Lib sc. 11; 1974; PAPER D.

A General Theory of Subject Headings.
(Cataloguing problems. 21). (Subject heading series. 5).

G Bhattacharyya, *Senior Lecturer, Documentation Research and Training Centre, Indian Statistical Institute, Bangalore 560 003, India.*

[The work of deriving subject headings and the work of classifying have their common foundation in the classification of the universe of subjects. Classification is always purpose oriented. As a process, it essentially consists of recognising " Groups " to suit the purpose in hand. When the groups are made to relate hierarchically, it is a product of " Organising Classification". Organising classification establishes " Coordinate—Superordinate—Subordinate—Collateral Relationships " (COSSCO-relationships) among subjects. Non-hierarchical groups are the product of " Associative Classification". Organising classification is based on the recognition of structures of subjects, wherever warranted, in two dimensions — the dimension of denotation, and the dimension of elementary constituents. The former may be referred to as " Semantic Structure ", and the latter as " Elementary Structure ". A coextensive name-of-subject in a natural language is not readily suggestive of its COSSCO-relationships. According to a coherrent set of postulates relating to the elementary structures of names-of-subject, it can be translated into an " Artificial Verbal Language " to make it readily suggestive of its COSSCO-relationships. The recognition of the elementary structure of a name-of-subject consists of recognising the elementary constituents—the " Base " and the " Complements ". A coextensive name-of-subject in an artificial verbal language augmented by introducing the superordinates of the base and of the complements is a " Modulated Name-of-Subject ". It is the horizontal version of a " Chain " resulting out of organizing classification. A modulated name-of-subject can be further translated into an artificial language of ordinal numbers called " Notational Language " to mechanise the determination of COSSCO-relationships. At each stage, it is a name-of-subject. When it is used or intended to be used as a search-name, it becomes a " Subject Heading ". The form of a modulated name of subject is readily amenable to transformation for creating groups of associative classification. Thus, the results of organising classification can serve as the source of deriving mechanically the associative classification; while the opposite process can never be reduced into a mechanical job. results of in serving the whole purpose of subject headings, organising classification and associative classification are complementary to each other.]

1 Introduction

On the basis of a thorough analysis of Cutter's rules of procedure for deriving specific subject headings, Ranganathan arrived at the following conclusion in 1930's:

" The difficulty ... with regard to a Doublet does not merely depend on a choice between alternative names obtained by transposition; it is more deeply rooted. It is in fact inextricably involved with the very concept of Specific Subject. To my mind most of these difficulties are traceable to absence of a definite objective impersonal method of arriving at the Specific Subject of a book. The impression produced by Cutter's rules is that he intends the Specific Subject of a book to be determined by the cataloguer. But surely determinantion of the Specific Subject of a book belongs to classification rather than to cataloguing. Even classification should not be dependent on the discretion of an individual classifier in an individual library. According to the Prolegomena (1937), classifying usually implies:

(i) presence and adoption of a scheme of classification;

(ii) implicit or explicit indication of the associated succession of characteristics;

(iii) Assignment of a book to the appropriate class of the scheme of classification by ascertaining the way in which each of the characteristics of the scheme is shared by it; and

(iv) assignment of the appropriate class number to the book.

" Thus determination of the Specific Subject of a book is ultimately in the hands of the scheme of classification adopted ... this shifting of the burden of determining the specific subject of a book from the cataloguer to the scheme of classificotion will resolve all the nightmare difficulties in framing rules for the Specific Subject Entry in a Dictionary catalogue ".

" If the scheme of classification in use possesses the necessary devices for fully satisfying the Canon of Hospitality in Chain, the Ultimate Class of a book will represent its Specific Subject. A definite procedure is to find the Class Number of the book and represent it in the form of a Chain of Classes. The last link in the chain gives the Specific Subject." (7).

To justify his conclusion, Ranganathan (1) selected representative examples from Cutter, (2) linked each of them with its class number in Decimal Classification, (3) represented each in the form of a chain, and (4) derived the specific subject heading for each from its last link. In every case, he showed that it was according to the pertinent prescription preferred by Cutter. Ranganathan's demonstration established it firmly that classification of subjects forms the foundation of the derivation of subject headings. His findings added a new dimension to the research on subject headings. It paved the way towards a general theory of subject headings. An attempt is made in this paper to consolidate the findings of researches in this dimension. The aim is to formulate a tentative outline of a general theory pertaining to the work of transforming forms of names-of-subject for the purpose of finding information on the subjects concerned.

