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PROLEGOMENA
TO
LIBRARY CLASSIFICATION

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PROLEGOMENA TO LIBRARY CLASSIFICATION

BY

S. R. RANGANATHAN, M.A., L.T., F.L.A.

Librarian, Madras University Library

Secretary, Madras Library Association

Vice-President, Indian Library Association

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To
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CONTENTS

Preface	..	x
Introduction	..	xii-xvi

PART I Theory

CHAP.		PAGES
1-3.	General Theory ..	1-92
1.	What is a Scheme of Classification? ..	1-29
	Diagrammatic approach, 1-7.	
	Analytical approach, 8-29.	
	Entity and Attribute, 8. Characteristic, 9. Complete Division, 10-11. Complete Assortment, 12-18. Pseudo-entity, 19. Filiatory Arrangement, 20-25. Scheme of Classification, 26-28. Classifying, 29.	
2-3.	Canons of Classification ..	30-92
2.	Characteristics, Arrays and Chains ..	30-61
	Differentiation, 31. Concomitance, 31. Relevance, 31-32. Ascertainability, 33. Permanence, 34-36. Relevant Sequence, 37-38. Consistency, 39. Exhaustiveness, 40. Exclusiveness, 41. Helpful Order, 42-45. Consistent Order, 46-58. Intension, 59-60. Modulation, 61.	
3.	Terminology and Notation ..	62-92
	Currency, 64-67. Reticence, 68. Enumeration, 69-71. Context, 71-72. Varieties of Notation, 73-77. Purity, 78. Long <i>v.</i> Short, 79-89. Relativity, 90-92.	
4.	Theory of Knowledge Classification ..	93-141
	Universe of Knowledge, 93-98. Hospitality in array, 99-106. Hospitality in Chain, 106-119. Mnemonics, 120-139.	

CHAP.		PAGES
5.	Theory of Book Classification .. Universe of Books, 142-143. Partial Comprehension, 143-148. Artificial Composite Book, 148-149. Local Va- riation, 149-153. Viewpoint, 153-157. Classics, 157-163. Common subdivi- sions and Distinctiveness, 163-175. Individualisation, 175-181.	142-181
PART II Comparative Study		
6.	Lay-out .. Decimal Classification, 184-187. Expansive Classification, 188-189. Congress Classification, 189-190. Subject Classification, 190-191. Colon Classification, 191-195. Comparison of lay-out, 196-210.	184-210
7.	Mathematics ..	211-235
8.	Economics ..	236-267
9.	Some hints, summary and conclusion .. Some hints and stages of classification, 268-279. Summary and Conclusion, 280-282.	268-282
	Index ..	283-305

PREFACE

BY

THE MADRAS LIBRARY ASSOCIATION

With the object of spreading the essential ideas of the Library Movement and of directing thought towards the creation of a library service suited to our country, the Madras Library Association inaugurated its Publication Series in 1929. The first volume, *The Library movement*, a collection of essays by Divers Hands, was widely circulated throughout the country. The second volume, *The five laws of library science*, by S. R. Ranganathan, which came out in 1931, sought to expound the principles of library organisation and management in a systematic form. The preface to that book contained the announcement "With the present volume on the *Five laws of library science* . . the Madras Library Association commences the publication of a series of books on the technical and practical aspects of library work."

In partial fulfilment of this announcement, the Association has already published the *Colon classification* in 1933, the *Classified catalogue code* in 1934 and the *Library administration* in 1935, all by S. R. Ranganathan. All these volumes have experienced a good circulation, both in India and abroad.

As another instalment of the Publication Series, the Association is publishing the present

volume entitled *Prolegomena to library classification*, the manuscript of which Mr. S. R. Rangathan had been good enough to place at the disposal of the Association.

The Association hopes that this volume will get as widely circulated as its predecessors and enable the libraries in India and elsewhere to organise their work in an efficient, scientific and serviceable manner.

INTRODUCTION

It has been my experience—one doubtless shared by many others—that, when one is engaged on a problem, the most useful ideas occur suddenly, seeming at once to cast a flood of light over murky tracts of half-formed thought and promising reward to further exploitation. These inspirations, which present themselves as ready-made wholes, come, as we all know, at the oddest moments. They seldom come if they are sought, and they delight in choosing moments when pen and paper cannot be used to impede their flight. They come and whisper in our ears as we lie sleepily after dinner or as we mechanically repeat a long-drawn-out hymn as part of the daily routine of worship. To sit at the study table, with note-book and pencil, with the intention of meditating on one's problem invariably produces nothing but sleep.

It is a feature of these ideas that they always seem at first inspired, and we think them quite original—as in fact they are. But before long, and usually before our first notes have been developed, there comes awakening. Somebody else, we find, has thought of the same thing before, and has expressed it all in some well-known work. One's feelings at this discovery are mixed. First there is dismay at being deprived—nay robbed—of well-deserved priority. Then there is relief that one is spared the labour of cudgelling one's brains over the pioneer work involved, and further there is satis-

faction in the thought that if others, and cleverer men, have trodden this way before, then one is probably on the right path, and not wandering hopelessly in the wilderness.

Finally one is buoyed up by the hope that if one continues long enough in this way, one will in the end have climbed the crests of the known and be looking forward to undiscovered country. Would that it were possible that in this book the distant peaks should be visible through the wreaths of mist! One can hope for no more than this, and yet one is conscious of a thoroughly enjoyable journey, which has recalled again and again the sentiments expressed by R. L. Stevenson, "To travel hopefully is a better thing than to arrive".

This book is one result of twelve years' work at forging and polishing the Colon Classification and of nine years' work of teaching the principles of classification to mixed classes composed of some highly-disciplined minds and a few bewildered but willing ones that needed to be led step by step with explanations and illustrations even of the obvious. In teaching such classes, the exposition given in existing text-books were sometimes found inadequate.

It is now five years since the manuscript of the first edition of the Colon Classification was put into the hands of the printer. During this period, the scheme has been applied to 50,000 additional volumes of which 25,000 covered the wave-front of nascent thought on all the most important subjects. It afforded a good test. The test disclosed hidden potentialities in the scheme, which had not been consciously sensed at the time of invention.

It also disclosed some minor maladjustments which could have been avoided no doubt if I had been working on the basis of a well-tested theory of classification. But the process was reversed in my case. My theory had to be developed later to discover the cause of such maladjustments and to set them right. The first edition of the *Colon classification* being almost exhausted, I decided that it would be advantageous to work out the theory of classification before preparing the second.

Thus, it became a personal necessity and seemed not a useless labour to collect my thoughts which bore upon the theory of classification and record them in exact terms. These thoughts had been incubating in extra-conscious regions of the mind during the last twelve years in a way which seems to me exactly expressed in the following passage of John Drinkwater's *Loyalties*:—

Haunting the lucidities of life
That are my daily beauty, moves a theme
Beating along my undiscovered mind.

These were the general pre-disposing causes. But the book was actually precipitated last June in an attempt to expound to my class the full import of the principle of hospitality in reference to Book Classification. The experience in the class room had stirred the latent thought-mass at all levels. When I came home I found sleep impossible. Seeing my restlessness and probably disturbed by it, a relation who was sleeping in my room gave an innocent piece of advice. "Why don't you take up a book and read for a while?," he said, "That will bring you sleep". No doubt he was not aware of

Schopenhauer's observation "To put away one's own original thoughts in order to take up a book is to sin against the Holy Ghost". However, this suggestion recalled two books which I had set aside for later study, when at the first attempt I had found them unmanageable. They were the books of Bliss¹ on Classification.

My mind was by this time so saturated with the theory of classification that so far from these two books proving difficult and causing sleep, before midnight, in a single movement, I had forged through their entire range of 740 pages. My mind was pressed through these pages in so intimate and critical a way that my own book emerged clear cut as from a mould. All that remained was to fill in details and provide illustrations.

The First Part expounds the theory of classification. After the first seven pages, the first chapter, which seeks to build up the necessary scaffolding of terminology, may prove to be stiff reading for beginners. But they may skip over that portion in the first reading and refer to it whenever need is felt for definition of technical terms.

The second and third chapters develop the canons of classification that belong to the general theory. It is believed that these two chapters carry the analysis further than existing books on the subject. The treatment of Terminology and Notation may be found to be new.

The fourth chapter which deals with the special theory of Knowledge Classification, shows the ad-

¹ Bliss (Henry Evelyn): *Organisation of knowledge*. 1929.
 „ *Organisation of knowledge in libraries*. 1934.

vantages, if not the necessity, of a synthetic classification, when the Universe to be classified is infinite.

The fifth chapter analyses the peculiar features of the special theory of Book Classification and leads to the recognition and isolation of four distinct stages in library classification.

The Second Part is mainly devoted to a comparative study of five current schemes of classification. These comparisons over limited ranges are of course only intended as models of a process that could be continued almost endlessly.

The stimulation received from the works of Bliss has already been mentioned and it is easy to see how much this book has received from the two well-known books¹ of Berwick Sayers.

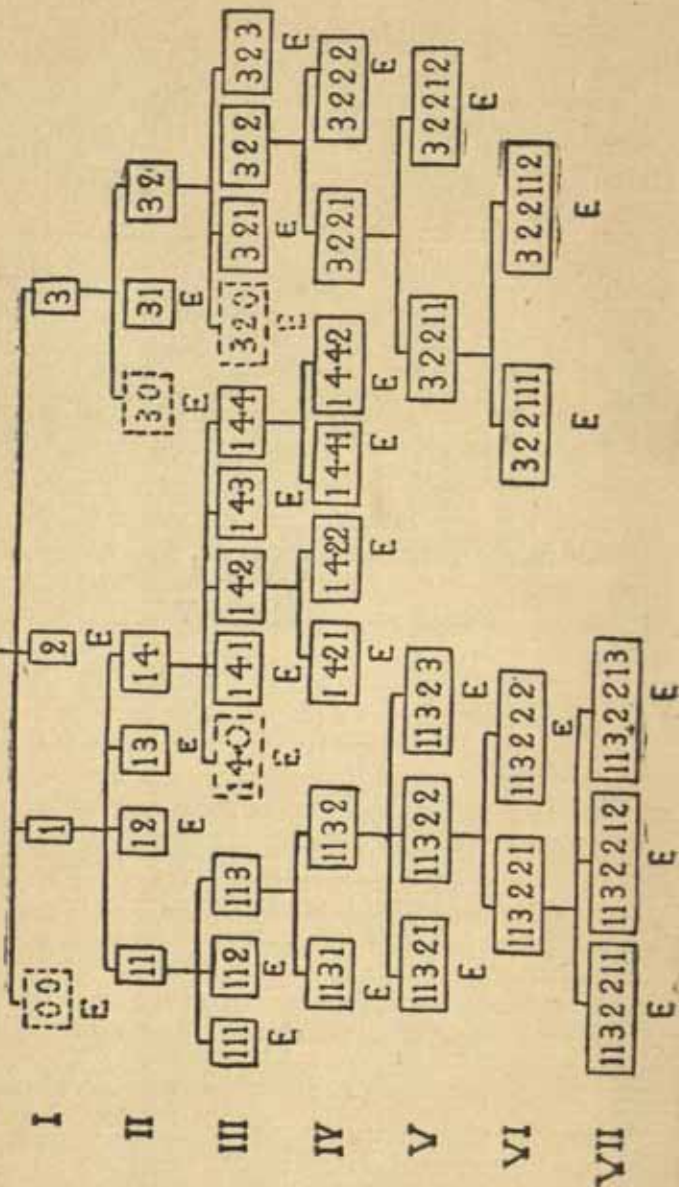
¹ Sayers (W. C. Berwick): *Manual of classification*. 1926.
" *Introduction to library classification*. 1935.

PART I
THEORY

Diagram showing Original Universe, Classes, Arrays, Collateral classes, Chains, Subordinate classes, Pseudo-classes, Order of classes and arrays, Division, Assortment and Filiality arrangement

ORDER

O



I. GENERAL THEORY

WHAT IS A SCHEME OF CLASSIFICATION?

