Classification Systems in their Historical Development:
Problems of Typology and Terminology

Abstract: The history of structural development of classification systems (CS) is typologically divided into three main stages. Enumerative CS developed from ordinal towards hierarchical. In combinational CS, combinatory techniques evolved from division by analogy towards a fully-fledged system of typical subdivisions of general and special use. Syntactic designations were employed to combine notational symbols within wide limits. The invention of categorial analysis facilitated the development of faceted or analytical-synthetic CS. The system types under consideration are functioning simultaneously in the indexing practice. Clearly defined continuity can be observed. Each higher-ranking type comprises structural elements of its predecessor. Otherwise stated, each combinational classification contains elements of an enumerative one, while each faceted or analytical-synthetic CS includes elements of a combinational system.

1. Introduction

The present paper is concerned with classification systems of a specific type, namely, 'library-bibliographical systems' which are also known as 'document' or 'documental' and 'information systems'. To reduce the length of the paper this specification of terminology will not reappear elsewhere: in what follows we shall keep to the notion "classification system" or "system of classification" and the corresponding acronym, CS. In our opinion, "classification" would not be an appropriate term in this context, as it inevitably requires additional qualifying due to its polysemic nature.

The history of CS goes back several thousand years. They appeared far back in antiquity - possibly, in the very first libraries that existed - and were used for the basic functions of organizing and control of library collection according to its content. Their development and increasing complexity was stimulated by library development and collection growth. Their evolution reflected the evolving structure of scientific knowledge and philosophical conceptions of their authors, since they were usually derived from some kind of universal philosophical classification of the sciences.

We in Russia have several fundamental works at our disposal that give nearly exhaustive treatment to the history of CS. A monograph by N.N. Ablov (1882-1942) entitled "Classification of books, its history and its methods in connection with the classification of the sciences in general" appeared in our country way back in 1921 (Ablov, 1921). Its author continued researching the field for many years to come but his work remained unpublished and is at present deposited in the archives of the All-Russian Book Chamber. "Essays on the history of library-bibliographical classification" by E. I. Shamurin (1889-1962) received international recognition (Shamurin, 1955-1959). They were translated and published in East (Samurin, 1964-1967) and West Germany (Shamurin, 1977). Apart from that, we also have excellent facilities for the study of the sources: the Library science reading room at the Russian State Library, whose stock accumulated since 1913, possesses a rich collection of classification schedules published in different periods of history in many languages of the world.
Classification systems can be analyzed on the basis of different characteristics. The history of science will be interested in the content of CS, while philosophy will examine their philosophical origins. Both these aspects are undeniably important to library and information science. But probably more essential is analyzing the structure of CS, their technical and technological possibilities.

A generally acceptable definition of structure is yet to be found. The structure of a system is usually described as the sum total of stable connections; the mutual relation of the elements of a system as determining its integrity. Thus, the structure is a characteristic of a system's internal organization.

The structure of a CS is also a reflection of its content, philosophy, and functions (purpose). Structural change is a historically predetermined phenomenon. It is not surprising, therefore, that each stage in the history of classification theory resulted in an increasing complexity of the classification structure in one way or another. A system of conventional signs (notation) is an external expression of the structure; therefore with the development of the structure the corresponding notation becomes inevitably more complex.

When considering CS in terms of their structure, notation, essential characteristics, connections, functions, relationships, we are involved in typology. Typology is indispensable for making an ordered description of a CS, the latter being an extremely heterogeneous object. Typology is naturally linked to terminology, since we are to properly name and precisely define the type of CS and demonstrate the essential characteristics of a particular type, which mark it off and set it apart from the others.

The typology of CS will be examined in the order that corresponds to the stages in the history of their structural development. In many cases this approach allows us to eliminate the necessity of describing individual systems.

2. Enumerative CS

A fairly long period in human history is commonly described as childhood. CS also went through this childhood stage in their development. In the same way as a child learns to distinguish attributes of shape and colour in the world of toys, the first librarians were learning to analyze the content of documents. Analyzing characteristics of classification was not an easy task for the first classificationists. At present, the term “characteristic of a classification” is used to describe an element in the conceptual content, which allows the classifier to assign this concept to a certain class in a certain CS. For the first CS to be designed, an essential characteristic was to be chosen as the basis of division. For the CS under consideration the characteristic in question was a branch of knowledge (a discipline of science, an area of practical activity). The knowledge universe existing at the time the system was created had to be divided and itemized. Thus appeared the first systems that are now known as enumerative. Several stages can be singled out in the development of their structure.