For the purpose of manual searching of a subject file, it is essential to use the names-of-subject as the headings of the entries. In this context, the term ' Subject Heading ' is full of significance. But for the purpose of computer searching, the names-of-subject need not occupy the headings of the entries. It can be anywhere is an entry. It requires to be associated with its standard address mark in the entry concerned. Therefore, in this context, the term ' Subject Heading ' has little significance; there, it is merely a name-of-subject. Though the term ' Subject Heading ' has been used in the discussion, the theory holds good equally well in both the contexts.

2 Classification

Ranganathan's conclusion is that the work of deriving subject headings and the work of classifying subjects have their common foundation in the classification of the universe of subjects. "What is Classification ? " — is then a vital question in this context.

Classification is always purpose oriented. As a process, it is applied to a universe. It results in mutually related groups of various orders within the universe concerned. A group may be either unitary or multiple. Mutual relationships among the groups are established by recognising their respective " Logical Forms " (5). The logical form of a group is the manifestation of its structure. The structure of a group refers to its parts and their interrelationships. Interrelationships among the parts of a group manifest in their respective ranks. The purpose of classification determines the orders of the groups to be recognised, and the degree of ranking to be incorporated. At bottom therefore, classification, as a process, consists essentially of recognising purpose oriented logical forms of the entities of a universe to recognise groups and their mutual relationships. In this context, classification, as a process, is defined to be consisted of grouping alone, or of grouping *cum* ranking (6).

Groups recognised through structural analysis are comparable among themselves. Ranks of the different groups are determined by a process of comparison of their respective structures. Ranking of groups results in a hierarchy. The degree of hierarchy to be incorporated is again purpose dependent. In an intensive hierarchy, each group gets distinguished, from all other groups with reference to its coordinates, superordinates, subordinates, and collaterals. Viewed from this angle, classisfication, as a process, consists of distinguishing each entity in the universe concerned from all other entities by recognising its relationships with its coordinates, superordinates, subordinates, and collaterals. For convenience of reference, these relationships can be called " COSSCO-Relationships ".

3 Subject

The next pertinent question, in this context, is — " What is a Subject ? " It is convenient to depend

upon a set of precisely defined terms to understand the denotation of the term 'Subject'. For this purpose, as a minimum, the terms 'Idea', 'Information', and 'Subject' may be considered.

Idea

Ordinarily, the term 'Idea' is used to denote any one of the following.

1 A meaningful impression of an entity obtained by use of senses (percept);
2 A mental image formed out of association of several percepts;
3 A generic mental image abstracted from percepts;
4 A product of reasoning;
5 A resultant of a generalising mental operation;
6 A product of mental reflection;
7 A product of imagination; and
8 A directly initiated entity of thought. (9).

The totality of all the entities mentioned above constitute the universe of ideas.

Information

The term 'Information' is used to denote a systematised body of ideas, communicated or acquired; or intended to be communicated or acquired (9). This is the sense in which the term 'Information' is extensively and universally used in the word group 'Information Science'.

The term 'Systematised' used in the definition is a derivative of the term 'System'. The term 'System' is used here in the sense in which it is used in the general system theory or system science. In brief, a system is an entity-complex deemed as an integrated whole made up of functionally related components of various orders.

"Systematisation" is the essence of "Information". It is only by this process, that a set of ideas get transformed into information. Therefore, the universe of information is a transformed universe of ideas.

Subject

The term 'Subject' is used to denote an idea or idea-complex that summarises indicatively a body of information.

This is the sense in which the term 'Subject' is extensively and universally used in the word group 'Subject Heading'. The universe of subjects is, therefore, a transformed universe of information.