To appreciate the strength and weakness of a scheme of classification, to compare the relative merits of two or more schemes and to do the day-to-day work of classification in a library consistently and in conformity to the chosen scheme, it is necessary and helpful to enunciate a set of tests and to lay down some systematic procedure. To arrive at the tests, to enunciate them in exact language, to lay down a system of procedure and to study schemes of classification in precise and concise terms, it is necessary and helpful to have the fundamental concepts and terms associated with schemes of classification examined and defined as a preliminary measure.

This chapter is devoted to the last mentioned problem. While its latter part will make an analytical approach in an abstract manner, the first part will deal with it diagrammatically and concretely.

DIAGRAMMATICAL APPROACH

The diagram on the left hand page is the basis of exposition. In the diagram there are forty rectangles excluding the four dotted ones, which are marked with numbers. They all represent classes. They all hang, as it were, from the class O, which we shall call the ORIGINAL UNIVERSE.

There are twenty-five rectangles marked E excluding the dotted ones. We shall say that these rectangles contain just *one* and *only one* ENTITY. We shall call them UNITARY CLASSES. We shall name or denote these entities by the numbers which are contained in their respective rectangles.

These numbers are 111, 112, 1131, 11321, 1132211, 1132212, 1132213, 113222, 11323, 12, 13, 141, 1421, 1422, 143, 1441, 1442, 2, 31, 321, 322111, 322112, 32212, 3222, 323.

This may look like a mess, if we read the numbers as integers. But if we read them as decimal fractions, *i.e.*, as if there is a decimal point to the left of each number, we can easily realise that the numbers are arranged strictly in the ascending order of magnitude. This is by the way.

COMPLETE ASSORTMENT

Let us go back to the twenty-five entities, which are contained in the twenty-five unitary classes. These twenty-five entities lie ISOLATED from one another. As we progress from left to right, they are arranged in a definite order—in the ascending order of the decimal fractional numbers denoting them.

An arrangement like this in a definite order is called a COMPLETE ASSORTMENT of the entities.

Let us think of a stage in which all these twenty-five entities were huddled together in the rectangle at the top which is marked O. We have already agreed to call this rectangle, originally containing all the twenty-five entities, the ORIGINAL UNIVERSE.

We shall trace the successive stages by which the entities should have been isolated.

CLASS AND ARRAY

Let us imagine that the aggregate of these twenty-five entities in the original universe O is divided into the three sub-aggregates or GROUPS, marked 1, 2 and 3, on the basis of some CHARACTERISTIC or ATTRIBUTE which distinguishes them as those assignable to group 1 or group 2 or group 3. Let us further assume, as it is actually in the diagram, that these groups are arranged in the ascending order of the numbers 1, 2, 3 which denote them. Then we say that the groups are arranged in a definite order. We also say that each group is assigned a rank, or simply, is RANKED.

A ranked group we shall call a CLASS. Thus the rectangles 1, 2, 3 are classes. The twenty-five entities of

the original universe O have been ASSORTED into the classes 1, 2 and 3. As the classes have been derived from the original universe by one process of assortment, we shall call the classes 1, 2 and 3 classes of the FIRST ORDER. The line of the classes 1, 2, 3 we shall call an ARRAY of the FIRST ORDER.

Now the class 2 is a unitary class as it is marked E. That is, it contains one and only one entity; it has isolated one entity. But the classes 1 and 3, not marked E, are not unitary classes. They must be MULTIPLE classes, because each of them should have had more than one entity. In fact, the remaining twenty-four entities of the original universe should have been shared by them. A little counting in the diagram will show that class 1 should have contained seventeen entities and that class 3 should have contained seven entities.

SECOND ORDER

The diagram will make us say that, at the second stage, class 1 would have been sub-divided into the four classes 11, 12, 13 and 14. These four classes may be said to be of the SECOND ORDER and their array also may be said to be an ARRAY of the SECOND ORDER.

Similarly class 3 also would have been sub-divided into its two classes 31 and 32. These two classes form another Array of the Second Order and the classes also are of the Second Order.

Now, of the six classes of the second order, the classes 12, 13 and 31 are unitary classes as they are marked E. The remaining three classes 11, 14 and 32 are multiple classes, sharing between themselves the twenty-one entities not yet isolated. A little counting in the diagram will show that the multiple class 11 should have had nine entities, the multiple class 14 should have had six entities and the multiple class 32 should have had six entities.

HIGHER ORDERS

At the third stage, class 11 would have been sub-divided into the three classes 111, 112, and 113, which are all of the THIRD ORDER. Similarly, class 14 would have been sub-

divided into the THIRD ORDER CLASSES 141, 142, 143 and 144, and the class 32 into the THIRD ORDER CLASSES 321, 322 and 323. These ten third order classes arrange themselves into three ARRAYS of the THIRD ORDER. Of these ten third order classes, six are marked E and hence are unitary classes and the remaining four, *vis.*, 113, 142 and 322 are multiple classes. These four multiple classes should have shared among themselves the fifteen entities not yet isolated.

In this way, classes of the fourth, fifth, sixth and seventh orders should have been formed at successive stages as shown in the diagram. As all the classes of the seventh order are marked E, no further division is possible.

Now the diagram shows that fourteen multiple classes, other than the Original Universe have been formed in the process of the Complete Assortment of the twenty-five entities of the original universe.

FILIATORY ARRANGEMENT

Let us arrange all the classes and all the entities (unitary classes) numbering forty in all in ascending order of the decimal fractions denoting them. We get 0, 1, 111, 112, 113, 1131, 1132, 11321, 11322, 113221, 1132211, 1132212, 1132213, 113222, 11323, 12, 13, 14, 141, 142, 1421, 1422, 143, 144, 1441, 1442, 2, 3, 31, 32, 321, 322, 3221, 32211, 322111, 322112, 32212, 3222, 323.

This arrangement in a special order, taking together all the twenty-five entities of the original universe and all the fifteen classes, including the original universe formed in the course of the complete assortment of the original universe of the twenty-five entities will be called a FILIATORY ARRANGEMENT.

The resemblance of the diagram to a genealogical tree is obvious. The above arrangement is like that which has the ancestor at the head with line after line of descendants coming thereafter in succession in the best order of filiation. Hence the arrangement is called a filiator arrangement.

The arrangement of the entities alone—*i.e.*, the result of knocking away from the filiator arrangement all the classes—has been already called a COMPLETE ASSORTMENT.

SCHEME OF CLASSIFICATION

A third alternative is to consider the arrangement of the fifteen classes alone—i.e., knocking away from the filiatory arrangement all the entities.

Thus we get the following arrangement of classes:—

0, 1, 11, 113, 1132, 11322, 113221, 14, 142, 144, 3, 32, 322, 3221, 32211.

This arrangement of the classes alone is called a SCHEME OF CLASSIFICATION.

It should be noticed that the arrangement of classes is not a random one. It is, on the contrary, a filiatory arrangement of the classes.

CHAIN OF CLASSES

A few more terms and concepts may be introduced:—

A set of classes, like 3, 32, 322, 3221 having lineal kinship, so to speak, will be called a CHAIN OF CLASSES.

The class 3 will be called the FIRST LINK of the above chain and the class 3221, the LAST LINK.

A chain like 0, 3, 32, 322, 3221 which has the original universe for the first link will be called a PRIMARY CHAIN.

A chain like 32, 322, 3221, 32212 whose last link 32212 is a unitary class will be called a LOOSE CHAIN.

A chain like 0, 3, 32, 322, 3221, 32212 which is both primary and loose will be called a COMPLETE CHAIN.

Now we pass on to a formal and abstract treatment of the question and give precise definitions of the various terms. If extra illustrations are felt necessary, they may be taken from the diagram at the beginning of this chapter and from illustrations given in the diagrammatic approach.

ANALYTICAL APPROACH

An ENTITY is any existent, concrete or conceptual, *i.e.*, things or ideas.

Examples:—

- | | |
|-----------|---------------------------|
| 1 A boy. | 3 A school of philosophy. |
| 2 A book. | 4 A subject of study. |

An ATTRIBUTE is any property or quality of an entity.

Examples:—

1. In the case of a boy, the following are some attributes:—

- | | |
|--------------------------|---|
| 11 Height. | 193 Character. |
| 12 Colour (of the skin). | 194 Date of birth. |
| 13 Possession of face. | 195 Age. |
| 14 Mother tongue. | 196 Horoscope (The position of planets at the time of birth). |
| 15 Intelligence. | 197 Mode of dressing of hair. |
| 16 Extent of knowledge. | 198 Nature of clothing. |
| 17 Handwriting. | |
| 18 Physical strength. | |
| 191 Ancestry. | |
| 192 Wealth. | |

and so on.

2. In the case of a book, the following are some attributes:—

- | | |
|--|-------------------------------------|
| 21 Subject-matter. | 23 Colour of the covering material. |
| 22 Form in which the subject-matter is expounded (say as a catechism or as a dictionary or as a skeleton, or as a continuous narrative). | 24 Quality of the paper. |
| | 25 Author. |
| | 26 Language. |
| | 27 Year of publication. |
| | 28 Printer. |

and so on.

3. In the case of a school of philosophy, the following are some attributes:—

- | | |
|---|---|
| 31 Number of ultimate principles assumed (<i>e.g.</i> , monism, dualism, pluralism). | 32 Attitude towards reality (or otherwise) of things. |
| | 33 Founder of the school. |
| | 34 Country of origin. |

and so on.

4. In the case of a subject of study, the following are some attributes:—

- | | | |
|----|-----------------------|----------------------|
| 41 | Field comprehended. | have been written on |
| 42 | Extent to which books | it. |
| | and so on. | |

Two entities are **LIKE** with reference to a given attribute when they share it equally in measure, intensity, extent or in any other way.

Two entities are **UNLIKE** with reference to a given attribute if they do not share it equally in measure, intensity, extent or in any other way.

Examples:—

1. Two boys, each 5 feet high but born in 1926 and 1927 respectively, are *like* with reference to their *height* but *unlike* with reference to their *age*.

2. Basu's *Algebra* and Radhakrishna Ayyar's *Algebra* are *like* with reference to their *subject-matter* but *unlike* with reference to their *author*.

It must be noted that the terms *like* and *unlike* have no significance

(1) except with reference to an attribute;
and

(2) unless there are two or more entities with that attribute.

CHARACTERISTIC

A **CHARACTERISTIC** is any attribute or any complex of attributes with reference to which the likeness or unlikeness of entities can be determined and at least two of them are unlike.

Examples:—

1. Height is a characteristic of boys but possession of face is not, although both of them are attributes. Possession of face is an attribute shared equally by all boys and hence with reference to it all the boys are *like*. Thus it is not a characteristic of boys considered as entities.

2. If we are considering boys-of-equal-height as entities, height will not be a characteristic.

A **UNIVERSE** is any aggregate of entities under consideration.

DIVISION of a universe is the process of sorting the entities of that universe into sub-aggregates with reference to a chosen characteristic, putting like entities into the same sub-aggregate and unlike entities into different sub-aggregates.

DIVISION will also be used to denote the result of division, *i.e.*, a group of sub-aggregates formed by a division of the entities of a universe or that state of such entities in which they have been divided.

✓ The chosen characteristic may be called the **DIVISION CHARACTERISTIC**.

Example:—The aggregate of boys in a class-room is a **UNIVERSE**. Sort them with reference to their height. Then the **DIVISION CHARACTERISTIC** is height and boys of the same height form a sub-aggregate. **DIVISION** denotes the state of having been sorted as well as the process of sorting.

Divisions of the same universe based on concomitant characteristics will not be different.

Divisions of the same universe based on independent characteristics will, in general, be different.

Example:—Height and age, since they are independent characteristics, will, in general, divide the boys into two different sets of sub-aggregates. But age and year of birth, since they are concomitant characteristics, will divide them into the same set of sub-aggregates.

The number of possible different divisions (considered as processes) of a universe cannot be greater than the number of independent characteristics of the entities of that universe.

Any sub-aggregate of a universe will now be called a GROUP.

A UNITARY GROUP is a group which contains one and only one entity.

A MULTIPLE GROUP is a group which contains two or more entities.