2.1. Enumerative ordinal CS

The simplest enumerative system consisted of a single array of classes and could comprise any number of divisions on a single level. These divisions received designations showing their position in an array. Thus the pragmatic purpose of library classifications was realized: they had to be linear to work effectively for the shelf arrangement of library stock. The tension between the spatial, multi-dimensional structure of scientific knowledge and the linear function of library classification was immediately obvious and for centuries remained a major problem. Philosophical classification of the sciences reflects the multiplicity of natural connections between objects. In contrast, library classification allows only two links for each

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division except the first and the last one, i.e. the links with the preceding and the following divisions. Initially, however, librarians were not interested in these links. Their aim was not to relate the neighbouring divisions but, rather, to separate them from one another, to mark them off, to bring out the differences between them.

The simplest way to designate the position in an array was by a succession of consecutive numbers: 1, 2, 3...9, 10, 11, 12... and so forth. Those designations were nothing but numbers assigned to divisions. At the first and initial stage of their development the enumerative CS were ordinal. Lists of concepts or objects can only provisionally be described as classifications, however, since this term implies the existence of a system of subordination, a hierarchy.

### 2.2. Enumerative hierarchical CS

The emergence of a hierarchy is quite comparable to the invention of the wheel. Classifications in the proper sense of the word appeared only with the understanding of coordination and subordination phenomena or, in other words, of the genus-species relations. Applying consecutive division, creators of CS opened broad horizons that allowed them to construct multilevel schemes. There appeared classification levels, chains of division in classification structure.

New problems of notation arose due to the increasing complexity of classification structure. Notation symbols were not only to stand for specific divisions in an enumerative hierarchical CS but also to show their relative positions in the overall structure, to link them with concepts on the higher and lower levels. The simplest solution was to use designations of different type for individual levels, e.g., to denote the first level by capital letters – A, B, C…, the second level by numbers – A1, A2, A3…, B1, B2, B3 and so forth. The graded hierarchy of decimal numbers was not immediately obvious: it took some time to realize that class number 452 presupposes the existence of at least 4 divisions on the first level and of 5 divisions on the second level. Mankind was to go through several centuries of trial and error before decimal notation was discovered.

It should be noted, that the concept of a “hierarchical classification” is largely tautological, since any classification is hierarchical. It does not take complex logical reasoning to prove that an alphabetical arrangement is also hierarchical. No matter how complicated the structure of a CS, a hierarchy is inherent in it. Our penchant for this word is truly amazing. Many contemporary textbooks still treat the hierarchical classification as a distinct type of CS. In our opinion, however, we can do entirely without this term, which does not appear to define anything in particular.

### 3. Combinational CS

The moment finally arrived when librarians were able to identify a number of characteristics of a single document and had to select one of them. The rest were initially ignored. Centuries had to pass before the advantages of listing several diverse characteristics were recognized. Some of the characteristics came to be regarded as the main ones, others as additional or auxiliary. Recurring concepts were discovered that we now call typical or standard. They first had to be identified, then arranged in a sequence and, finally, positioned in a CS.

The concept of a “combinational CS” has not so far become popular in special literature, though the majority of classification experts are well aware that in between the enumerative and the faceted systems there are a great number of other systems, including the Dewey DC and the UDC which are the best known and most used CS in modern history. There were
several stages in the development of the combinational systems.

3.1. Congruent and parallel subdivisions

There was a natural and understandable wish to order, organize, achieve maximum structural uniformity of enumerative systems. The first stages of their development were characterized by preliminary accumulation of material. As the volume of classified (actually, listed) concepts increased, new and further ways of improving the system were being identified. Unavoidable multiple entries of similar concepts were discovered. They formed arrays that, when juxtaposed to each other, revealed a similarity of classification characteristics together with a striking discrepancy in the grouping and arrangement of the concepts.