4 Subject-Classification

41 Nature of Subject-Classification

When applied to the universe of subjects, classification is not essentially different from classification in general. Like classification of any other universe, subject-classification also is purpose-oriented. This implies that there cannot be any absolute COSSCO-relationships of subjects; and therefore, there cannot be any absolute subject-classification. In other words, subject-classification, and therefore, COSSCO-relationships of subjects can only be relative to some pertinent pattern of grouping. Corresponding to the different pertinent patterns of grouping, different effective COSSCO-relationships can be recognised. For every specific pattern of grouping, there is a specific pattern of COSSCO-relationships. Therefore, when the purpose warrants multiple patterns of grouping, subject-classification has to avoid rigidity and welcome flexibility, by all means.

The purpose of finding (discovering and retrieving) information calls for multiple patterns of grouping. Consideration of economy, consistency, and effectiveness suggests to adopt a standard pattern of grouping which can serve as a source-pattern for the derivation of all other pertinent patterns. A pattern incorporating the necessary and sufficient hierarchy can serve as a source-pattern for deriving mechanically the pertinent non-hierarchical patterns. On the contrary, the opposite procedure cannot be reduced into a mechanical job. Obviously therefore, the standard pattern should incorporate the necessary and sufficient hierarchy.

42 Organising Classification

The arrangement based on a standard pattern of grouping results in an "organisation" — that is, a hierarchical grouping. For convenience of reference, the classification resulting in "organisation" may be denoted by the term 'Organising Classification'. In organising classification, the COSSCO-relationships are explicit; and the related groups are juxtaposed.

43 Associative Classification

The arrangement based on the derived patterns of grouping results in "associative grouping." For convenience of reference, the classification resulting in an associative grouping may be denoted by the term 'Associative Classification'. In associative classification, the COSSCO-relationships are not explicit; and the related groups are linked up by cross-references.

44 Semantic Structure of a Subject

The designing of a standard pattern of grouping is based on the recognition of structures of subjects. When a subject consists of an idea deemed to be a unit by itself (for the reason of not warranting analysis into more than one units for the purpose in hand), its structure can be recognised in one dimension only. This dimension consists of the non-wholes constituting the subject deemed to be a whole, and of their inter-relationships. The non-wholes may be derived on the basis of more than one characteristics. Their recognition is based on the denotation of the subject concerned. The structure of a subject determined on the basis of its denotation may be designated as its "Semantic Structure". The semantic structure of a subject is analogus to the vertical structure of an object. This may also be referred to as "Non-whole-Structure". The semantic structure of a subject is intrinsic to it.

45 Elementary Structure of a Subject

When a subject consists of an idea-complex, its structure can be recognised in two dimensions.

Firstly, it has its intrinsic semantic structure. And secondly, it consists of more than one unit-ideas or elementary constituents. Therefore, the unit-ideas constituting the idea-complex and their inter-relationships constitute the second dimension. The recognition of unit-ideas is based on postulates. The postulates are propositions or other formulations adopted for their helpfulness to the purpose in hand. Depending upon the purpose in hand, postulates may vary. Even for one and the same purpose, different sets of postulates may prove more or less equally helpful. Postulation is an artificial measure. In relation to the universe of subjects, postulates are primarily concerned with the following two areas:

1 The categories of elementary constituents and their subcategories; and

2 The relationships (manifested in sequence) among the elementary constituents when they occur in association.

An elementary constituent is recognised to be either a " Base " or a " Complement ". Their recognition is again purpose dependent. When the purpose is to make all the subjects relating to a particular elementary constituent to form a group, the elementary constituent concerned is recognised as a " Base ". A " Complement " may consist of a " Modifier " of an idea or idea-complex deemed to be a subject. A modifier reduces the extension of a subject without affecting the conceptual wholeness of its idea-correlate. A complement may also consist of a non-whole of a recognised base. But, it is neither formed by explicit or implicit association of a modifier with the base concerned; nor does it warrant to be recognised as a base for the purpose in hand. A modified base is a " Compound Base ". A modified non-whole complement is a " Compound Complement ".

The structure of a subject determined in terms of its elementary constituents may be designated as its " Elementary Structure ". The elementary structure of a subject is analogous to the horizontal structure of an object. The elementary structure of a subject is artificially imposed on it. Its value lines in its helpfulness for the purpose in hand. The epithets " true " and " false " do not apply to the elementary structure of a subject.