Each multiple group may, in its turn, be considered a universe, and divided on the basis of a further characteristic. Each multiple group will, then, give rise to a number of groups, some of which may be unitary and some multiple. If the process of division is continued with each resulting multiple group, and if the number of entities is finite, a stage will be reached when there is no multiple group left and the universe will have been sorted into unitary groups. That is, the entities of the original universe will have been isolated.

COMPLETE DIVISION of a universe is the process of extending division of that universe on the basis of a sequence of characteristics until no multiple group is left.

COMPLETE DIVISION will also be used to denote the result of complete division, *i.e.*, the completely isolated state of the entities of any divided universe.

It is obvious that in the second sense of the term, there can be one and only one Complete Division of a universe, whatever be the initial characteristic and the further characteristics used and whatever be their sequence of succession.

Example.—If the universe of boys in a class room is divided on the basis of their height, the first multiple group so formed may be divided by age, the second by weight, the third by colour, the fourth by age, and so on. Again further subdivide the multiple groups that still remain by appropriate characteristics. Ultimately the boys will be separated. The same would be the result even if we had divided first by colour and then by age, *etc.*

ASSORTMENT of a universe is the process of its division into groups *plus* that of arranging the groups in a definite order (*i.e.*, of ranking or assigning a rank to each group that arises).

ASSORTMENT will also be used to denote the result of assortment (*i.e.*, the groups so formed and ranked).

The ASSORTMENT CHARACTERISTIC is the characteristic on the basis of which (or *by which*) the universe is assorted.

Example.—Consider the universe of the boys in a class-room. Use height as the characteristic of assortment. Let us assume that the height of every boy is between 50 and 65 inches. Put into one group all the boys who are above 50 but not above 51. Put into another group those that are above 51 but not above 52, and so on. Then the number of groups will be 15 or less. Let us assume that there are 15 groups.

These 15 groups can be arranged among themselves (ranked) in several ways, *e.g.*, in ascending order of height, in descending order or so that the group having the greatest height is in the centre and those on either side of it in descending order as we proceed away from it, and so on. Let us assume that the groups are arranged in ascending order of height. Then each group is ranked.

Now there are $15!$ ($1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 \times 13 \times 14 \times 15$) possible ways of arranging the groups among themselves. Thus, while only one *division* by height is possible, there are $15!$ ($=1,307,674,368,000$) possible *assortments*.

Similarly, every different division of a universe will give rise to several assortments of it.

A CLASS is a ranked group.

An ARRAY is the sequence of the classes of a universe arranged among themselves according to their ranks.

A UNITARY CLASS is a class which comprises one and only one entity.

A MULTIPLE CLASS is a class which comprises two or more entities.

Consider the classes in any particular array: some may be unitary and some multiple.

Consider any one multiple class. Look upon it as a universe. Assort it into classes by a further characteristic. These classes will now form another array. The classes, the array itself, each of the arrays similarly derived from the other multiple classes of the original universe, and each class of each of such arrays may be said to be of SECOND ORDER (with respect to the original universe). The words within brackets will henceforward be understood.

In the same way each of the first set of classes of the original universe and its array may be said to be of FIRST ORDER and the original universe itself may be said to be a class of ZERO ORDER.

Further assort each multiple class of the second order by further characteristics. This will give rise to classes and arrays of THIRD ORDER.

This process continued will give rise to classes and arrays of higher and higher orders till no multiple class is left.

Then the assortment may be said to be COMPLETE. This process of progressive assortment, as well as its result, may be called COMPLETE ASSORTMENT.

The classes belonging to one and the same Array may be called CO-ORDINATE CLASSES.

See the diagram on p. 2 for examples.

The ORDER of a CLASS may be defined by the number of successive characteristics used to derive that class from an original universe.

The ORDER of an ARRAY may be taken to be the same as that of the classes that form it.

The IMMEDIATE UNIVERSE of a class of given order is that class of the next smaller order from which it has been derived.

The IMMEDIATE UNIVERSE of an array of given order is that class of the next smaller order from which it has been derived.

Any class of any order may be considered a class of the first order of its immediate universe. The latter class (the immediate universe) may in its turn be considered a class of the first order of its own immediate universe. This last immediate universe may then be considered the immediate universe of the second remove of the class with which we started. In the same way, we can define the immediate universe of the third remove, fourth remove and so on, until we reach the original universe.

Classes which are of the same order but are not co-ordinate may be called COLLATERAL CLASSES.

Arrays of the same order may be called COLLATERAL ARRAYS.

A class may be said to be SUBORDINATE to its Immediate Universe of any remove.

See the diagram on p. 2 for examples.

A CHAIN is a sequence of classes made up of any given class, its immediate universe, its immediate universe of the second remove, of the third remove, etc. A chain may be arrested at any stage, short of the original universe concerned.

Example.—In the diagram on p. 2, the classes marked 11, 113, 1132, 11322 and 113221 form a chain.

It is obvious that no two classes of a chain can be of the same order.

THE FIRST LINK of a chain is the class of the lowest order comprised in it.

THE LAST LINK of a chain is the class of the highest order comprised in it.

Example.—In the example of chain cited above, class 11 is the first link and class 11322 is the last link.

THE ORDER of a chain is the order of its first link.

Example.—In our example the order of the chain is 2 since the order of class 11 (its first link) is 2.

A PRIMARY CHAIN is a chain of zero order, i.e., a chain whose first link is an original universe.

Example.—In the diagram of p. 2, the chain whose successive classes are 0, 3 and 32 is a primary chain. It will be seen that there are many other primary chains in the diagram.

A LOOSE CHAIN is a chain whose last link is a unitary class.

Example.—In the diagram of p. 2, the unitary classes are marked E, since each of them contains only one entity. The classes marked 3, 32, 322 form a loose chain.

A COMPLETE CHAIN is a loose primary chain.

Example.—In the diagram of p. 2, the classes 0, 3, 32, 322 and 3222 form a complete chain.

It is obvious that there is only one class (an original universe) that can be the first link of a complete chain. But any one of the entities of a universe may be the last link of a chain. Thus the number of complete chains possible is the number of entities in a universe.

TO INDIVIDUALISE the entities of a universe is to separate them and arrange them in a definite order (RANK THEM).

A complete assortment individualises the entities of a universe.

Consider a class of the n th order which has rank a_n in its array and the primary chain of which it is the last link. Consider the successive classes in this chain beginning from the original universe. Suppose the class of the first order in the chain has rank a_1 in its array, the class of the second order in the chain has rank a_2 in its array, the class of the $(n-1)$ th order in the chain has rank a_{n-1} in its array. Then the class of the n th order in question may be said to have, in the assortment as a whole, rank a_1 of the first order, rank a_2 of the second order rank a_{n-1} of the $(n-1)$ th order and rank a_n of the n th order or to be more compact ($a_1 a_2 a_3 \dots a_n$) may be taken to be the MEASURE OF ITS RANK. This number may be considered a pure decimal fraction (i.e., as if there were a decimal point before a_1).

Consider a complete assortment. Consider the last links of the complete chains (the individual entities of a universe). They will stand arranged according to the measures of their ranks. Take an entity a . Suppose it is of order n . Suppose it has rank a_1 of the first order, a_2 of the second order, etc. and a_n of the n th order. Then the decimal fraction ($a_1 a_2 a_3 \dots a_n$) may be taken as the measure of the rank of the entity a in the complete assortment.

It is now obvious that no two measures of rank will be equal and that the measures of rank of all entities taken together will have a definite ordinal relation among themselves.

Thus a COMPLETE ASSORTMENT may be defined as the process of arranging *all* the entities of a universe, entity by entity, in a definite order, i.e., giving a different rank to each of them.

COMPLETE ASSORTMENT may also be used to denote the state of entities so ranked and arranged.

A SCHEME OF ASSORTMENT means a statement of

- (1) the characteristic used; in conjunction with,
- (2) their sequence; and
- (3) the mode of ranking of classes in each array that arises in the progress towards *complete* assortment of an original universe.

By varying the *scheme of assortment* it may be possible to vary the *complete assortment*.

While the number of *complete assortments* of a universe is limited (*viz.*, $n!$ if the universe contains n entities), the number of schemes of assortment may be far greater. Thus it is possible for two or more different schemes of assortment to give one and the same complete assortment.

AN ASSOCIATED SCHEME OF ASSORTMENT of a given complete assortment is any of the schemes of assortment which gives the complete assortment in question, which in turn may be called the ASSOCIATED COMPLETE ASSORTMENT of the scheme of assortment in question.

Example.—Let us consider the simple case of a classroom of 4 boys; 24 complete assortments of these boys are possible.

Let us take their names to be Gopu, Ramu, Seenu and Yogu.

Let us also assume that

- Gopu is short, fair and light (in weight);
- Ramu is tall, fair and heavy (in weight);
- Seenu is tall, dark and very heavy; and
- Yogu is short, dark and very light.

Now there are four characteristics available for arriving at a complete assortment of the four boys.

Let us consider a few of the possible schemes of assortments and the associated complete assortments.

Scheme 1. Characteristic: name. Ranking: alpha-

betical. The associated complete assortment: Gopu, Ramu, Seenu, Yogu.

Scheme 2. Characteristic: weight. Ranking: descending order of weight. The associated complete assortment: Seenu, Ramu, Gopu, Yogu.

Scheme 3. Characteristic: weight. Ranking: very light, very heavy, heavy, light. The associated complete assortment: Yogu, Seenu, Ramu, Gopu.

Scheme 4:—

(1) Characteristic: Height. Ranking: Descending order of height.

(2) Characteristic: Colour. Ranking: Dark and fair for the tall and fair and dark for the short.

The associated complete assortment: Seenu, Ramu, Gopu, Yogu.

Scheme 5:—

(1) Characteristic: Colour. Ranking: Fair, dark.

(2) Characteristic: Name. Ranking: Alphabetical.

The associated complete assortment: Gopu, Ramu, Seenu, Yogu.

Scheme 6:—

(1) Characteristic: Height. Ranking: Descending order of height.

(2) (a) For the tall:—

Characteristic: Colour. Ranking: Dark, fair.

(b) For the short:—

Characteristic: Name. Ranking: Alphabetical.

The associated complete assortment:—Seenu, Ramu, Gopu, Yogu.

We can improvise several other schemes with the given attributes, by varying the succession of characteristics and the ranking in each array. We can also increase the number of schemes by introducing other independent characteristics.

In the examples given,

Schemes 1 and 5 give the same complete assortment.

Schemes 2, 4 and 6 give the same complete assortment, but different from that of *schemes 1 and 5*.

Scheme 3 gives a third kind of complete assortment.

Consider any array and its immediate universe. Each class of the array will contain one or more entities. Before their assortment, they will all have been comprised in their common immediate universe. Into this immediate universe introduce the immediate universe itself as an additional entity. This additional entity may be called its PSEUDO-ENTITY. We shall assume that it possesses no attribute in common with any other entity of its class.

A class which is enriched by the addition of a Pseudo-entity may be called an AMPLIFIED CLASS.

In the assortment of such an amplified class, its pseudo-entity will form a unitary class and may be called a PSEUDO-CLASS.

Make its rank smaller than that of any other class in the array produced by the assortment. This may be done by making the rank of the pseudo-class zero.

Example.—In the diagram of p. 2, a few pseudo-classes, 00, 140, 30, 320, are shown by dotted lines.

Any loose chain whose last link is a pseudo-class may be called a PSEUDO-CHAIN.

Any loose chain whose last link is a pseudo-class may be called a COMPLETE PSEUDO-CHAIN.

Amplify each multiple class in each array by the addition of its pseudo-entity. Amplify the original universe also by its pseudo-entity. Then the result will be as if the original universe were amplified with as many pseudo-entities as there are multiple classes. The original universe so amplified may be called a COMPLETELY AMPLIFIED ORIGINAL UNIVERSE.

It is also obvious that every multiple class that arises in the process of assortment of a completely amplified original universe will be a COMPLETELY AMPLIFIED CLASS, in the sense that it will comprise all the pseudo-classes possible to it.

A FILIATORY ARRANGEMENT of the entities of a universe is a complete assortment of that original universe completely amplified.

Let us examine in what essential respects a *filiatory arrangement* will differ from a *complete assortment* of a given universe.

