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Systems Theory and its Relevance to Documentary Classification

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In view of the impact of systems theory for the construction of classification systems the two major contributions of Dewey are summarized as well as the new methods of facet analysis and organization brought into classification by Ranganathan. With the latter's 'canonical' solution for the contents and arrangement of main classes, however, contemporary philosophical thought regarding the organization of knowledge seems to have been neglected. The work of the Classification Research Group and elsewhere considering integrative level theory will improve the science of classification systems construction. Besides this the influence from psychology and linguistics on the regocnition of relationships between concepts is outlined as well as some practical implications of the systems approach on classification.

I.C.

1. Dewey's approach

The history of classifications of knowledge shows that schemes for the ordering of knowledge or of documents containing knowledge always, and inevitably, reflect the philosophies and theories of knowledge which are dominant at the time. H. E. Bliss called it the "educational and scientific consensus". It need not surprise us: if a philosophy has a social function, and I believe it has, it is precisely to provide a method for investigating the structure of knowledge in order to understand the world about us. And once we start speaking of "structure", we are in the realm of classification.

The two major contributions of Melvil Dewey are in this same tradition. In 1870, the current dominant philosophy was the result of combining Aristotelian logic with empirical investigation of nature, in the classificatory sciences; this gave Dewey the idea of hierarchical subdivision of subjects and their relative location on library shelves, replacing the fixed location of specific books. From mathematics he took the decimal fraction notation, which admirably reflects hierarchical subdivision and the subordination of subjects:

599	Mammals
599.8	Primates
599.88	Apes
599.884	Gorillas

Dewey also realised that hierarchical subdivision was not sufficient by itself, and introduced what he rightly called a "mnemonic principle" for subdividing geographically by the use of numbers taken from class 900, and also by his "form divisions" for dictionaries, periodicals and so on. Even in his first edition, he noted that "users of the scheme will notice this mnemonic principle in several hundred places in the classification".

Dewey calls his principle "mnemonic"; we now call it "synthesis", and it has been developed to a high degree in the UDC and by Bliss in his Bibliographic Classification. Ranganathan was the first to develop a true theory of analytico-synthetic classification, and his system of facet analysis went so far to meet the needs of ordering and indexing the complex subjects of modern documentation that it has passed into the common stock of professional knowledge, and many people who now speak confidently of facet analysis have never heard of Ranganathan. As Goethe said, "Die Tat ist alles, nicht der Ruhm".

2. Ranganathan's method

Like all epoch-making discoveries, Ranganathan's method was simple: he showed that a classification scheme could incorporate hierarchical subdivision of classes – a most valuable aid to research, as Sandison has recently confirmed (1) – into a framework which kept in separate schedules those terms which related in different ways to their Main Class. In his Colon Classification, these are terms which represent categories of Matter and Energy, and they are separate from each other and from terms which represent Space, or geographical division, and Time, or chronological division. This method released schemes of classification from the straitjacket of "bound terms", that is, hierarchies in which subdivisions of a class derived by different characteristics are listed in the same schedule, as if they were derived by the same characteristic. For example, consider this array from the UDC:

37	Education
37.018	Fundamental forms of education
37.018.2	School education
37.018.26	Attitudes of parents to school
37.018.263	Parent-teacher relations

It is obvious that, unlike the single hierarchical array from Dewey above, this supposedly single hierarchy in fact presents a mixture of several characteristics: schools, parents, attitudes, are all terms which belong to different areas of knowledge. They are not a hierarchy, but are bound together as if they were.

Facet analysis thus provides a complete solution to one of two major problems in documentary classification. No modern scheme is without it, and we can also find recognition in thesaurus construction, even where it is ignored or disguised, as in most American thesauri, which attempt to solve indexing problems by the steamhammer method of including every conceivable term, variant and synonym, and as many bound term compounds as the compiler may chance to come across in the literature of his subject, no matter what the cost. Some attention to relations and categories has been forced on the compilers, as is shown by the ceaseless activity of altering, and publishing so-called "revised editions". It is unfortunate that

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this "might is right" philosophy has had so much influence through the sheer weight of American publications.

In Europe, we have a much longer tradition of intellectual analysis, and some spirited resistance has occured. To give but one example: the EUDISED Thesaurus compiled by Jean Viet for the Council of Europe has a faceted structure which is immediately understood by users in many different countries; the ERIC Thesaurus of the United States Office of Education, despite its 6 editions, continues to earn harsh damnation even from institutions within the ERIC system.