5 Subject Headings

51 Subject Headings and Classification

A subject heading is a name-of-subject, used or intended to be used as the heading of an entry. Such a name containing the base and the complements necessary and sufficient in a definite context, and whenever warranted, the relationships among them, is a " Coextensive Name-of-Subject ". A coextensive name-of-subject augmented, whenever applicable, by introducing as far as necessary, the superordinates of the base and of the complements is a " Modulated Name-of-Subject ". Formulation of subject headings in the context of information science, documentation, and library science consists of transforming the structure (parts and their relationships) of names-of-subject in such a way that it admits of adopting a suitable principle of their arrangement for the purpose of designing a file of entries which help expeditious finding of information about sources of information on any subject covered by the file concerned. In relation to the needed information, a source of information may be exclusively devoted to the specific subject, or it may be one embedding information on a subject of greater extension; or it may be one embedding information on a subject of smaller extension. A source of information on a collateral subject also may furnish useful information. When the problem relating to the sources of information is so, the solution lies in organising classification only.

52 Artificial Verbal Language

If the organising classification is in the verbal plane, the arrangement of the names-of-subject is to be alphabetical. In alphabetical arrangement, the advantages of organising classification can be exploited only to a limited extent. Again, the arrangement of names-of-subject in a natural language cannot normally ensure any organising classification. A coextensive name of subject in a natural language whenever necessary uses auxiliary words to indicate the different relationships among the components. And therefore, it does not require to pay much attention to the sequence of the substantives than what is warranted by the rules of grammar. Again, coextensive name, of subjects in a natural language are not readily suggestive of their COSSCO-relationships. For this purpose, such names are to be restructured in standard patterns according to a coherent set of postulates relating to their elementary structures. They are to be further augmented by the introduction of the superordinates of the bases and of the complements wherever necessary. The results will be modulated names-of-subjects. A modulated name of subject avoids the use of auxiliary words. The relationships among the components are expressed largely by their sequence and non-verbal relation indicators. Though the words in a modulated name-of-subject are drawn from a natural language, its grammer is basically different from that of the natural language concerned. For convenience of reference, such a language can be designated as an " Artificial Verbal Language ". It is a translating-*cum*-transforming language meant for transforming the forms of names-of-subject so as to make them readily suggestive of their COSSCO-relationships.

53 Notational Language

Alphabetical arrangement of modulated names-of-subject can ensure organising clasification to a great extent. But, to exploit the full advantages of organising classification, the modulated names of subjects are to be translated and transformed further into artificial language of ordinal numbers. Such a language can mechanise the determination of COSSCO-

relationships to the extent desired. In this case, the names-of-subject (subject headings) are in notations or class numbers. The alphabets, and also the grammar of this language are quite distinct from that of the original artificial verbal language. For convenience of reference, it can be designated as a "Notational Language" or "Language of Class Numbers."

6 Evolution of Languages of Subject Headings

61 Language of Organising Classification

The language of organising classification has naturally been, in the majority of cases, the notational language. The subject headings in notational language — that is, class numbers — derived by using Dewey's Decimal Classification, Cutter's Expansive Classification, the Universal Decimal Classification of the International Federation for Documentation, the Classification of the Library of Congress, Brown's Subject Classification, Ranganathan's Colon Classification, and Bliss's Bibliographic Classification, are all meant for implementing the principle of organising classification in different notational languages. The first attempt for organising classification in artificial verbal language can be recognised in systematic catalogues based on verbal subject headings. Its development in the next stage took place in alphabetico-classed catalogues. Cutter's procedure of linking superordinates, subordinates and collateral by cross references without indicating the relationships precisely, marked the next stage of development in attempting organising classification in an inadequate measure by using artificial verbal language. The latest development in this direction has taken place in the systematic part of the catalogue based on modulated names of subjects, designed by using POPSI (Postulate-based Permuted Subject Indexing)—a specific version of Ranganathan's Chain Procedure (1, 2).

62 Language of Associative Classification

An associative classification need not pay much attention to COSSCO-relationships. Therefore, an artificial verbal language is more suitable for an associative classification. Naturally, in the majority of cases, associative classification has been attempted in artificial verbal languages.