One obvious difference is that whereas a complete assortment merely separates the entities of a universe and ranks each of them (arranges them in a definite order), the corresponding filiatory arrangement introduces into the sequence the different *classes* that were formed in the process of complete assortment. Further, these classes are not interpolated among the entities at random but each has a unique position.

The peculiarities of this unique positioning of the classes may be visualised in two ways.

FAMILY OF SIDDHAS

First, let the original universe (the class of zero order) be the ancestor of a family of beings (known as *Siddhas* in India) several generations of whom are alive at the same time with him.

Then a chain of classes corresponds with the beings in one line of descent (a set of lineal kinsmen).

An array is a set of brothers (a fraternity). The immediate universe of the array is the father of the fraternity.

Assume that every being has either no son or more than one son. Call a being with no son a *non-father*. Assume also that the brothers in any fraternity are ranked in descending order of age.

Then an entity or a unitary class or a loose link of a chain (which are the same) corresponds with the members of the family who are *non-fathers*.

The order of classes corresponds with the order of generations.

Suppose the members of the family are to be arranged in a line according to their degree of relationship. To put each father close to his sons and them together would be ideal. But obviously we cannot do so for all fraternities, since the members of some fraternities have their own children and in remaining with them are necessarily separated from their brothers.

Now it will be assumed that persons have more attachment to their own lineal descendants than to their brothers or to the lineal descendants of their brothers. Then a reasonable compromise will be that the degree to which the wish of any father and his family to be together (the sons arranged according to age) is satisfied is made to vary with the generation to which the family belongs. The later the generation, the closer must the brothers be, the earlier the generation, the more willing should the brothers be to be separated from each other by their descendants. In other words, it should be secured that no two lineal groups get intermingled. Also, if we ignore, for the moment, the presence of the descendants of the members of any fraternity, the members of that fraternity should be in order of age with their father at their head. Of course the ancestor will be at the head of all.

Such an arrangement is the best arrangement of the ancestor in relation with all his descendants or the FILIATORY ARRANGEMENT of the family.

It will be seen that the *ancestor* represents the *original universe* and the *fathers*, the various *classes*.

Alternatively, each multiple class of any array of any order, including the original universe, may be considered as a sorting box. The multiple classes constitute the different sorting boxes used in the complete assortment of the universe (*i.e.*, the group of sorting boxes through one or more of which each entity of the universe has to pass before attaining its rank in the final arrangement).

Mark the boxes with distinctive symbols. Whenever an entity is put into a box, let it acquire the symbol of that box.

An entity is said to be a **RELATED ENTITY** with reference to a given box, if it passes through that box in the course of complete assortment.

An entity which is not a related entity is a **STRANGER ENTITY** with reference to a given box.

Similarly, a box is said to be a **RELATED BOX** with reference to a given entity, if the entity passes through it in the course of complete assortment.

A box which is not a related box is a **STRANGER BOX** with reference to a given entity.

Two boxes are said to be **RELATED BOXES** if they have a common related entity and **STRANGER BOXES** if they have not.

It is obvious that the box corresponding to an original universe will have no stranger entity or stranger box and that an entity and a box, or a box and a box, will be related if they lie on a chain, *i.e.*, if they have *lineal kinship*.

Assume that

- (1) all the entities are equal in size; and
- (2) the size of each sorting box is just that which is necessary and sufficient to hold all the entities that it must receive during sorting of the entities of an original universe.

When the entities are completely assorted all the sorting boxes will be empty. It will be seen that the empty boxes correspond with pseudo-entities.

Arrange all the entities in a line in accordance with their final rank in the complete assortment. Let the empty

boxes be arranged among the entities in the following way:—

Consider any box. It will be seen that the entities related to it will be contiguous (*i.e.*, no entity which is stranger to it will lie between the entities related with it). Place the box just before the first of its related entities. When every box has been so placed it may happen that two or more boxes lie side by side. Then they will necessarily be of different capacity. Arrange them in descending order of capacity. When all the boxes are so ranked each entity acquires a new rank.

This arrangement implies

- (1) that no box will be posterior in rank to any of its related entities;
- (2) that no box will be posterior in rank to any smaller related box;
- (3) that the box corresponding with the original universe will rank first;
- (4) that the last place will be occupied by an entity and not by a box; and
- (5) that, if we start from a box and proceed along the line, we shall meet with no box or entity stranger to it until we have passed the last of its related entities.

There is also a sixth implication which the following may make clear.

COLLECTING THE ENTITIES

Collect all the entities into the biggest box at the head of the line, proceeding systematically as follows:—

Locate the last box in the line, pick out in their order each of the entities posterior to it and put them into the box until it is full. The number of entities posterior to it will be just enough to fill it, or more than enough, but never less than enough.

Then take the empty box prior to the last. Pick out in their order, each of the entities posterior to it and put them into it until it is full. If the box first filled is reached before the second box is full, there will be enough space in the second to empty into it the whole content of the other.

Further there will be posterior to the second box either enough or more than enough entities (either stray or in a filled up box) to fill that second box.

Again take the next prior empty box. Fill it up as before with the entities posterior to it. If a filled box is reached before this third box is full, there will be enough space in it to receive the whole content of the filled box.

If this is done with every box, at the penultimate stage the first box will be empty and the line will contain some filled and some empty boxes and some stray entities.

THE ULTIMATE STAGE.

At the ultimate stage, all the boxes but the first will be empty, the first will be full and there will be no stray entity. In other words, all entities will have been collected into the first box, which is the biggest and which corresponds with the original universe.

The arrangement proposed implies that

- (1) no entity will pass through a stranger box;
- (2) every box when it is full will contain all its related entities;
- (3) no box will receive a stranger entity;
- (4) no filled box will be emptied into a smaller or a stranger box;
- (5) no box will receive the content of a bigger or a stranger box; and
- (6) when a box is full all its related smaller boxes will be empty.

This arrangement of entities and boxes (pseudo-entities or the classes that arise in the process of complete assortment) shows the kind of coherence implied by *filiatory arrangement*.

In this general theory the concept of pseudo-entity (an empty box) may appear artificial. But in book classification there will be books corresponding with each pseudo-entity (empty box).

In other words, the universe of knowledge as embodied in books is a *completely amplified universe*.

Let us now compare the relation of a *complete assortment* of a given universe with its *filiatory arrangement*. We have remarked that the filiator arrangement of a universe comprises the entities and the classes derived by the process of complete assortment in a *coherent* or *filiatory* order. If we remove all the classes from the filiator arrangement and retain only the entities, we get a complete assortment.

Now considerations of symmetry suggest examination of a third kind of arrangement—that which arises when we remove from the filiator arrangement all the entities and retain only the classes. Then we shall have an arrangement comprising only the classes arranged in a *coherent* or *filiatory* order.

This third arrangement may be called a
SCHEME OF CLASSIFICATION.

It is easy to see that any given *scheme of assortment* gives rise to a definite *associated complete assortment* as well as to definite *associated scheme of classification*.

Also by *varying* the scheme of assortment, we can get *different schemes of classification*.

A SCHEME OF CLASSIFICATION may be defined as a statement showing a *coherent* or *filiatory arrangement* of the classes that arise in the course of the complete assortment of a given universe.

A scheme of classification, therefore, implies

- (1) that there is an associated scheme of assortment, *i.e.*—
 - (a) a statement of the succession of characteristics used in the course of the complete assortment;
 - (b) a scheme of ranking adopted for the classes in any array that may arise in the course of the complete assortment;
- (2) that the classes belonging to any array lie ranked continuously with their common immediate universe (if we ignore the presence of the classes of the lower order which are lineally related to them); and
- (3) that any class in the statement has immediately next to it:—
 - all the classes belonging to all the chains of which it is the first link, no class belonging to any other chain intervening,

or in other words

that any class has immediately next to it
all the classes of lower order which are lineally related to it, no class of a lower order not lineally related to it nor any class of the same or higher order, intervening.

That is to say

A scheme of classification involves three concepts:—

- (1) Characteristics;
- (2) Arrays of classes; and
- (3) Chains of classes.

Although we started with *entities*, and used successively the ideas of *universe*, *complete division*, *complete assortment* and *filiatory arrangement* of a universe before reaching the idea of a *scheme of classification*, a scheme of classification or its definition does not explicitly refer to entities or the number of entities in a universe.

A scheme of classification states explicitly only classes. And definition of a scheme of classification refers only to classes, characteristics and the ranks in each array of classes.

The advantages of thus eliminating entities and the number of entities in a universe will be seen when we deal with the theory of knowledge classification and of book classification.

The aids necessary to make a scheme of classification easily applicable correspond with the facts that

- (1) there are classes in the scheme; and
- (2) the classes fall into a unique order or have a unique ordinal arrangement.

The first fact suggests that we must have a set of names by which the classes can be denoted. The second fact suggests that it will be convenient to have a set of ordinal numbers to represent the classes in their order so that the ordinal arrangement of any random sample of the classes in the scheme may be mechanical (there being no need to remember or consider the exact connotation or denotation of the classes in their mutual relation).

This leads us to two additional concepts:—

- (1) the terminology of the scheme; and
- (2) its notation.

✓ The **TERMINOLOGY** of a scheme of classification is the system of terms used *to denote* or name the classes of the scheme.

✓ The **NOTATION** of a scheme of classification is the system of ordinal numbers used *to represent* the classes of the scheme.

The **CLASS NUMBER** of a class is the ordinal number representing it in its position in a scheme of classification.

Another auxiliary necessary to make a scheme of classification easily applicable is an **ALPHABETIC INDEX** of the terms occurring in the scheme and their equivalents showing against each term its class number or class numbers, as the case may be. When two or more class numbers are shown against a term, there must be an adequate and unambiguous indication of the circumstances in which the several class numbers are to be used.

CLASSIFYING the entities of a universe ordinarily implies

- (1) the presence and the adoption of a scheme of classification applicable to the universe;
- (2) the implicit or explicit indication of the associated succession of characteristics;
- (3) the assignment of each entity 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
- (4) the assignment of the appropriate class number to each entity.

It will be seen later that, when the universe is one of knowledge or books, classifying may also imply the creation of new classes in accordance with set rules of practice and the location of the same in appropriate places in the scheme of classification, before the assignment of some of the entities to their appropriate classes.

2. GENERAL THEORY

CANONS OF CLASSIFICATION

Characteristics, Arrays and Chains

A theory of classification must determine the principles and procedure by which two different schemes of classification of one and the same universe may be compared with regard to their suitability or efficiency. Even apart from comparison such principles and procedure will make possible evaluation of the soundness and usefulness of any given scheme of classification. Mr. Sayers has invented the phrase CANONS OF CLASSIFICATION to denote such principles.

In this and the next chapter, we shall enunciate the general canons of classification pertaining to the general theory of classification and reserve to later chapters the additional special canons, if any, that may be indicated by special theories of classification such as those of knowledge classification and book classification.

FUNDAMENTAL CATEGORIES

The *general canons of classification* may be developed in five groups, in relation to the following five concepts or fundamental categories involved in a scheme of classification:—

- (1) Associated scheme of characteristics;
- (2) Any array of classes;
- (3) Any chain of classes;
- (4) Terminology; and
- (5) Notation.

Associated Scheme of Characteristics.

The associated scheme of characteristics and each characteristic of the scheme should satisfy the following canons:— *the 7 canons*

DIFFERENTIATION

✓ (1) Each characteristic used should be an attribute that differentiates, *i.e.*, one which gives rise at least to two classes.

This may be referred to as the CANON OF DIFFERENTIATION.

This has been already enunciated, when characteristic was defined. The necessary examples also were given at that stage.

CONCOMITANCE

✓ (2) No two characteristics should be concomitant.

This may be referred to as the CANON of CONCOMITANCE.

It is obvious that the use of a concomitant attribute is futile. This has also been pointed out already.

RELEVANCE

✓ (3) Each characteristic should be *relevant* to the purpose of classification.

This may be referred to as the CANON of RELEVANCE.

Examples:—

I. Taking the universe as the boys in a class room,

(1) If the purpose of classification is to divide the boys into convenient graded groups for tutorial work,

Mother tongue, intelligence, and extent of knowledge may be relevant characteristics;

Height, colour, handwriting, physical strength, wealth, mode of dressing hair and nature of clothing may not be relevant characteristics.