3. The problem of the 'Main Class'

But facet analysis does not offer a solution to another major problem of classification: the choice of Main Classes. Facet analysis requires a starting point, a named and defined area of knowledge, a Main Class in which the technique can be applied. Ranganathan avoided attacking this problem on the grounds that there are recognised "canonical" Main Classes, and he had other more urgent questions to answer. But he acknowledged the need for something more than tradition by his introduction of what he called "Basic Classes". These are in effect any subjects that a compiler may choose to name as starting points, the type of special subject for which the British Classification Research Group has been making faceted classifications for more than a quarter of a century. This is satisfactory as far as it goes, and indeed has been a fertile source of ideas on concept analysis, relational analysis, and several problems connected with the choice and ordering of terms within facets. But fundamentally it is a pragmatic approach, and so more or less subjective. Certainly, we cannot escape the subjective in a matter like the structure of knowledge, but I believe that we have so far made little progress in resolving the main issue precisely because we rarely attempt to reflect current dominant philosophies. We do not take enough notice of what contemporary philosophers and scientists have to say about the nature of knowledge.

A few centres have been remedying the situation. The FID/CR Committee, because of its close connection with the UDC, has given some attention to the problems of general classifications. The British CRG has provided the factory of ideas for the PRECIS system of indexing used in the British National Bibliography and for the new edition of Bliss's Bibliographic Classification under the direction of Jack Mills. The Seminars of the DRTC in Bangalore continue and enlarge the work of Ranganathan, and the three International Study Conferences on Classification Research (Dorking 1957, Elsinore 1964, Bombay 1975) have been notable landmarks; the Third in particular contains several papers relevant to my present theme (2). This is particularly significant because that Conference took the perspective of "global information networks", which of necessity involves considering the whole universe of knowledge and not special subject areas in isolation from one another. In my book on the social sciences (3) I drew attention to the difficulty, in making a special subject scheme, of knowing how and where to stop drawing on terms from marginal fields.

This problem is entirely a matter of the relationships, in real life, between concepts. These may be of two main types: for convenience, I shall call them basic or primary, and occasional or secondary. The basic relations, which correspond more or less to what J.-C. Gardin calls "paradigmatic relations", are those which maintain the identity of a concept and are part of what J. E. Farradane calls its "unique definition". The occasional relations are those which come into being as part of a particular set of phenomena which are not necessary to the existence of the concept, but may affect it. A human being is always a vertebrate mammal; a human being may have red hair, or engage in professional conferences, but neither of these are essential attributes without which the being could not exist as human.

We are therefore inextricably involved with the process of concept formation, and I have put forward some preliminary thoughts on this, some years ago, in a paper on "User psychology" (4). Some very important recent work has been published by Ingetraut Dahlberg, first in her contribution to the Bombay Conference, and more fully in her Ranganathan Lectures in Bangalore (5); the latter, perhaps for the first time since H. E. Bliss, discuss in detail the question of the organisation of knowledge through the medium of general schemes of classification.

4. The Contribution of 'General System Theory'

My paper here is an attempt to add to this line of thought by discussing some ideas derived from General System Theory. There are many works on this, but the basic text, in my view, is that of Bertalanffy, *General System Theory* (6). However, the basic ideas were first discussed by the CRG in the late 1950s, through a paper by Joseph Needham dating back to 1937, his Herbert Spencer lectures given to the University of Oxford (7). The idea of "integrative levels" in nature seemed to provide a clue to an objective method of ordering concepts which related to natural entities; central to this is the concept of a "whole", something which has a discernible identity and can be distinguished in isolation. This line of thought also offered an explanation of Ranganathan's concept of "personality" which was more detailed than any which he himself gave. It thus fitted in very neatly with the technique of facet analysis.

In his paper to the Bombay Conference, Eric de Grolier does less than justice to these ideas (8). He dismisses Derek Austin's NATO Project, which was wholly a CRG project, but pays tribute to the work of J. L. Jolley and A. J. Mayne, both of whom were CRG members, and certainly Jolley's concept of the "holotheme" relates closely to the theory of integrative levels.