The simplest solution was the first to be realized: to ensure uniformity of related subdivisions; to denote similar concepts by the same notational symbols; to make the arrays completely exhaustive of the class. The unification was accomplished and the result was inserted into the structure. In consequence, there was a dramatic increase in the size of CS, since essentially the same lists of concepts began to reappear.

Next came the greatest discovery of all. Multiple locations of parallel subdivisions based on a recurring characteristic proved completely unnecessary. They could be listed once! Whenever there was a necessity to use such subdivisions, a reference was made to the corresponding class in the CS. One technical question had to be resolved: what was the appropriate location for a particular array? A reasonable solution was that the most exhaustive and highly ordered lists of recurring concepts should be positioned in the main class where they were most commonly used. Let us pose the questions our colleagues asked in the past, find the answers and see how simple and rational their solutions were. Where should the exhaustive list of languages appear? - Obviously, in linguistics. Where should we list place, countries and continents? - Evidently, in geography. Where should historical periods or chronological concepts be classified? - No doubt, in history. All that was needed was a hint on how to synthesize the appropriate characteristics in a single class number.

The process outlined here in a couple of paragraphs evolved during several hundred years of human history. While enumerative systems remained superficially the same, spontaneous revolutionary changes were being prepared within their structure. By the end of the 19-th century the ground was laid for decisive action.

3.2. Typical or standard subdivision. From Schleiermacher to Cutter

According to classification historians, typical or standard subdivisions separated from the main classification table appeared for the first time in "Bibliographisches System der Gesammten Wissenschaftskunde, mit einer Anleitung zum Ordnen von Bibliotheken, Kupferstichen, Musikalien, Wissenschaftlichen und Geschäftspapieren" which was published by Andreas August Ernst Schleiermacher (1787-1858) in Brunswick in 1847. A table consisting of 64 parenthesized numerical divisions was not placed outside the main classification tables but included in one of the subdivisions. In this way, special typical divisions were invented before typical divisions of common use.

We are certain that Melvil Dewey was unaware of this technical innovation of Schleiermacher's. In all probability, Schleiermacher remained unknown to Charles Ammi Cutter (1837-1903) who supplemented the main tables of his "Expansive Classification" (1879) with standard subdivisions of form (digital designations with a previous point) and with standard geographical subdivisions (numerical designations). Regrettably, Cutter's classification was never extensively adopted either in its country of origin (the USA) or in Europe. It was undoubtedly superior to the Dewey Decimal Classification with respect to its
structure and scholarship but it lost on account of its formal presentation. The decimal classification was the winner.

3.3. Paul Otlet and Henri La Fontaine: the finishing touches

Paul Otlet (1868-1944) and Henri La Fontaine (1854-1943), the founders of the International Institute of Bibliography, developed Cutter's ideas and substantially widened subject scopes of typical subdivisions placing them outside the main classification tables. Most significant with regard to combinability was the introduction of techniques to combine notational symbols in the main tables by using special signs: the relation sign (:), the extension sign (/), and the addition sign (+). P. Otlet and H. La Fontaine greatly expanded the retrieval possibilities of the Dewey Decimal Classification. They came to be regarded as "the inventors" of the combinational CS proper, since combining concepts and their corresponding notations in the European version of the Decimal Classification not only resulted in the emergence of a new system but marked the end of the development of the combinational systems as a distinct type. It should be noted, that the Universal Decimal Classification received its present name much later, at the end of the 1920-s. Since the invention of the UDC and up to this day the vast majority of systems being developed were combinational CS. The principles of selection, ordering and representation of classification characteristics in combinational systems are clear and simple, so that fairly recent systems were from the outset being designed as combinational ones. As recently as 30 years ago the work was completed on the Library-bibliographical classification, which is the national classification system in Russia. As far as its content is concerned, this classification is, without doubt, considerably more up-to-date than the Dewey Decimal Classification or the UDC and in many respects more logical. But structurally it is not original; it makes use of all the achievements of the combinational systems but goes no further.