- (2) If the purpose of classification is to divide the boys into convenient graded groups for physical game,

Height, physical strength, and age may be relevant characteristics; but

Colour, extent of knowledge, handwriting, ancestry, wealth, mode of dressing hair and nature of clothing may not be relevant characteristics.

- (3) If the purpose of classification is to divide the boys into convenient graded groups for answering matrimonial queries from outside,

Colour, mother tongue, ancestry, wealth, age and horoscope may be relevant characteristics; but handwriting, mode of dressing hair and method of clothing may not be relevant characteristics.

II. Taking the universe of books,

- (1) If the purpose of classification is to suit the needs of printers;

Typography, leading, margin, illustrations and paper may be relevant characteristics.

- (2) If the purpose of classification is to suit the needs of binders;

Thread and tape used for stitching, style of stitching boards used, covering material used and tooling may be relevant characteristics.

- (3) If the purpose of classification is to suit the needs of the readers in a library;

Subject matter, language, date of publication and author may be relevant characteristics.

TOO MANY RELEVANT ONES

The number of characteristics relevant to the purpose of classification are usually many. Practical considerations however would restrict us to the inclusion of just a few of them only in the Associated Scheme of Characteristics. Further, it may also happen that the Scheme of Classification becomes as efficient as it can be even without giving us an opportunity to employ all the relevant characteristics. If then there is need for a selection of just a few only of the possible relevant characteristics, it follows that we can construct different Schemes of Characteristics and they may yield different Associated Schemes of Classification for one and the same universe. All these Schemes of Classification may not be equally helpful to the purpose in view.

GENIUS AND FLAIR

This naturally raises the question, how to select just those relevant characteristics for the construction of the Associated Scheme of Characteristics that will give us the most satisfactory Scheme of Classification. There can be no definite answer to this question. Obviously there can be no *a priori* rules as to how we may hit upon the most helpful characteristics. Generally, it depends on genius, except that, other things being equal, we can say that he, who has more knowledge and more experience, is more likely to have the flair to reject the less helpful characteristics.

✓(4) Each characteristic should be definitely ascertainable.

This may be referred to as the CANON of ASCERTAINABILITY.

Unless this test is satisfied, it will be difficult to use the characteristic. To give a ridiculous example, the date of death is a characteristic of the persons in a group, as there is next to no probability for *all* the persons to die on the same date. But, it is not definitely ascertainable.

✓(5) Each characteristic should be definable and should endure unchanged, as long as there is no change in the purpose of the classification.

This may be referred to as the CANON of PERMANENCE.

Unless this test is satisfied, confusion will be caused whenever a characteristic undergoes a change in an entity. Such a change may lead to the shifting of the entity to a new class and consequently the classes themselves will undergo a change.

Examples:—

1. Imagine the result of using colour as a characteristic for classifying chameleons! We often experience a similar difficulty in classifying politicians by their political complexion or their party affinity!

PERIODICALS

2. To take some examples from the universe of books, it has been the tradition to divide periodicals into two classes—those that are published by Learned Societies being put in one class and those that are not so published into another class. This has led to not a little difficulty in libraries. As has been fully discussed in the *Classified catalogue code*¹ periodicals undergo frequent changes in the authority or agency publishing them. For instance,—

(i) The periodical *Medical library* which had been running its course from 1883 without a “learned” godfather, was taken over in 1890 as its official organ by the American Electrotherapeutic Association which was just then founded.

(ii) Here is another example from India. The *Journal of Indian botany* was launched as a private concern at Madras in September, 1919. It was the property of a private individual Mr. T. R. D. Bell, late Chief Conservator of Forests, Bombay. In 1920, the Indian Botanical Society came into existence. At a meeting held on February 3rd, 1922, it was decided that the *Journal* should be taken as the property and official organ of the Society.

¹ Ranganathan (S.R.): *Classified catalogue code*. 1934. (Madras Library Association Publication Series, 4.)

In fact, with the second issue of V. 3, it became the official organ of that Learned Body.

(iii) Here is another example belonging to the universe of periodicals in Physics. The following extract from the first page of the first volume of the second series of the *Physical review* will make clear how the characteristic under consideration underwent a change in January, 1913. "With the present number the American Physical Society takes over the *Physical review*".... In so doing the Society wishes to give expression to its deep appreciation of the great service done to physics and physicists in America by the editors who, in July-August, 1893, put forth the first number of a new journal During nearly twenty years the original editors have carried on the arduous task of maintaining this journal on a high standard. The former editors have now thought best to complete their task by transferring their control to the American Physical Society, and the *Physical review* now becomes, the Journal of that Society."

In the Madras University Library, which has about 1,600 periodicals, the difficulty caused by such cases of change of characteristic was so pronounced that the library has now decided to give up this characteristic of classification and to put both kinds of periodicals in one and the same class.

POETRY.

3. Here is another example from the universe of books, belonging to the category, poetry.

Form is one of the commonest attributes used in the classification of literature. In fact, poetry itself is a form division of literature. Let us consider the further division of poetry on the basis of the same characteristic form. Here is a typical pronouncement. With regard to poetry, form is used in ways not only divergent but also contradictory. And all the ways are in turn justifiable.¹

In English poetry the forms change through different causes.² Form in poetry is often merely an aspect, some-

¹ KER (W.P.): *Form and style in poetry*. 1928. P. 95.

² *Ibid.* P. 159.

thing one takes for convenience of understanding and then lets go.¹ Opinion changes frequently regarding the forms of poetry such as lyric, narrative, ode, elegy, sonnet, epic and so on. To his own *Tintern Abbey*, Wordsworth added the note "I have not ventured to call this Poem an Ode". Probably he thought of it as nearer to lyric.

The result of this lack of definability of the form-characteristic is that in most of the schemes of classification, no attempt is made to classify poems into different forms. In other words, "form" is not used as a characteristic to divide or classify the universe of poems. This practice is in conformity with canon 5.

¹ KER (W. P.): *Form and style in poetry*. 1928. P. 286.

✓(6) The sequence in which the characteristics of the scheme are to be used should be *relevant* to the purpose of classification.

This may be referred to as the CANON of RELEVANT SEQUENCE.

Examples:—

1. Take the problem of classifying the boys in a class room for matrimonial purposes. Let us assume, for definiteness, that they are all Hindu boys. Then the following sequence of the relevant characteristics may be considered relevant:—

Mother tongue, Ancestry, Horoscope, Wealth, Age and Colour.

Suppose that the families with mother tongue *B* give more weight to wealth than to horoscope and more weight to horoscope than to ancestry and that in language *C*, colour is ignored but otherwise the same sequence as *B* is preferred, then the relevant succession of characteristics will have to be stated as follows:—

First characteristic: Mother tongue.

Further characteristics:—

- (a) For mother tongues other than *B* and *C*, ancestry, horoscope, wealth, age and colour.
- (b) For mother tongue *B*, wealth, horoscope, ancestry, age and colour.
- (c) For mother tongue *C*, wealth, horoscope, ancestry and age.

2. Let us take an example from the universe of books. According to the scheme of Colon Classification, Organ as well as Problem is used as characteristics both in Medicine and in Zoology. But in Medicine, Organ occurs before Problem whereas in Zoology, Problem occurs before Organ. This variation in the sequence of the two characteristics is made in the light of the primary lines of specialisation which obtain in the two subjects and of what is felt to be a comfortable order by the readers of the books in these two subjects.

3. Both in the Decimal Classification and in the Colon Classification, Problem and Substance are used as characteristics in classifying Chemistry. Both the schemes agree that putting the Problem characteristic before the Substance characteristic is demanded by the purpose of classifying books in Chemistry in a library.

4. In the Decimal Classification, Language, Form, Period and Author are the four characteristics used in classifying literature. There are twenty-four different sequences in which these four characteristics can be used. But the Decimal Classification has rightly chosen the sequence, Language, Form, Period and Author, as most relevant to the purpose of the classification of books, which is the convenience of the readers.

5. Similarly, in the Colon Classification, Language, Form, Author and Work are the four characteristics used in classifying literature. Out of the twenty-four different sequences available, the Scheme has fixed the sequence, Language, Form, Author and Work, as the most relevant order. The implications of this choice in shelf-arrangement are discussed fully in that Scheme.¹

¹ Ranganathan (S.R.): *Colon classification*. 1933. (Madras Library Association Publication Series, 3.) Rule 701 and the commentary on it.

✓ (7) The characteristics of the scheme and the sequence in which they are to be used should be fixed and consistently adhered to.

This may be referred to as the CANON of CONSISTENCY.

This canon requires consistency not only in the characteristics used but also in the *sequence* in which they are used. It is obvious that lack of consistency will lead to chaos and defeat the purpose of classification.

It may be possible to find any number of characteristics to make up an associated scheme of characteristics. As we have seen already a selection of them will be sufficient for the purpose of classification. Practical convenience also will make us restrict the selection to as few of them as possible. If it is a question of choosing a few and not all the available characteristics, the choice of those few that are most helpful is a matter of flair. Decision as to the number chosen is also a matter of flair. Once the choice and the decision with regard to their sequence are made, we should not deviate from them. Let us take a few examples:—

1. For the universe of books in history, the Decimal Classification has chosen the Geographical and the Period characteristics as the only necessary characteristics and has decided their sequence as Geographical and Period. Those that use the Decimal Classification should not change this decision from time to time. They should adhere to the decision consistently.

2. For the same universe, the Colon Classification has chosen three characteristics instead of two. They are the Geographical, the Point of view and the Period characteristics. The scheme has also decided the above as the most relevant sequence.¹ Those that use the Colon Classification should adhere to these decisions consistently. Otherwise, confusion will arise.

¹ Ranganathan (S.R.): *Colon classification*. Rules 80 and 801.

Each array of classes in a scheme of classification should satisfy the following canons:—

4 canons

EXHAUSTIVENESS

✓ (1) The classes in any array of classes should be totally exhaustive of their common immediate universe.

This may be referred to as the CANON of EXHAUSTIVENESS.

This means, that every entity comprised in the immediate universe should find a place in one of the classes in the array derived from the immediate universe. This is always possible. The real value of the canon consists in drawing our attention to the need for examining if the enumeration of classes in the array has been correctly completed.

1. To take an example, let us consider the universe of rational numbers. Let the characteristic used be the remainder that is left by dividing a number of the universe by 2. It is obvious that the remainder may be 0 or 1 or a fraction. If we enumerate the classes of the array merely as "odd numbers" and "even numbers"—as one is likely to be tempted to do on account of their intimate association with division by 2—the classes in the array will not be totally exhaustive of the universe in question. The least that should be done to make them totally exhaustive is to introduce at least one more class into the array under the name "Mixed or pure fractional numbers".

2. As another example, we may cite a practice that obtains in Decimal Classification. Throughout the class literature, a class entitled "Minor poets" or "Minor dramatists" or "Minor writers" comes after the enumeration of certain individual authors. Such a provision of residual classes under the caption "other" can also be seen scattered throughout the scheme of Decimal Classification.

3. The Colon Classification employs the concepts of "open arrays" and "octave notation" to meet this canon. This will be explained in a later chapter.

✓ (2) The classes in an array of classes should be mutually exclusive.

This may be referred to as the CANON of EXCLUSIVENESS.

This means that no entity comprised in the immediate universe can belong to more than one class of the array. In other words, no two classes of the array can overlap or have an entity in common.

This condition will be automatically satisfied if we follow the instruction that the classes of an array are to be derived from its immediate universe on the basis of a single characteristic.

To show that it is possible to construct an array without adhering to a single characteristic, an example may be given. We may divide the universe of professors into the array comprising the classes "mathematicians," "physicists," etc., and "dull lecturers," "brilliant lecturers," etc. The earlier set of classes are formed by using the subject they profess as the characteristic, while the later classes are formed on the basis of their rhetorical ability as the characteristic. It is obvious that each professor will fall into two classes of the array so formed and that the canon will be violated.

(3) The order of the classes in any array should be according to some convenient principle and not arbitrary, wherever insistence on one principle does not violate other more important requirements.