It is true that, in its original formulation twenty years ago (9), the theory concentrated on "things", because this seemed the simplest way to relate it to Ranganathan's concept of a Personality facet: "the basis, the host, the locus of all other fundamental categories". But of course we never assumed that things existed in total isolation from all other natural phenomena. Taken in turn as a series of Personality facets, Things attract to themselves a similar series of Matter and Energy facets. The theory thus readily meets de Grolier's criticism that is does not deal with the ordering of social fields or activities. What it does is to relate these activities to the very entities which engage in them; one can certainly have the concept of an activity, just as Ranganathan has the concept of an Energy facet, but in the real world activities are no more and no less than the mode of existence of things, and indeed things and their activities are inseparable.

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This has been demonstrated by the now large body of material, published mainly in the USA, of which Bertalanffy, Kenneth Boulding and Ervin Laszlo are among the chief contributors. The idea of a "system" is any entity whose characteristics are identified as the nature of its parts and the relations between them. A bicycle is more than a heap of bits of metal, rubber, plastic, and so on; the relationships set up between these parts transforms the heap into the characteristic appearance of a bicycle and enables it to perform the characteristic function of a bicycle by converting the rotary motion of the pedals into the horizontal motion of bicycle and passenger along the road. A Committee is more than a collection of single individuals: they group themselves in a specified relationship, elect a chairman, address their comments to the chairman, and take collective decisions binding on all of them. In fact, the activities of any system are just as essential a feature as its constituents.

A system may also be a constituent part of another system of a higher order of organisation. Thus a word is a system of letters organised in a certain way – their sequence. A sentence is a system of words organised in a particular sequence, and a paragraph is a system of sentences. A book is a system of paragraphs and a library is a system of books. A classification conference is a system of classificationists. Thus we have, in the real world which provides the subjects for documentation, a system of systems in an order of increasing complexity of parts and relations. Applying this concept to schemes of classification will produce an ordered system which strongly resembles the scheme produced in outline by Ingetraut Dahlberg in her Ranganathan Lectures.

The notion of a series of systems integrated by increasing complexity of organisation is not new in the natural sciences; it is implicit in the work of Auguste Comte, to go back no more than 150 years. The series of Fundamental particles – atoms – molecules – masses, is universally accepted. Whether the notion can be carried throughout the whole field of knowledge remains in dispute. In the CRG, for example, D. W. Langridge has consistently claimed that one cannot apply the idea of levels to the Humanities (10), and performs an extremely useful service relevant to this paper, in analysing the theories of several contemporary philosophers concerning the structure of knowledge. His principal objection is that systems theory implies that natural science is the paradigm of all knowledge and that what holds good for ordering knowledge in the sciences must apply to all the other areas of thought.

This objection certainly applies to a mechanical transfer of particular theories in science to the other areas, but that is not my view of systems theory. A "general" theory can only be general if it can indeed apply through all fields; this is what makes it general, and generalisations have been the main aim of philosophers and scientists throughout the ages. The crucial test of any theory is the extent of its application, and a theory is replaced when another theory is proved to account for a wider range of phenomena.

Langridge is right, however, when he claims that more investigation is needed. Much of the ground has been covered by Ervin Laszlo, who does extend systems theory to the Humanities (11). His aim was, not to refute the theories of other philosophers, but to collate or map them into "a common, internally consistent framework wherein their particular propositions become mutually reinforcing as descriptions and explanations of one reality with a rationally knowable, overarching species of order". By considering Man himself as a cognitive system, we can see that he exists as an individual by virtue of two sets of relationships: those internal to his own individual body, which become progressively organised through his own personal experience, and those external to him, which consists of the world or environment in which he finds himself. These external relations are physical, biological, technological and social and they react on, and are reacted on by, his individual self. On this view, Laszlo has no difficulty in refuting the common objection of determinism, and showed conclusively that systems philosophy encompasses social and human value in a "framework for a normative ethics". In a letter to me, he agreed that my Sayers volume paper was completely in accordance with his own ideas, and indeed extended them into a new area – documentary classification.

5. The influence from psychology and singuistics

Recent work in two other major fields, which serve to illustrate the interpenetration of science and the humanities, follows a similar path: psychology and linguistics. In psychology, I. Dahlberg has drawn attention to the essential basis of concept formation, with reference to German literature, and I have drawn on the work of leading psychologists, notably J. P. Guilford and Jean Piaget, in my literature review on 'Informatics' (12). Guilford's "structure of intellect" model also influenced J. E. Farradane's well-known work in relational analysis. Piaget has shown, through a long series of books, that concept formation proceeds by the assimilation of data given by the senses, through observation and experiment, into a structure of concepts already formed in the mind of the learner; through the study of growing children, he and his co-workers proved that it is by this process of classification that infants begin to develop the ability to cope with their environment. Teachers all over the world have learned how to teach through study of these works. Piaget has also contributed to the philosophy of Structuralism. "In short", he writes, "the notion of structure is comprised of three key ideas: the idea of wholeness, the idea of transformation, and the idea of self-regulation" (13). He applies the notion to the whole of knowledge, and it is not difficult to see that it has direct resemblances to systems theory and with documentary classification.

