term" reference covers a wide variety of kinds of term connections. It is believed that careful analysis would result in an exhaustive list of categories which could serve as a set of criteria for choosing the kinds of relationships a given vocabulary will display. In addition to those represented in the present tables, one would expect the list to include the following kinds, among others: genus-species, class-member, activity-example, whole-part, used in.

The table headed "'See' and 'Use' References" displays the employment and meaning of these terms in the vocabularies studied. It will be noted that with one exception the two terms are used for reference away from an excluded term and direct the assignment of one or more alternative terms instead of the A term. The exception is shown in the last line of the table, which--together with Euratom's "Reference Structure" table--records the fact that after an accepted term "use" is an instruction in this thesaurus to assign one or more additional terms.

The purpose of this essay has been to present a kind of analysis that may have value in clarifying the language and structure of subject access vocabularies with a view to achieving maximum compatibility among them. Again, all those interested in standardiz ion in this field are urged to comment on both the method and the details of this analysis.

+) also in Part II of the second edition, Brussels, December 1967.

Washington, D. C.
30 August 1967
Revised January 1968

References

1. Angell, R. S. "The Specific-to-General See Reference in Thesaurus Construction." Symposium paper IIIg4 International Congress on Documentation, Tokyo, September 1967.

2. The ten lists studied are cited below.

3. For an interesting proposal on the representation of term relations in a set of graphic symbols, cf. C. D. Gull, "Structure of Indexing Authority Lists." Library Resources and Technical Services 10:507-511, Fall 1966.

List of Vocabularies Studied, with Abbreviations

(The five lists marked with an asterisk were not available for the original version of this study. They will be included in a later version.)

AIChE — American Institute of Chemical Engineers.
Chemical engineering thesaurus; a wordbook for use with the concept coordination system of information storage and retrieval. New York, ©1961.

API — American Petroleum Institute. Information Retrieval Project.
Subject authority list. 4th ed. [New York] 1967.

BuRec — U. S. Bureau of Reclamation.
Thesaurus of descriptors; a list of keywords and cross-references for indexing and retrieving the literature of water resources development. Tentative ed. Denver, 1963.

BuShips — U. S. Bureau of Ships. Technical Library.
Thesaurus of descriptive terms and code book. 2d ed. Washington, Bureau of Ships, Navy Dept., 1965.

DDC — U. S. Defense Documentation Center.
Thesaurus of DDC descriptors. Alexandria, Va., 1966.

*DoD — U. S. Department of Defense.
Thesaurus of engineering and scientific terms. (Developed by Project LEX, Office of Naval Research, with joint sponsorship of the Engineers Joint Council. Will replace DDC and EJC. Publication expected in March 1968.)

EJC — Engineers Joint Council.
Thesaurus of engineering terms; a list of engineering terms and their relationships for use in vocabulary control in indexing and retrieving engineering information. 1st ed. New York, 1964. (Will be replaced by DoD).

*ERIC — U. S. Office of Education. Educational Research and Information Center.
Thesaurus of ERIC descriptors. (Publication expected in March 1968.)

Euratom — European Atomic Energy Community. Information and Documentation Center.
Euratom-thesaurus; indexing terms used within Euratom's nuclear documentation system. 2d ed. pt. 1 [Brussels] 1966.

LC U. S. Library of Congress. Subject Cataloging Division. Subject headings used in the dictionary catalogs of the Library of Congress. 7th ed., edited by Marguerite V. Quattlebaum. Washington, 1966.

*NAL U. S. National Agricultural Library. Agricultural/biological vocabulary. 1st ed. Washington, 1967. 2 v.

NASA U. S. National Aeronautics and Space Administration. Guide to the subject indexes for Scientific and technical aerospace reports. Issue no. 1, Apr. 1964. [Washington] 1964.

* -- Thesaurus. Preliminary ed. December, 1967. 3 v. (NASA SP-7030)

NLM U. S. National Library of Medicine. Medical subject headings 1967. Washington, U. S. Department of Health, Education, and Welfare, Public Health Service. (Index medicus vol. 8, no. 1, pt. 2, January, 1967).

*OWRR U. S. Office of Water Resources Research. Water resources thesaurus. Washington, November 1966. (Replaces BuRec).