This may be referred to as the **CANON of HELPFUL ORDER.** *Sequence*

Various principles may be available for fixing the order of classes. *See New Prolego*

QUANTITATIVE ORDER *Pr. of increasing quantity*

(i) If the characteristic used for the formation of the classes admits of quantitative measurement, the order of the classes may be in the ascending order of the measure in which the classes share the characteristic.

Examples:—

1. If the universe under consideration comprises the boys in a class room and the classification-characteristic is age, it is convenient to arrange the age-classes in ascending order of the age rather than to arrange them in any random order.

2. In classifying the universe "Geometry" on the basis of the dimension of the space under consideration, the Colon Classification arranges the classes in the order, Plane, Three dimensions, Four dimensions, Five dimensions and n dimensions, i.e., in ascending order of the dimensions of the spaces.

DEVELOPMENTAL ORDER *Pr. of later in evolution*

(ii) If the characteristic is of a developmental nature, the order of the classes may be parallel to the course of development.

Examples:—

1. In classifying the universe "Zoology" on the basis of the Natural Group as characteristic, the Congress Classification, the Decimal Classification as well as the Colon Classification arrange the resulting classes in the developmental order beginning with Protozoa and ending with Mammalia.

2. In classifying the Universe "Philology" on the basis of the "Element" of study as characteristic, the Colon Classification arranges the resulting classes in the order, Isolated sounds, Syllables, Words, Phrases, Clauses, Sentences, Pieces of composition and Readers as practising materials, which is the correct developmental order.

3. In classifying the universe "Geography" on the basis of the "Problem of study" as the characteristic, the Colon Classification sets down the classes in the order, Mathematical geography, Physical geography, Bio-geography, Anthropogeography, Political geography and Economic geography which is an acceptable developmental order.

SPATIAL OR TIME ORDER *Pr. of spatial Contiguity*

(iii) If the classes correspond to phenomena or relations in nature or society which we have been long accustomed to look for in a certain spatial, temporal or other relational order, the classes may be arranged in the same familiar order.

Examples:—

1. In classifying the members of the Solar System, the Congress Classification uses the order, Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune—which is their correct spatial order.

2. In classifying the universe of the processes involved in Laundry, the Decimal Classification arranges the classes in the order, Marking, Washing, Starching, Bluing, Drying and Ironing which is the correct time-order.

3. Let us next give some examples from the Colon Classification.

(i) In classifying "Syntax" in Philology, the classes are arranged in the order, Subject, Adjuncts to the Subject, Predicate and Adjuncts to the Predicate, which is the correct relational order.

(ii) Again, in classifying "Family Ethics", the classes are arranged in the order, Husband and Wife, Parent and Child, Guardian and Ward, Dependent Relatives, Other Relatives, Guests and Domestic Servants, which is an acceptable relational order.

(iii) In classifying "Contracts" in Law, the classes are arranged in the order—Capacity, Consideration, Formation, Avoidance, Lien, Enforcement and Dissolution—which is the correct time-order as well as developmental order.

(iv) In classifying the parts of human body on a basis different from regional and functional, the classes are arranged in the order—Bones, Muscles, Connective Tissues, Skin, Hair, etc.—which is acceptable as a convenient spatial order.

4. In classifying "Stratigraphy", the Congress Classification, the Decimal Classification as well as the Colon Classification arrange the classes in the order, Archaen, Primary or Palaeozoic, Secondary or Mesozoic, Tertiary or Cenozoic, Quaternary or Glacial and Recent, which at once agrees with all orders—numerical, developmental, spatial and temporal.

CANONICAL ORDER *Pr. of Canonical Seq.*

(iv) If the classes are being traditionally referred to in a specific order, though no underlying principle is discoverable, it will be a convenience to conform to this traditional order. It may even happen that no specific characteristic can be isolated as forming the basis of the derivation of the classes, except that the classes may be simply the classes into which their immediate universe has been traditionally divided. In the Colon Classification such classes are known as *canonical divisions* and their order *canonical order*.

The classes of many arrays in almost all schemes of classification are arranged only in canonical order. That is because, in most cases, the classification-characteristic does not lead to classes with quantitative or developmental or spatial or temporal or any other relational affinity or sequence or order.

Examples:—

COLON CLASSIFICATION

1. In the Colon Classification the classes in the following arrays are only in canonical order:—

(i) The classes in the first array derived from "Mathematics", *viz.*, Arithmetic, Algebra, Analysis, Other methods, Trigonometry, Geometry, Mechanics, Potentials, Astronomy.

(ii) The classes in the first array derived from "Physics", *viz.*, Properties of matter, Sound, Heat, Light, Electricity, Magnetism, Cosmic hypotheses.

(iii) The classes in the first array derived from "Geology", *viz.*, Mineralogy, Petrology, Structural geology, Dynamic geology, Stratigraphy, Palæontology, Economic geology, Cosmic hypotheses.

(iv) The classes of precious stones given under "Mineralogy", *viz.*, Diamond, Ruby, Sapphire, Opal, Topaz, Spinel, Pearl.

(v) The classes of physical characters of minerals given under "Mineralogy", *viz.*, Density, Hardness, Touch, Taste, Smell, Thermal characteristics, Optical properties, Electrical properties, Magnetic properties, Etching.

(vi) The form classes of "Literature," *viz.*, Poetry, Drama, Fiction (including short stories), Letters (literature written in the form of letters), Orations, Other forms of prose, *Campū*.

DECIMAL CLASSIFICATION.

2. In the Decimal Classification the classes in the following arrays are only in canonical order.

(i) The classes of fruits in "Agriculture," *viz.*, Pome fruits, Stone fruits, Citrous fruits, Minor fruits, Nut fruits, Palmaceous fruits and small fruits.

(ii) The classes showing the departments of the United States Government, in the subject "Administration," *viz.*, State department, Treasury department, Interior department, Post office department, Justice department, War department and Navy department.

(iii) The classes in the first array derived from "Law," *viz.*, International law, Constitutional law, Criminal law, Martial law, Private law and Church law.

✓(4) Whenever the same or similar classes occur in different arrays, their orders should be the same or similar in all such arrays, wherever insistence on such sameness or similarity does not violate other more important requirements.

This may be referred to as the CANON of CONSISTENT ORDER. *Sequence*

Conformity to this canon will be conducive to economy of time and of attention or mental energy. It will minimise load on memory both for the classifier and the user.

It is the first aspect of this canon in the form "arrange the same group of classes in the same order, whatever be the array in which they occur" that is responsible for certain practices in some of the printed schemes of classification.

SUBJECT CLASSIFICATION

(1) The Categorical Table of the Subject Classification is an instance in point. In introducing this concept, Brown says, "In the absence of a more expressive portmanteau word, 'categorical' is used to denote a table of forms, phases, standpoints, qualifications, etc., which apply more or less to every subject or subdivision of a subject. It was thought unwise to load the Classification Tables themselves with repetitions of such categories". The construction of such a Categorical Table has automatically secured the fulfilment of the first aspect of the canon to a large extent.

EXPANSIVE CLASSIFICATION

(2) In a similar manner, we find in the Expansive Classification, two auxiliary tables of classes, which secure automatic conformity to this particular aspect of the canon. The two tables are—

(a) the Local List which arranges the geographical divisions in a definite order; and

(b) the table of Common Subdivisions.

DECIMAL CLASSIFICATION.

(3) In the Decimal Classification, the geographical classes, the classes of industries and the common subdivisions are arranged in exactly the same order, wherever they occur.

(a) The prototype for the order of the geographical classes is given in the History Schedule covering the numbers 940 to 999. Wherever classification on that basis is warranted, instruction is given to divide like 940-999.

Examples:—

(1) Under the class "376.9 Education of women in special countries," we find the following note: "Subdivided like 940-999, *e.g.*, 376.943, Education of women in Germany".

(2) Under the class "325.2, Emigrants", we find the following note. "Divided by country of origin like 940-999, *e.g.*, Chinese emigrants 325.251".

(b) Next, the prototype for the order of industries is given in the schedule of Useful Arts covered by the numbers 620 to 699. Wherever classification on the basis of industries is warranted, instruction is given to divide like 620-699.

Examples:—

(1) Under the class "331.8928 Strikes—By industry" we find the note "82-89 divided like 620-699".

(2) Under the class "658.9 Sales and salesmanship in specific industries" we find the note ".92-.999 Special material. May be subdivided like 620-699, *e.g.*, Dry goods stores 658.977".

(c) The common subdivisions are always given in the same order under each class and an alphabetic index of the common subdivisions is given separately in "Table 2, Form divisions" at the end of the later editions.

COLON CLASSIFICATION.

(4) In the Colon Classification, this practice of automatically securing conformity to the canon in question is developed to a much larger extent resulting in great economy in the length of the schedule.

COMMON SUBDIVISIONS

(a) Table 2 of its schedule is one of common subdivisions, the application of which automatically secures that all common subdivision classes found in whatever array fall in the same order.

GEOGRAPHICAL DEVICE

(b) Table 3 of its schedule gives the geographical divisions. The use of this schedule in securing sameness of classes in all geographical arrays wherever they occur is laid down by rule 62 entitled Geographical Device¹ which "consists in using the appropriate Geographical Number for the further subdivision of a class which is capable of geographical division or when the individualisation of the subclasses may be made to depend conveniently on the place of origin or on the place of prevalence or on the place of habitation or on the place that may be definitely associated with the respective subclasses in any other manner or for any other reason. The cases where this device may be applied are generally indicated either in the Schedules of Classification in Part II or in the Rules of Classification in this Part".

Examples:—

In addition to the geographical classes of Geography, History, Economics and Sociology following the same order as in the Geographical Table, the Geographical Device is also used in several other places such as the classification of dialects and jargons in Philology, certain religions in the main class Religion, and certain systems of philosophy in the main class Philosophy. Further, several common sub-divisions such as laboratories, exhibitions, periodicals of all nature, statistics, commissions, travels and history are also further subdivided by the Geographical Device. The result is that in all these and other similar cases the geographical classes come in one and the same order.

¹ Ranganathan (S.R.): *Colon Classification*. Rule 62.

CHRONOLOGICAL DEVICE

(c) Table 5 of the schedule is entitled Chronological Divisions and rule 63 enunciates the Chronological Device¹ and shows how the arrangement of periods given in this table should be automatically adopted in all cases where classification proceeds on a chronological basis.

The Chronological Device is used in quite a large number of cases in the Colon Classification—practically, several times in all subjects.

Examples:—

- (1) In the main division Mathematics,
special forms of Diophantine equations,
special arithmetic functions,
special forms of algebraic equations,
special determinants,
special algebraic transformations,
special types of infinite series,
special integrals of real variable, and
special functions of complex variable

are divided by the chronological device and in all these cases the chronological classes are arranged in the same order.

- (2) In the main division Economics, special theories of distribution and special types of organisation are classified by the chronological device.

In fact there is hardly any subject where this device is not employed.

COLON DEVICE

- (d) In the tables relating to most of the subjects, two or more schedules based on different characteristics are given.

For example, in the table for Medicine, we have the Organ Schedule and the Problem Schedule. The organ schedule contains about 200 classes. The problem schedule contains even a larger number of classes. But a few of its main classes are Morphology, Physiology, Diseases and Growth. As a result of the Colon Device,² the problem divisions of all the two hundred and odd organ-classes

¹ Ranganathan (S.R.): *Colon classification*. Rule 63.

² *Ibid.* Rule 61.

automatically get arranged in one and the same order, *viz.*, the order in which the problem classes are given in the problem schedule.

Such an automatic conformity to the canon of consistent order is secured by the Colon Device in every subject. As stated in the Introduction to the *Colon classification*, its schedules consist of a number of standard schedules, which correspond to the standard pieces in a Meccano Apparatus, the colon (:) playing the role of bolts and nuts. By picking out one class at a time from some of the unit schedules according to assigned combinations and arranging those classes in assigned permutations, the class numbers of all possible classes are constructed. The standard order of classes fixed in the unit schedules automatically persists in all arrays where these classes figure no matter what the subject is and no matter what the order of the array is.