The historical development of the Dewey Decimal Classification is remarkable: it came all the way from being a strictly enumerative system in the early editions to combinational in recent ones. The Dewey DC underwent radical structural change subsequent to the death of its author, i.e. since the 13-th edition. The history of the DDC's structural development is reviewed in John Comaromi's excellent book (Comaromi, 1976).

4. Analytical-synthetic CS

For the invention of the next type of classification system some leap in consciousness was necessary: it required a shift of paradigm from typical concepts to categories.

The accepted definition of a category is as follows: it is the most generic notion encompassing the most universal and essential attributes, properties, connections and relations of objects and phenomena in the real world. The notion of a category is as old as time. The categories of space and time were being defined far back in antiquity.

The system of categories in philosophy can be treated under different aspects. In its epistemological aspect, the system of categories reflects the process of cognitive perception of the intrinsic attributes of a given object and thus forms a categorial model of cognition. In its ontological aspect, the system of categories reflects the current level of cognitive knowledge of the universe and presents a universal model of any object of reality. The system of categories sets the general direction to cognizing any object and demonstrates the sequence of reasoning during its mental dissection. Hence the methodological aspect of categorial knowledge. A stimulating and original monograph by the Russian philosopher V.N. Sagatovsky (Sagatovsky, 1973) classifies over a hundred philosophical categories.

Categorial knowledge is the highest level of knowledge organization. The enumerative

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systems were indispensable at the stage of accumulation and preliminary classification of knowledge. The combinational systems delimited subject fields and prepared the ground for categorial analysis.

4.1. S.R. Ranganathan and Faceted classification

The achievement of Shiyali Ramamrita Ranganathan (1892-1972) can justifiably be called an invention: the third type of CS was from the very start presented in a totally original outer form. Structural changes led to considerable alteration of notation. More than that, "Colon Classification" has given us a special language, an expressly designed system of terminology largely untranslatable from Ranganathan's own language. In addition, the new CS required novel principles of cataloguing. It undermined accepted notions of proportions between a catalogue and its supplementary index. Retrieval possibilities of a traditional card catalogue were drastically improved by the use of the chain procedure. At the time when Ranganathan was working on his bibliographic retrieval ideology computers and computer programming had not been invented. "Manual logic", however, had reached perfection and there was but one step to automatic retrieval.

Decades had to pass before we realized that many of Ranganathan's concepts were readily translatable into a scientifically acceptable language. Such concepts as facet and category are synonymous, and so are facet and categorial analysis, facet and classification formula. In our opinion, the former terms in these synonymic pairs should belong exclusively to "Colon Classification" and the latter – to any CS of the third type under consideration in this paper.

For reasons just given, the use of the term " semifaceted" in connection with the combinational systems does not appear to us to be entirely justified. The facet analysis proposed by S.R. Ranganathan is applied within the framework of a certain subject field. Main facets (categories) essential for each area are synthesized and combined. In the case of the combinational systems, divisions combined are defined both by the main characteristic and by the typical, standard characteristics recurring in many divisions.

4.2. Classification Research Group: development of Ranganathan ideas

Ranganathan's ideas found their development in the work of the Classification Research Group which at different times included such eminent figures as B.C. Vickery, C.W. Cleverdon, E.J. Coates, J. Mills, B.I. Palmer, J. Farradane, D.J. Foskett, B. Kyle and many others. This remarkable company of very high-qualified specialists which was established in February 1952, continues functioning to this day. ("Knowledge Organization" keeps us informed of the CRG's activities; over 300 meetings have taken place). Up to the middle of the 1980-s we in Russia used to receive extensive information about the achievements of the group from regular publications by A.Y. Kushul (1907-1985). We are greatly indebted to D. Foskett for the invaluable information support he rendered to us.

The CRG's publications could form a most interesting collection. There is much to attract one in the CRG's work: the open discussions where everyone could always express their views, however inconsistent or controversial, which were supported by arguments and illustrated with experimental tables as well; fierce criticism of outdated ideas and creative propaganda of innovations. One can only regret that S.R. Ranganathan did not live to see how far (or in depth) his followers went in developing classification theory.