Tables

1. Tables 1 through 8-9 are numbered to correspond to the statement numbers of Figure 1, Classification of Term Relations. They are followed by tables entitled:

   "See" and "Use" References
   Reference Structure of the Euratom Thesaurus

2. In general no attempt has been made in the tables to indicate the relative frequency with which a given relation is employed in a particular vocabulary. If an example occurs, the appropriate table is marked accordingly. NLM points out, for example, that its use of the reference in Table 4 is infrequent and declining.

1. For A forbidden, B instead

	Expressed as A ... B	Recorded under B as	Relation of B to A				
			Synonym	Antonym	Alternative form	More general term	More specific term
AIChE	see	SF (seen from)	*	*		*	
API	use	used for	*	*	*	*	
BuRec	use	—	*		*		
BuShips	use	includes	*		*	*	
DDC	use	UF (used for)	*			*	
EJC	use	UF (used for)	*	*1/	*	*	*2/
Euratom3/	use	—	*			*	
	see	—	*				*
LC	see	x	*		*	4/	
NASA	S (see)	—			*		
NLM	see	X	*		*		*
	see under5/	XU				*	

1. Uncommon in EJC 1964; specified for DoD.
2. Uncommon in EJC 1964; not specified for DoD.
3. For examples see the appended "Reference Structure of the Euratom Thesaurus," November 1967.
4. The see reference to a more general term was abandoned in Library of Congress subject heading practice many years ago. Some examples remaining in the list are being eliminated.
5. NLM also employs "see under" for statement 4. See Table 4.

	2. For A forbidden, B and C instead			
	Expressed as A ...	Recorded under B as	Recorded under C as	Relation of B and C to A
AIChE				
API	use B plus C	UF A plus C	UF A plus B	More general terms, whose intersection is synonymous with A
BuRec				
BuShips	use B C	—	—	same as API
DDC	use B and C	UF +A 1/	UF + A 1/	same as API
EJC	use B C	UF A 2/	UF A 2/	same as API
Euratom	use B + C	—	—	same as API
LC				
NASA				
NLM				

1. DDC tracings are to be read, respectively, as "B and another term are used for A," "C and another term are used for A."

2. DcD tracings will show that two or more terms are used for A.

3. For A forbidden, B and C and ...N instead

	Expressed as A ...	Recorded under B as	Recorded under C ... N as	Relation of B, C ...N to A
EJC	use B C ... N	UF A[1]	UF A[1]	more general terms
Euratom	use B + C ... + N	——	——	more general terms

1. DoD tracings will show that two or more terms are used for A.

	4. For A forbidden, B or C or ... N instead					
	Expressed as A ...	Recorded under B as	Recorded under C ... N as	Relation of B, C, ... N to A		
				Components, divisions, examples	Alternative form	Various
AIChE						
API	see B C ... N	—	—	*	*	*
BuRec						
BuShips						
DDC						
EJC						
Euratom[1/]	see B or C ... or N	—	—	*	*	
LC	see B C ... N	x	x	*		
NASA	S B C ... N	—	—	*		
NLM	see under B, C, ... N	XU	XU	*		

1. For examples see the appended "Reference Structure of the Euratom Thesaurus." November 1967.

5-7. For A permitted, B ... also required

		Expressed as A ...	Recorded under B ... as	Relation of B ... N to A	
				More general term	various
5.. B only	API	Broader terms (autoposted) B	Narrower terms A	*	
		Related terms (autoposted) B	See also A*	*	*
	Euratom	Use B	———	*	
6-7 B and C B and C and ... N	API[1]	Broader terms (autoposted) B C ... N	Narrower terms A	*	
		Related terms (autoposted) B C ... N	See also A*	*	*
	Euratom[2]	Use B + C ... + N	———	*	

1. In some of the 2-term cases B and C together define A, but most relations are looser.

2. In the 2-term case, B and C together define A.
In the 3 or more terms case, B, C ... N are members of class A or attributes of A.