SUBJECT DEVICE

(e) The Subject Device¹ enunciated in rule 66 reads "The Subject Device consists in using appropriate Class Numbers for the further sub-division of a class which is capable of such sub-division or when the individualisation of the sub-classes may be made to depend conveniently on a Class Number that may be definitely associated with the respective sub-classes in any manner or for any reason. The cases where this Device may be applied are generally indicated either in the Schedules of Classification in Part II or in the Rules of Classification in this Part".

This rule adds greatly to the profuseness as well as the minuteness of the classes. At the same time, sameness of order is automatically secured wherever it is possible, in all similar arrays. This device also is employed frequently in almost all subjects.

Examples:—

Several divisions of the main class Useful Arts,
 most of the buildings under the utility-characteristic in Architecture,
 most of the subjects under the figure-characteristic in Sculpture,

¹ Ranganathan (S.R.): *Colon classification*. Rule .66.

most of the special views under the view-characteristic and all the classes under the subject-characteristic of Metaphysics,

the classes under the division teaching technique in Education,

the classes under the divisions, rights, duties, administration and records in History,

the classes of *ad hoc* bodies for special functions in Politics,

most of the businesses under the business-characteristic in Economics, and

most of the implements, other material equipments and activities under the problem-characteristic in Sociology are arranged by the Subject Device and their order is thus automatically secured to be the same.

We find the subject device in an incipient stage in a few places in the Decimal Classification, though it is not applied as frequently as possible.

Under "Subjects of study" in Education, we find the note "divided like the classification 010-999, *e.g.*, 375-5 Place of science in the curriculum, 375-84 French literature in the curriculum, 375-88 Classics in the curriculum."

Again under "Relations of capital to labour. By industry" in Economics, we find the note "divided like 620-699. For occupations not included in 620-699, use 331-181 divided like main classification".

This device is applied also twice in the class "Bibliography".

BIAS NUMBER DEVICE

(f) The Bias Number Device¹ enunciated in rule 68 is another means by which orders of the same classes are secured to be the same, in all the different arrays in which they occur.

Thus in the Colon Classification, conformity to the first aspect of the canon under consideration is automatically secured in many ways. In a sense, if the Subject Classification respects the canon in one way, the Expansive

¹ Ranganathan (S.R.): *Colon classification*. Rule 68.

Classification in two ways, and the Decimal Classification in three ways, the Colon Classification seeks to satisfy it automatically in six ways.

CONGRESS CLASSIFICATION

(5) But the Congress Classification is quite indifferent to the canon of consistent order.

INCONSISTENCY IN GEOGRAPHICAL ORDER

(a) Arrays of geographical classes occur in hundreds of places in the schedules of the scheme. But in comparing them, one is tempted to say "Inconsistency, thy name is geographical array!"

Examples:—

(1) In "Paleontology," the countries of continental Europe are arranged strictly by the alphabet.

(2) But in several classes of "Natural History," "Botany" and "Zoology," some of the countries in continental Europe are grouped and the groups are alphabetised, with the result that Holland, Belgium and Luxemburg are placed with N under Netherlands, Poland and Finland are placed with R under Russia and so on.

(3) Here is another whimsical variation. Under "Fauna," Holland precedes Belgium; but under "Flora," Holland succeeds Belgium.

Again, the countries of Africa are arranged alphabetically under "Fauna," but are grouped under "Flora" with the result that Natal, Transvaal, East Africa, Nigeria, and Uganda come with B under British Africa, Abyssinia comes before British Africa. But West Africa comes before Abyssinia and so on.

(4) In "History of printing," the continents are arranged in the order: Europe, Asia, Africa, America and Australia; and Great Britain comes after Germany among the sub-divisions of Europe.

(5) But in "History of Copyright Laws," all the countries of the world are arranged in one alphabetic sequence which gives no quarter to names of continents.

(6) On the other hand under "Bibliography in Botany," the countries of the world and the names of the continents including oceanic areas like Arctic Regions are merged in one alphabetic order.

(7) The geographical array prescribed for arranging "Library reports" prescribes a still another sequence giving the first place to the United States and giving Great Britain precedence over Austria in an order which is otherwise alphabetic by countries.

(8) An altogether different order is prescribed for the geographical classes under the division "Light House Service" in the class "Naval Sciences". It is as follows:—
Europe, Great Britain, Norway, Denmark, Sweden, Russia, Germany, . . . Africa . . . Asia . . . Australia . . .
South America

The illustration of the richness of this idiosyncrasy can be continued to any extent. It is not clear what purpose is served by arranging the geographical classes in so many ways, ruthlessly flouting the canon of consistence, conformity to which would have considerably shortened the bulk of the schedule, would save classifiers a good deal of unnecessary strain in their daily work and would cause less irritation to readers, in whom curiosity is not altogether dead.

INCONSISTENCY IN SUBJECT ORDER

(b) The idea of Subject Device—which is explicitly exploited in the Colon Classification, which is incipient in the Decimal Classification and which figures, though meagrely and in an unrecognised form in the categorical tables of the Subject Classification—is quite foreign to the Congress Classification. One example will do.

Example:—

We find the following different orders:—

In the Schedule of "Fine Arts."	In the Schedule of "Bibliography by subjects"
Architecture	Architecture
Sculpture	Engraving
Drawing	Painting
Painting	Sculpture
Engraving	Decoration and ornament
Decoration and ornament	Drawing

INCONSISTENCY IN ORDER OF COMMON SUB-DIVISIONS

(c) The pestering trivial discordance in the order of common sub-divisions is endless. None but the Law of Permutation can find delight in such eccentricities.

Examples:—

(1) In most subjects, no distinction is made between *Periodicals* and *Societies*. In some, they are distinguished but put consecutively. But in certain subjects like "Science (General)" and "Decoration and Ornaments," they are separated by *Yearbooks*.

(2) In most subjects, *Exhibitions* and *museums* come after *Study and teaching* and *Laboratories* very near the end of common sub-divisions. But in "Chemistry" and "Sculpture," they come very near the beginning—immediately after *Periodicals* in the former and one place later i.e., after *Congress* in the latter—while, in the subject "Engraving," it comes still later after *Dictionaries* and *Directories*. A more meaningless variation is that of *Museum* preceding *Exhibitions* in some subjects like "Fine Arts (General)," while the order is the reverse in some subjects like "Sculpture," "Graphic Arts," and "Chemistry".

(3) In "Fine Arts (General)," *Directories* comes about the middle and occurs between *Biography* and *History*. But in "Engraving" it comes much earlier immediately after *Yearbooks* and *Dictionaries*, while *History* and *Biography* come several places later. On the other hand, a place near the end is found for *Directories* quite after *History* and *Biography* in "Science (General)" and "Geology".

(4) *Yearbooks* is usually given the second place. But in "Geology," it is taken a long way down and is clubbed with *Directories*.

(5) *History* and *Biography* are separated by *Directories* in "Fine Arts (General)". But in most other subjects they are put consecutively. Again, *History* comes before *Biography* in "Sculpture," "Engraving" and in most of the "Natural Sciences". But *Biography* comes before *History* in "Fine Arts (General)," "Graphic Arts" and "Painting".

(6) *Nomenclature* comes at the very end in "Anatomy," very early in "Botany," "Geology" and "Chemistry" and somewhere in the middle in "Science (General)".

(7) *Studies and Teaching* usually comes immediately after *Essays and Lectures* and about two-thirds way down in the array of common sub-divisions. But, it comes last and gets separated from *Essays and lectures* by many divisions in "Physics". In "Anatomy," "Botany" and "Zoology," on the other hand, *Studies and Teaching* retains its usual place two-thirds of the way down the array but *Essays and lectures* comes last.

(8) *Study and Teaching* comes after *History* in most subjects but it comes many classes before *History* in "Decoration and Ornaments".

(9) *General works* usually comes immediately before *Studies and Teaching* in most of the subjects and is about two-thirds way down the array. But in "Decoration and Ornaments," *General works* comes near the end of the array and *Studies and Teaching* occurs somewhere in the middle.

(10) *Essays and lectures* usually comes near *General works* about two-thirds way down the array. But in "Botany" it comes almost near the end of the array.

Surely no useful purpose can be served by such haphazard variations. A little coordination and forethought would have secured conformity with the canon of Consistent Order and resulted in compactness, convenience and economy of space, time and energy.

PARALLEL ORDER OF SIMILAR CLASSES

(6) The Colon Classification seeks to exploit the advantages of the canon of Consistent Order not only by arranging the *same* classes in the *same* order in whatever array they occur, but also by arranging *similar* classes occurring in different arrays in a *similar* order.

Examples:—

Compare the following arrays and mark the similarity or parallelism.

In Psychology: Array formed on the basis of Entity characteristic	In Education: Array formed on the basis of Educand characteristic	In Sociology: Array formed on the basis of Group characteristic
Child ..	Pre-secondary ..	Groups arising from age and sex
Newborn ..		
Toddler ..	Pre-school ..	Children
Infant ..	Elementary ..	
Pre-adolescent ..	Secondary ..	Youths
Adolescent ..	Adult ..	Old persons
Post-adolescent ..	Literate ..	Women
Middle-age ..	Foreigner ..	Family
Old age ..	Illiterate ..	Groups arising from residence
Vocational ..	University ..	Groups arising from occupation
Sex ..	Sex ..	Groups arising from birth or status
Male ..	Male ..	
Female ..	Female ..	
Abnormals ..	Abnormals ..	Abnormals
Genius ..		
Subnormal ..	(To be subdivided as in Psychology)	(To be subdivided as in Psychology)
Insane ..		
Sick and infirm ..		
Criminal ..		
Deaf and dumb ..		
Blind ..		
Race ..	Backward classes ..	Race as a social group
Social ..		Groups arising from association
Other ..	Other ..	Other
(To be divided by the Subject Device)	(To be divided by the Subject Device)	(To be divided by the Subject Device)

(2) Note the parallelism in the following tables also:—

In Mathematics	Dynamics ..	Hydro-dynamics	Aero-dynamics
In Physics ..	Solids ..	Liquids ..	Gases
In Civil Engineering	Land transport	Water transport	Air transport
In Mechanical Engineering	Principles of Mechanism	Hydraulic Engineering	Pneumatic Engineering
In Dynamic Geology	Glacial Geology	Action of water	Action of air
In Ecology (Physiographic regions)	Land ..	Water ..	Air
In Sport and Games	Athletics ..	Aquatic sports..	Air sports
In Geography ..	Geomorphology	Oceanography..	Meteorology
In History ..	Military history	Naval history ..	Aerial history
In Economics ..	Land transport	Water transport	Air transport
In International Law (Laws of War)	Invasion, etc. ..	Maritime warfare	Air warfare

(3) Here is another set of parallels:—

In each of the Natural Sciences and in Medicine: (Problem divisions)	Morphology ..	Physiology ..	Diseases
In Philology: (Problem divisions)	Structure, morphology	Function syntax	
In Politics: (Problem divisions)	Parts of Government	Functions of Government	
In Sociology: (Problem divisions)	Material equipment	Activities ..	Social pathology

Such examples can be multiplied to any extent.

DECIMAL CLASSIFICATION

(7) The Decimal Classification also respects the canon by arranging similar classes in similar order to some extent.

Examples:—

In Medicine		In Psychology	
Eye	..	Vision	
Ear	..	Hearing	
Organs of smell	..	Smell	
" taste	..	Taste	
Organs of touch	..	Touch	

In Physics		In Chemistry		In Therapeutics	
Mechanics	..	Solid state	..	Mechanical rendering	
Liquids	..	Liquid state	..	Imponderable rendering	
Gases	..	Gaseous state	..		
Light	..	Photo-chemistry	..	Light	
Heat	..	Thermo-chemistry	..	Heat	
Electricity	..	Electro-chemistry	..	Electro-therapeutics	
Magnetism	..	Magneto-chemistry	..		
		Radio-chemistry	..	Radio-therapy	

CONGRESS CLASSIFICATION

(8) The Congress Classification, on the other hand, severely ignores the advantages of such similar arrangement:—

Examples:—

In Physics.		In Chemistry.		In Therapeutics	
Heat	..	Thermo-chemistry	..	Photo-therapy	
Light	..	Electro-chemistry	..	X-ray therapy and	
				Radio-therapy	
X-rays and Electric radiations		Magneto-chemistry	..	Thermo-therapy	
Electricity	..	Photo-chemistry	..	Electro-therapy	
Magnetism	..			Magneto-therapy	

CHAINS OF CLASSES

Each chain of classes in a scheme of classification should satisfy the following canons:—

INTENSION *Canon of Deem. extension*

- ✓ (1) As we go down a chain from its first link to its last link, the intension of the classes should increase and the extension of the classes should decrease.