There were so many scholarly achievements in the CRG's work that their mere enumeration would result in a long list. In actual fact, they failed in one respect only: they were unable to prove that CS could be established without dividing the main classes according to the branches of knowledge. The CRG's greatest triumph, "Bliss Bibliographic
Classification. Second edition” has a disciplinary structure at the first level - as, incidentally, does “Colon Classification” (7-th edition). Nevertheless, the general principles of the analytical-synthetic classification were not only retained, but found further development in these systems.

4.3. The feasibility of restructuring the UDC into a faceted system - while preserving the UDC?

This was the question posed in the paper “A Feasibility Study on the Restructuring of the Universal Decimal Classification into a Fully-Faceted Classification System” presented by N.Williamson and I.McIlwaine at the 3rd International ISKO Conference in Copenhagen. The date was the 24-th of June 1994, and I again thought of what an obstacle the language barrier was to you. Yes, I do mean to you, because it is often technically impossible for you to keep up with special literature in the Russian language. We in Russia are reasonably well informed professionally, because, even though we may not have a perfect command of the language, we are nonetheless able to read in English. Quite a few specialists are competent in other foreign languages, primarily French and German. We do our best to acquire and acquaint ourselves with library literature from many countries of the world.

We may have a straightforward answer to the question put in the above-mentioned paper. At the beginning of the 1970-s research was carried out in Moscow at the Russian National Public Library for Science and Technology in the course of which several targets were achieved. A translation was made in our country of the “Colon Classification”, 6th edition (1970); a comprehensive analysis of the faceted classification was performed; a review was undertaken whose aim was to study the feasibility of transforming the combinational structure of the UDC into a faceted one. The results had shown that such a restructuring was indeed possible and could be quite successful. The only problem was that the UDC disappeared somewhere along the way.

In a few years’ time nearly identical research was done at the Russian State Library (formerly the V.I.Lenin State Library of the USSR) on the Library-bibliographical classification schedules in connection with the development of a conceptual basis for its second edition. As in the case of the UDC, the conclusion was that it was quite possible to develop ""facetization” methods; that the project appeared entirely realistic and might bring satisfactory results. Nevertheless, the outcome would not be the Library-bibliographical classification but something completely different.

We possess a databank on the two investigations conducted, which we are ready to share with our colleagues abroad. The only inconvenience is that all the articles, reports and documentation are in Russian. This might be the reason why they remain unknown.

The Library-bibliographical classification was developed in the 1960-s. It incorporated many practical and theoretical achievements made in other CS. I do not know of any other practical uses of Ranganathan’s octave notation except in the structure of one of the LBC’s classes. There are quite a few examples of categorial layout of classification groupings according to several characteristics. Such is the evolutionary technique of optimizing a system which retains its essential characteristics. The development of the LBC follows this path.

5. Conclusion

This paper has examined several historical types of CS. The typology and terminology presented here was published by us in 1973 in the article “Library-bibliographical classifications” of the Great Soviet Encyclopaedia (Vol.12, p.268). In the process of discussing and reviewing the article in what was then the USSR I was confronted with serious competition. But rival opinions to the effect that “there exist enumerative, hierarchical,
"semi facetted and facetted types of CS" did not appear equally well-argued.

It should be kept in mind that in the actual classification practice all the above-mentioned types of CS are functioning simultaneously, with the possible exception of the enumerative ordinal systems. The existence of the enumerative hierarchical systems appears pragmatically justified. The combinational systems (e.g. the Dewey DC, the UDC, the LBC) seem to be strongly entrenched. "Colon Classification" (7-th edition) is still regarded as excessively complex. "Bliss Bibliographical Classification. Second edition" is receiving growing recognition.

There is an obvious continuity in the development of classification systems. Each classification type of a higher order includes structural elements of its predecessors. In other words, every combinational classification contains elements of an enumerative classification, while each faceted or analytical-synthetic classification incorporates elements of a combinational and, inevitably, of an enumerative CS.

The feasibility of automatic retrieval is being actively discussed at present; therefore it seems advisable to consider which structure could better satisfy the requirements of the 21-st century. However, the debate on which search strategy is more convenient, simple or effective – by subject or by class number – will become pointless if we agree that high retrieval efficiency can be attained by means of a high-level CS with an alphabetical subject index in the shape of a thesaurus.

References