8- 9 For A permitted, consider B ... N also

Expressed as A ...	Recorded under B ... N as	Relation of B ... N to A			
		more general	more specific	related in use	various relations

"See" and "Use" References: Terminology, Meaning, Occurrence

(Numbers in brackets are those of the statement formulas in Figure 1)

Vocabulary	A see B	A use B	A use B and C	A use B and C and ... N	A see B or C or ... N
	A is a forbidden term --assign B instead	[1]	[2] A is a forbidden term-- assign both B and C instead	[3] A is a forbidden term-- assign B and C and ... N instead	[4] A is a forbidden term-- assign B or C or ... N instead
AIChE	*				
API		*	*		*
BuRec		*			
BuShips		*	*		
DDC		*	*		
EJC		*	*	*	
LC	*				*
NASA	*				*
NLM	*				* 1/
Euratom	*	* [5] If A is an accepted term, assign B also.	* [6] If A is an accepted term, assign both B and C also.	* [7] If A is an accepted term, assign B and C and ... N also	*

1. NLM's "see under" is also used for this reference.

November, 1967

Reference Structure of the Euratom Thesaurus[1/]

Type of Term	Examples			Symbolic
1. Keywords (no references)	ACETIC ACID			K
2. Accepted Index Terms (only USE-references)	ACETYL RADICALS	USE	ACETIC ACID	A → K
	ACETYLATION	USE +	ACETIC ACID CHEMICAL REACTIONS	A → K_1, K_2
	ACETOLYSIS	USE +	ACETYL RADICALS DECOMPOSITION	A_1 → A_2, K_2
3. Forbidden Terms (Synonyms and Abbreviations) (only USE-references)	-COLUMBIUM	USE	NIOBIUM	-F → K
	-ADU	USE +	AMMONIUM COMPOUNDS URANATES	-F → K_1, K_2
	-ADRENOCORTICOTROPIC HORMONE	USE	ACTH	-F → A
4. Forbidden Terms (Homographs) (only SEE-references)	-CONDUCTIVITY	SEE OR	ELECTRIC CONDUCTIVITY THERMAL CONDUCTIVITY	-H ?! K_1, K_2
	-BADGES	SEE	FILM BADGES	-H ?! A
	-MPA	SEE OR	MERCAPTOPROPYLAMINE MP-ACTIVITY	-H ?! A_1, A_2

1. This table was kindly supplied by Mr. Loll M. Rolling, Head, Mechanized Documentation, Euratom, Brussels, and is included in this version with his permission.

The Specific-to-General See Reference in Thesaurus Construction

A common constructive feature of thesauri, subject heading lists, "indexing vocabularies," and the like, is the cross reference which specifies that a general term is to be assigned to relevant documents instead of a specific one having a hierarchically subordinate relation to the general term. Despite the prevalence of this kind of reference, this paper advances the proposition that it is a faulty element in the structure of subject access vocabularies1/.

As a basis for discussing the reasons for this view, attention is called to some of the results presented in the preceding paper, "The Language of Term Relation Designations in Subject Access Vocabularies." An analysis of ten vocabularies2/ was made for the purpose of identifying the kinds of connections between terms which are established in representative vocabularies and the manner in which these connections are conveyed and displayed.

For this identification it became useful to develop a complete list of the ways in which terms are connected in the vocabularies and to express these relations in a set of formula statements from which the terms used in the lists were excluded. Figure 1, Classification of Term Relations (page 2 of the preceding paper) contains the list and the formula statements.

In these formulae, "A" represents a term referred from; "B," "C," "...N" the term or terms referred to. "A" may be an excluded or a permitted term; "B," "C," "...N" are of course permitted terms. "Target terms" is sometimes a convenient designation for "B," "C," "...N."

In the preceding study, the formula statements of Figure 1 are used as headings for a set of tables designed to show how each relation is expressed in each of the ten vocabularies. The tables also show whether or not the relation is recorded under the target term or terms, and if so, how; and the kind of relation the target terms bear to the A term.

The specific-to-general see reference falls in Section I of the outline, where A is a forbidden or excluded term. It occurs in two forms: term-to-single-term and term-to-two-terms. Table 1 (page 10) exhibits the term-to-term reference as used in the ten vocabularies studied. It will be observed that the specific-to-general reference is used in seven of them (the "more general term" column under "Relation of B to A"). One vocabulary expresses the relation by "see," five by "use," and one (NLM) by "see under." This is the only vocabulary in which the specific-to-general reference is given its own formulation. As Table 1 shows, "see" or "use" is employed

by other vocabularies for all of the term-to-single-term relations that a given list displays.