In order to achieve communication, concepts in the mind of an author have to be expressed in a form which a reader or listener can understand, and everywhere there are barriers. Piaget himself relates his work to linguistics and received some critical comments in what I regard as a seminal work in this field, *Thought and language* by L. S. Vygotsky (14). First published in Moscow in 1934, it had hardly any impact until an English translation was produced by the Massachusetts Institute of Technology in 1962, with an introduction by Jerome S. Bruner. In Vygotsky's view, the crucial activity in concept formation is the transforming of "spontaneous concepts" into "scientific concepts" by incorporating sense-data derived

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from the environment into a network of related concepts already in the mind, and expressing them in "units of verbal thought", or "word-meanings", which combine scientific thoughts with units of speech and so become communicable. Word combinations form sentences, and "just as the sense of a word is connected with the whole word, and not with its single sounds, the sense of a sentence is connected with the whole sentence, and not with its individual words".

I give these two major examples to illustrate what I have described more fully in 'Informatics', namely, that we can find the basic concepts of systems theory in the works of leading modern thinkers in a wide range of subjects. They are also related, as both Piaget and Vygotsky acknowledge, to the philosophical aspects of dialectical materialism as developed by Marx and, more particularly by Engels in his *Dialectics of Nature*. There is plenty of evidence to show that we can cover the whole knowledge by relating subject analysis, or classification, to a general theory of systems.

In a general classification for documentation, any system can be named a Basic Class, in DRTC terms, because all systems can be analysed by facet analysis. The system itself, considered as a whole, becomes the Personality. Its constituent parts and the relations between them become the Matter and Energy, which I will call Energy A. The relations of the system with its environment are also processes, which I will call Energy B. The other systems in the environment, which react with our original system, are Agents or, in Ranganathan's own terms, Second Round Personality. Of course, we do not have to accept Ranganathan's terms; I do so here in order to illustrate how appropriately systems theory fits the scheme of the greatest contributor to documentary classification since Bliss and Dewey. The work of the CRG and of many compilers of thesauri demonstrate that the fit is even more obvious if the categories or terms used are chosen on a pragmatic basis to suit each subject field, without being related to any set of fundamental categories.

From the point of view of the foundations of general classification schemes, moreover, we gain little from criticisms of any scheme on a purely empirical basis, asking only questions like "What has been omitted?" or "What has been placed in the wrong schedule?" This sort of unproductive approach disfigures some of the articles on the UNISIST Broad System of Ordering in the recent issue of the FID journal, *International Forum on Information and Documentation*(15).

6. Practical implications of the systems approach

What, then, are the practical implications of the systems approach to documentary classification? The main purpose of any scheme of classification is to order documents in a way which makes sense to specialists in each field. It may not always be the most useful order, because the way in which even the same specialist approaches the literature may vary from one occasion to another. But the order must make sense: the specialist must be able to recognize the basis for the order, hence the incentive to reflect the current dominant philosophy. Specialists need and know about classification as an intellectual tool for their work; witness the success of the Classification Society and of the Gesellschaft für Klassifikation. These specialists look at knowledge from the point of view of their own subject; only librarians and information officers look at classification from the perspective of the whole universe of knowledge. A scheme for documentary classification must therefore be more than merely a collection of specialist schemes: this would not be a system in itself, it would be no more than a heap of unrelated parts.

Systems theory says that internal relations between the parts are essential if these parts are to have the organisation of an entity capable of existence as an integral whole in a particular environment. In our case, the environment is the library and information service and the documents it contains; our aim in classifying is to reflect and demonstrate the order and harmony existing in the real world, the universe of nature, including the world of Man. This is what writers write about from their own experience, and this forms the contents of the documents we have to organise. The record of the thought is always incomplete, always changing, always advancing.

The aim of scientists and philosophers is to find explanations, or "laws of nature" which can be used to our advantage in our never-ending struggle to master our environment. Knowledge advances not only by more and more detailed analyses of individual subjects in isolation, but by the formulation of more general principles and explanations with wider and wider application. Classification theory must take the same path.

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