The subject headings derived by using Cutter's Procedure of Specific Subject Indexing, Dewey's Procedure of Relative Indexing, Kaiser's Procedure of Systematic Indexing, the Procedure of the Library of Congress, Ranganathan's Chain Procedure and its different versions, Sear's Procedure, PRECIS (Preserved Context Index System) of BNB, and the procedure prescribed by any thesaurus, are all meant for implementing the principle of associative classification in different artificial verbal languages. The first attempt for associative classification in notational language can be recognised in UDC-prescription for permuted class numbers; but it has now been recommended to be abandoned for its problems and disadvantages (8).

7 Symbiosis Between Organising Classification and Associative Classification

71 From Organination to Association

Organising classification is essential in exploiting the advantages of COSSCO-relationships for the purpose of coping with the nature of embodiment of information in sources. But, the need of information may centre round an idea deemed to be a complement going with different bases in the organising classification in use. In this context, the role of COSSCO-relationships is comparatively unimportant. On the contrary, getting together everything relating to the idea concerned, is most important. Such a situation is analogous to treating the idea as if it were a base by itself, and all other ideas associated with it as complements. In other words, it calls for an associative classification. In serving the whole purpose of subject headings it is always necessary to complement an organising classification by an associative classification.

In the initial stage of development, and during a long period after that, organising classification was not supplemented by associative classification. Gradually, the disadvantages of this policy were realised. Attempts for simultaneous organising *cum* associative classification were first made in the alphabetico-classed catalogues at the beginning of the nineteenth century. But this compromise resulted in a sacrifice of some of the advantages of both varieties of classification. In the last quarter of the nineteenth century, very substantive development took place in Dewey's realisation of the need of supplementing organising classification by associative classification. He designed a tool of very high order — the Decimal Classification and Relative Index — to implement the principle and to ensure consistency in practice. Development in this direction culminated in Ranganathan's Colon Classification — a novel scheme for organising classification — and Chain Procedure — a device for implementing associative classification. Both the tools originate from the same foundation — namely, the postulate based modulation of names of subjects. The theoretical foundation of these tools, developed by Ranganathan himself is adequately general to explain any specific attempt in this direction.

72 From Association to Organisation

Associative classification originated as an alternative to organising classification in the middle of the seventeenth century. Gradually, it was realised that associative classification by itself could never be an effective substitute for organising classification; and therefore, it required to be supplemented by organising classification in some form or other. Cutter's realisation in this respect is noteworthy:

"The systematic catalogue undertakes to exhibit a scientific arrangement of books in the library in the belief that it will thus best aid those who would pursue any extensive or thorough study. The dictionary catalogue sets out with another object and a different method, but having attained that object —

— facility of reference — is at liberty to try to secure some of the advantages of classification and system, in its own way. Its subject entries, individual, general, limited, extensive, thrown together without any logical arrangement, in most absurd proximity — Abscess followed by Absenteeism and that by Absolution, Club-foot next to Clubs, and Communion to Communism, while Bibliography and Literary history, Christianity and Theology, are separated by half the length of the catalogue — are a mass of utterly disconnected particles without any relation to one another each useful in itself but only by itself. But by a well-devised net-work of cross-references the mob becomes an army, of which each part is capable of assisting many other parts. The effective force of the catalogue is immensely increased ". (3). Cutter introduced organising classification in the main body of associative classification by linking up coordinates, superordinates, subordinates and collaterals without a precise indication of their respective relationships, through a network of cross references. The need of cross referencing without indicating the relationships precisely, could be met well in an artificial verbal language. But Cutter realised that his approach was too inadequate to introduce even elements of organising classification. He realised further that such an attempt would virtually result in the development and incorporation of an ill-designed scheme for organising classification within the catalogue itself; and that would be a task of " immense labour ". Therefore, he concluded, " But what is too much for each catalog to undertake may profitably be done for all catalogues. In a way it has been done by the tables and the indexes of two well-known systems of classification; the " Decimal " and the " Expansive " which offer to the persistent inquirer — the only one who would ever use such a table — an opportunity to push his investigations into every ramification of his subject ". (4). In other words, Cutter realised that (1) a subject index made up of specific subject entries alone, can meet the demand of associative classification only; (2) cross referencing was, on the one hand, an ineffective and uneconomic means of incorporating organising classification in the main body of associative classification; and on the other it cannot become operative without a predesigned scheme for organising classification; and therefore, (3) it was effective and economic to depend upon a predesigned scheme to meet the demand of organising classification. Cutter did not proceed further. If he would have proceeded further, perhaps, he would have realised that any associative classification has for its foundation an organising classification — whether explicit or implicit. The implications of Cutter's realisation was enormous. It certainly strengthened the foundation of the principle: Subject headings are both for organising classification and associative classification; and one complements the other. Dewey seized the principle simultaneously with Cutter, perhaps without an elaborate experience as that of Cutter. This is evidenced in his approach to subject headings through his Decimal Classification — a scheme for organising classification, and Relative Index — a scheme for associative classification. Kaiser followed Cutter in a restricted field of interest. He recognised commodities as the bases for his associative classification, and incorporated elements of organising classification through cross-referencing. On the basis of an elaborate experiment and investigation, Ranganathan consciously seized the fundamentals regarding the relationship between organising classification and associative classification. This is evidenced in his general theory of classification and subject headings. These fundamentals can be abstracted as follows:

An organising classification is based on the recognition of structures of subjects, wherever applicable, in two dimensions — namely, semantic structure and elementary structure. Semantic structure is intrinsic to the subject. Elementary structure is postulated. Recognition of elementary structure equals to recognition of the base and the complements. The recognition of the base, the complements, and their mutual relationships, in a name-of-subject and augmenting it by introducing, wherever warranted, the names of their respective superordinates, result in a modulated name-of-subject. A modulated name of subject is a chain in horizontal dimension. It is suggestive of every link in the chain. In associative classification, each component of a modulated name-of-subject is deemed to be as if it were a base. Therefore, the structure recognised for organising classification can serve as the basis for recognising the structures for associative classification. On the contrary, an associative classification by itself can never serve as the basis for organising classification. The structure of a name of subject for associative classification, when derived from its structure for organising classification, if necessary, can be made to be readily indicative of the latter. The specific subject heading prescribed by Cutter is a name of subject structured by deeming the last link of the chain (or the modulated name-of-subject) as if it were a base.

Modern uniterm indexing based on a thesaurus is primarily an example of associative classification. A thesaurus is a scheme for organising classification in an artificial verbal language. The choice of the unit concepts and the determination of their different roles are impliedly based on a modulation of names-of-subject on the basis of the recognition of their respective semantic and elementary structures. Essentially the form of a thesaurus is systematic — that is, organising or hierarchical. But, it can be presented in a dictionary form also indicating explicitly the co-ordinates, superordinates, subordinates, and collaterals. This form of presentation appears to be more popular. The derivation of subject headings for uniterm indexing and the formulation of search-strategies are intimately linked up with the thesaurus concerned. Therefore, while the uniterm subject index presents predominently associative classification, the thesaurus itself complements it as an organising classification.

In a computer readable file, each single modulated name-of-subject can be exploited to meet the demand of organising classification and associative classification simultaneously. On the contrary, a non-modulated name-of-subject cannot be exploited to meet the demand of organising classification, unless it is intimately linked up with a thesaurus.

8 Varieties of Schemes of Subject Headings

In the light of the general theory of subject headings presented in the earlier sections, it is possible to conclude that any conventional scheme for classification can be regarded as a scheme (list) of subject headings; and any conventional list (scheme) of subject headings can be regarded as a scheme for classification. In other words, both conventional schemes for classification and conventional lists of subject headings including thesauri are essentially schemes for classification. A scheme for classification, therefore, may be a scheme for organising classification or a scheme for associative classification. A scheme for organising classification is hierarchical in form. A scheme for associative classification is predominantly non-hierarchical in form. A scheme for organising classification may be in an artificial notational *cum* verbal language or in an artificial verbal language alone. An index to a scheme for organising classification is a scheme for associative classification. Every scheme for associative classification has for its foundation a scheme for organising classification whether explicit or implicit.

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Note: The paper is based on a presentation in the DRTC Refereshcr Seminar on Subject Headings held on 9–14 August, 1973.