It is worth noting that the seven vocabularies using the specific-to-general see reference have been developed for collections in scientific and technical fields and that all of them are used in mechanized systems. Exploration of the reasons for this circumstance is beyond the scope of this paper.

Two of the vocabularies (AIChE and API) do not call attention in prefatory material to the use of this kind of reference. The others note the practice without comment3/.

Appended to this essay is a set of examples relating to Table 1 drawn from the vocabularies studied. It contains specific-to-general term-to-term see references; or, in the formulation of Table 1, A forbidden, B instead (when B is a more general term than A). The examples are set up in the following manner: in the left column is an A to B reference; in the right column the target term is listed, and under it the A term and any others from which reference is made. If the target term also has narrower terms (NT) listed under it, these have been included. The dots indicate omissions of parts of the entry not relevant to the present discussion. Numbers in parentheses are those of the pages on which the term is listed in its vocabulary.

Examination of these examples suggest that it will be useful to consider separately the two cases:

1) Only A terms appear under the target term, (e.g. BuShips, Programming languages);

2) Both A terms and narrower terms (NT) are listed under the target term (e.g. API, Mathematics)

A typical example in the first group is BuShips' treatment of Programming languages, namely, the general heading is used both for works on the topic as a whole and for works on each of the particular languages4/. Other examples in this set will be recognized readily, though not all have the same complexion. While it can be argued that BuShips' Programming languages and EJC's Analogies assemble homogeneous topics, and that a searcher interested in one of them would find the literature on all of them useful, the same representation could hardly be made for BuShips' Underwater clothing and EJC's Projectiles. In any event the consequence of the practice is that a user interested only in FORTRAN will be presented with all the documents, or the entries for them, on Programming languages and ALGOL and COBOL and FROLIC. As a result, the user seeking material on a specific topic that is included under a general topic must examine items extraneous to his interest. It appears, for example, that in the Euratom

example, at least 66 entries under Triga series would have to be scanned to be sure of locating all references to one of the 36 particular reactors5/.

It has been noted that in some cases both A terms and narrower terms are listed under the target term. The narrower term designation is a see also reference to a term of lower rank in a hierarchy, to a member of a class, and the like. NTs are permitted terms and the designation means that there are also entries under the narrower term or terms.

It will be observed that in most of the Table 1 examples of this kind, the A terms ("used for," "includes") and the NTs are not different in kind. Simple examples are DDC's Vegetables and EJC's Food. More complex are API's Mathematics and Legal consideration and DDC's Equations.

Presumably this result has its origin in a desire to limit the number of terms in the vocabulary. It may be assumed that the presence of a term in one or the other block is based on the frequency with which the term is expected to be applied. When that number is small, the term is a forbidden one.

Despite the apparent economy of this practice it is believed that the examples offered (which, while not numerous, are representative) show the following disadvantages:

1. The reference acknowledges the existence of a specific subject but denies the searcher direct access to material on that subject through a specific subject heading or index term.

2. As a consequence, review of an undeterminable amount of non-relevant material is required in the retrieval process.

3. With the growth of the collection, extensive re-indexing under specific terms is a probable requirement.

4. The consequence of assigning different structural relations to terms of the same intrinsic relation to a permitted term is that the pattern of term relation is unclear, to the indexer and searcher.

The foregoing considerations are strong enough in relation to the construction of a particular vocabulary and operation of the system based on it. They gain additional force when any thought is given to making different vocabularies compatible. It seems intuitively clear that the more a vocabulary expresses generally accepted subject relationships and the less its term relationships are based on the circumstances

and content of a particular collection, the more easily it can be made compatible with other vocabularies. A brief example suggests the problems that arise in the present case:

NLM	DDC
Alcoholism	Alcoholism Use Addiction
Addiction see Drug addiction	Addiction UF Alcoholism RT Narcotics

While the difficulties in the way of compatibility between vocabularies are many and formidable, it is believed that a significant contribution to achieving it would be made by removing the anomalies created by the employment of the specific-to-general see reference.

For these reasons, it is believed that this reference should be abandoned as an element in the construction of subject access vocabularies. Thus, the type 1 reference (A forbidden, B instead) would be limited to synonym, antonym, and alternative form[6].

References

1. The expression "subject access vocabulary" is used as a general term for subject heading lists, thesauri, and the like.

2. A list of the vocabularies is appended to the "Term Relations" paper.

3. For DDC the statement is contained in: U. S. Office of Naval Research. DoD Manual for Building a Technical Thesaurus. Project LEX. Washington, 1966. p. 15.

4. DDC treats Programming languages in the same manner, but in EJC the particular languages and classes of programming languages are NTs.

5. The Euratom thesaurus includes a count of the number of assignments of each descriptor.

6. If the specific-to-general reference is eliminated, all of the term-to-single-term references of the DoD Manual can be comprehended in these three.

Table 1 Examples - 1

API	Algebra (11) Use Mathematics	Mathematics (180) Narrower terms Dimensional analysis Distribution Equation Probability Statistical analysis ... Used for Algebra Analytical geometry Applied mathematics Calculus Extrapolation, Mathematical Fourier analysis Interpolation, Mathematical Linear algebra Matrix algebra
	Condemnation statute (64) Use Legal consideration	Legal consideration (168) ... Narrower terms Concession Contract Lease License Patent ... Used for Bill, Legal Condemnation statute Consent decree Decision, Legal Decree Law Lawsuit Legislation Regulation, Legal Ruling, Legal Statute Treaty

Table 1 Examples - 2

BuShips

Sulfur dyes (S-43)
Use:
Dyes

Dyes (D-20)
Includes:
Sulfur dyes

ALGOL (A-20)
Use:
Programming languages

Programming languages (P-32)
Includes:
ALGOL
COBOL
FORTRAN
FROLIC (Proposed language)

...

Diving suits (D-15)
Use:
Underwater clothing

Underwater clothing (U-2)
Includes:
Diving suits
Swim suits

Banach algebra (B-2)
Use:
Algebras

Algebras (A-20)
Includes:
Banach algebra
Boolean algebra
Jordan algebra
Lie algebra
Linear associative algebras
Nonassociative algebras

...

Narrower terms
Matrix algebra

Table 1 Examples - 3

DDC	Fat embolism (182) Use Embolism	Embolism (170) UF Embolus Fat embolism + Oil embolism + Pulmonary embolism + Thromboembolism ... NT Gas embolism
	Pulmonary embolism (356) Use Embolism and Lungs	
	Beets (86) Use Vegetables	Vegetables (467) UF Beets Carrots Onions ... NT Potatoes
	Functional equations (198) Use Equations	Equations (174) UF Functional equations Linear equations Riemann's functional equation Secular equations Sourian-Frame characteristic equation Transcendental equations ... NT Differential equations Equations of motion Integral equations Lanchester equations Simultaneous equations

Table 1 Examples - 4

EJC Electric Analogies (82)
Use Analogies

Artillery shells (16)
Use Projectiles

Bread (28)
Use Food

Analogies (12)
UF Electric analogies
Hydraulic analogies
Mechanical analogies

Projectiles (206)
UF Artillery shells
Bullets

Food (105)
UF Bread
NT Beverages
Coffee
Frozen Food
Meat

Table 1 Examples - 5

Euratom	-Triga Veterans	Use Triga series (83)
	-Triga-Arizona	Use Triga series
	...	
	-Triga-F-Dasa	Use Triga series
	...	
	-Triga-I-La Jolla	Use Triga series
	...	
	-Triga-II-Bandung	Use Triga series
	...	
	-Triga-III-Mexico	Use Triga series
	...	
	-Triga-Kansas	Use Triga series
	...	
	-Triga-Texas	Use Triga series

NLM	Amino acid deficiency (8) see under Deficiency diseases	Deficiency diseases (42) XU Amino acid deficiency XU Hunger edema XU Malnutrition XU War edema
	Kleptomania (91) see under Neuroses, Obsessive-compulsive	Neuroses, Obsessive-compulsive (113) XU Kleptomania XU Mania XU Obsession XU Psychasthenia XU Trichotillomania

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