This may be referred to as the CANON of INTENSION.

The terms extension and intension require elucidation. Much controversy exists in logic about the proper use of the terms and the inverse relation between them implied in the canon of intension. But as applied to a chain of classes in a scheme of classification defined in the last chapter, these can be determined without complicating ourselves with this controversy. Applying only to classes subordinated one to another in chains, the canon is an attempt to explain the nature of classification, as chains of classes so related that each class is of wider extension and smaller intension than the next below it in its chain.

For practical purposes, we may say that *extension* of a class has for its measure the number of entities or the range comprised in the class, while its *intension* has for its measure the number of characteristics used in deriving the class from the original universe or the order of the class.

In a certain sense we may also say that

Extension is a quantitative measure of a class; and
Intension is a qualitative measure of it.

INTENSION ILLUSTRATED

Sayers puts the matter in this way.¹ A main class covers a wide field, a great number of things. Its compass

¹ Sayers (W. C. Berwick): *An introduction to library classification*. 1935. P. 13.

is its *extension*. *Intension* on the other hand signifies meaning: the broader the class, the fewer are the attributes that can be predicated of it; or the greater the extension the smaller its intension. Philosophy has great extension; Ethics, which is a division of Philosophy, is of less extension but is of very much greater intension. Sobriety, which is a division of Ethics, is of much less extension but of much greater intension; Abstinence has still further reduced extension and increased intension, and Total Abstinence is of very small extension and very great intension. Classification moves according to that method.

Examples:—

(1) If we take the chain relating to chemical substances—Substances, Inorganic substances, Elements, Halogens, Chlorine—the number of entities comprised in each class decreases and the number of characteristics that have been used to derive it from the original universe Substances increases as we go down the chain and reach Chlorine.

(2) If we take the chain—World, Asia, India, Bengal—the range comprised in the class decreases and the order of the class increases, as we progress from the class World to the class Bengal.

WHEN APPLICABLE?

It may be emphasised here that the canon of intension is applicable only to the classes in *one and the same* chain, i.e., to classes that have lineal kinship and not to any set of classes. Obviously it would be ridiculous to compare in this matter such different classes as *democracy* and *steam engine*; it is equally unmeaning to compare classes which, though belonging to the same main class, occur in different chains of subordination; *bird* and *reptile*, for example, both belong to the same class *animals*, but are not subordinate one to the other (do not occur in the same chain), and nobody can well tell which has the greater intension, nor if that were decided would be able to infer from the decision, which had the greater extension, or comprised the larger number of subordinate species.

- (2) A chain of classes should comprise one class of each and every order that lies between the orders of the first link and the last link of the chain.

This may be referred to as the CANON of MODULATION.

Examples:—

(1) To take the first example given in the preceding canon, "Substance" is the first link and "Chlorine" is the last link of the chain. "Substance" is a class of order zero and "Chlorine" of order four. The canon of modulation stipulates that the scheme of classification would be defective, if the chain omitted to give either "Inorganic substances," or "Elements," or "Halogens" which are the classes of the intermediate orders, one, two and three, in the chain in question.

(2) Again, if we take the second example given under the preceding canon, "World" is the first link and "Bengal" is the last link of the chain. "World" is a class of order zero and "Bengal" of order three. The canon stipulates that the scheme of classification would be defective, if the chain omitted to give either "Asia" or "India", which are the classes of the intermediate orders, one and two, of the chain in question.

canons for filial sequence

1) Canon for subordinate classes

2) " " co-ordinate classes.

3. GENERAL THEORY

CANONS OF CLASSIFICATION

Terminology and Notation

The second chapter dealt with the canons of classification to be observed in the choice of the Characteristics of Classification and in the formation of the several Arrays and Chains of a Scheme of Classification. In this chapter we shall deal with the remaining two categories—Terminology and Notation.

✓ TERMINOLOGY

Terminology, it may be recollected, is the system of Terms used to *denote* or name the classes in a Scheme of Classification. Two parties are to be recognised in the discussion of Terminology. There is the author or the accredited revisor and editor of the scheme of classification on the one hand and the classifier or the user of the scheme on the other. We shall have to search for the canons to be observed by each of these parties in regard to Terminology—the canons to be observed in the construction of the schedule and those to be observed in interpreting the Terms in the schedule while applying them in the process of actual classification.

VAGUENESS

In spite of we humans priding ourselves on our possession of articulate speech or language, which is denied to other creations, many of our social, economic, political and even domestic ills are traceable to the imperfection and vagaries of language. Classification Schemes will have to share with other human endeavours, some consequences of such imperfection and vagaries. The language of every conversation is notoriously vague. The language of even carefully prepared documents yields several interpretations and hides or confuses the original intention to such an

extent that society is forced to maintain the costly profession of advocates and, what is worse, unintentionally divert to that profession, by the lure of disproportionate emoluments, some of the best brains which should be used in more substantial creative work.

The language of even technical treatises is not always very much better. Everybody is familiar with the difficulty of deciding whether certain micro-organisms are "plants" or "animals", whether a given society is or is not a "democracy", whether we do or do not have certain "rights". Such words are vague, because their denotation shades off imperceptibly into the denotation of other words. The vagueness of ordinary words is one of the principal reasons why technical vocabularies must be constructed in special sciences.

Much of the best effort of human thought must go, therefore, to delimit the vagueness of words and eliminate their ambiguity. This is the justification for standing committees on terminology, appointed on an international basis in different departments of knowledge. With all that, vagueness can be reduced but never completely eliminated. So also with ambiguity.

CREATION OF NEW TERMS

To add to this difficulty, new words are coined and brought into use sometimes to express new ideas and sometimes to express even old ideas. The publication of the sumptuous supplementary volume of the *New English dictionary* is a proof of this phenomenon so far as a single language is concerned. This volume and the original volumes together demonstrate also the changes that came over the meanings of the terms with the progress of time, with nobody in particular shouldering the responsibility for such changes.

Then we have the multiple meanings of certain terms. Etymologists may find justification for them and may even enjoy the semasiological pleasure they impart to them. But they are a source of trouble to classifiers of either class—the inventor and the user—and this has to be met by some carefully framed canons.

The following canons relating to Terminology must be observed in the construction and use of a Scheme of Classification:—

1. Each of the terms used to denote the classes in a Scheme of Classification must be the one in current use among those who specialise in the universe to which the scheme is applicable.

This may be referred to as the CANON of CURRENCY.

This canon implies two things. In the first place the terms chosen at the time a Scheme of Classification is forged should accord with the usage then current among the specialists concerned.

Secondly, there should be some arrangement by which the terms can be changed over to current ones, as and when changes take place among the specialists.

CONGRESS CLASSIFICATION

In this matter, the best provided scheme today is the Congress Classification as the library-minded Government of the United States of America is at the back of the organisation and has provided a liberal establishment of specialists to be in constant charge of the revision of the classification. This staff of specialists has one of the biggest libraries of the world, adding books at a far greater rate than any other library, as the testing laboratory for the terms of the Scheme. Thus financial resource, human resource and book resource are at their maximum to help the perpetual fulfilment of the Canon of Currency by the Congress Classification.

DECIMAL CLASSIFICATION

The astute organiser that he was, Melvil Dewey provided the necessary machinery for the fulfilment of this canon by his Scheme by entrusting the future editions of the Decimal Classification to the Lake Placid Club Education Foundation chartered by the University of the State of New York, January 26, 1922. He turned over to this Foundation the considerable property owned by the Lake

Placid Co., thus assuring permanent financial support, which has already been further increased by gifts and bequests from interested friends. One important condition imposed on the publication of the future editions of the Decimal Classification is that the entire receipts above necessary expenses should be used for ever solely for improving Decimal Classification. A Committee on Decimal Classification, consisting of the most interested Foundation Trustees, in consultation with committees of American Library Association and Institute International de Bibliographie, is to ensure the observance of the above condition. So much for the business side.

On the academic side, the editor appointed is one who had been in close association with Dewey and the Decimal Classification for the last thirty-five years, i.e., from the Seventh Edition onwards. During this period the Decimal Classification has grown from 792 pages to 1645, a fact which shows that continuity of policy will be well preserved.

NUNC DIMITIS

But the irrepressible ambition and the uncanny farsight of Dewey did not allow him to be satisfied with these provisions. By persistent efforts spread over many years, he ultimately succeeded in turning all the resources of the Congress Library to the advantage of the Decimal Classification from the year 1930. How much he had set his heart on the consummation of this ambition of his can be inferred from the following remarks of his:—"When I see the Decimal Classification Numbers on the Library of Congress Cards, I shall be ready for the *nunc dimitis*."

AMBITION FULFILLED

1930 saw the establishment of the Office for D. C. Numbers on L. C. Cards in the Library of Congress and 1933, the formation of the D. C. Section as part of the staff of the Library of Congress. At present the Editorial Office of the Decimal Classification is also located in the Library of Congress and the intimate way in which the resources of the Library of Congress are exploited for the fulfilment of the Canon of Currency by the Decimal Classification is described in the following words by J. C. Pressy, Assistant in

charge, D. C. Section, Library of Congress.¹ "Of necessity, the Decimal Classification Section must work in close cooperation with the editors of D. C. *They* are constantly at work rounding out and expanding D. C., and reinterpreting the older parts in modern terms; *we* are constantly at work applying the D. C. to the stream of printed material, new and old, which is entering the Library of Congress. They help us when we are puzzled by the interpretation of numbers and topics in the tables, and by new subjects; we help them—and hope to do so still more in the near future—by serving as a kind of testing laboratory for their work.

TESTING LABORATORY

"As a 'testing laboratory' our shelf list is available to the editors of D.C., whenever they wish to examine it. And they, in turn, send copies of tentative expansions for us to consult and to criticise. These tentative expansions cannot be used until they are surely permanent. But they do offer suggestions to us, for new sub-topics included under a heading that has already appeared in the printed tables are not likely to be shifted and put under another, even though their order, and therefore the numbers assigned to them, may be altered. These schedules, though tentative, are useful to us in that they indicate the scope of many numbers now printed in Edition 13. And as we study them and compare them with our shelf list, we hope to be able to make practical suggestions to the editors as to the application of these schedules to classification of books."

HELP FROM CATALOGUE

As a secondary means of meeting the second implication, the class index cards in the catalogue of a library should be constantly revised. Cards which have old obsolete terms for headings should be marked obsolete and, if practicable, be furnished with an additional note in distinctive style showing the period when it was current. Also new cards should be written in terms of the current equivalent headings. This impact of the theory of classification on the theory of cataloguing has been set forth in the

¹ American Library Association. Catalog Section. *Comp.: Catalogers' and classifiers' yearbook*, 6. 1937. Pp. 54-56.

following terms in the *Classified catalogue code*¹:— "There is another factor which makes the Class Index Entry a source of trial for cataloguers. One of the basic Canons of Classification is that the term used to denote a Class in the Schedule of Classification should have a fixity of meaning. In deference to this canon, individuals that have to do with the administration of libraries may use the same term with the same meaning at all times. But there are forces, beyond the control of individuals, which change the meaning of terms in course of time. The vicissitudes in the meaning of terms like Philosophy, Philology, Anthropology, Sociology and so on, are cases in point. Nobody in the world, much less the classifier and the cataloguer, can arrest this semasiological change and evolution of the words in human use. Apart from the changes that come through ages,—a library catalogue, being a permanent entity, has no doubt to take note of these—the recent publication of the supplementary volume of the Big Oxford Dictionary demonstrates the extraordinary rate at which new terms are born and old terms change their colour and meaning even in a single generation.

INTERNAL REPAIR

"What cannot be prevented must be met with suitable adjustments. It is here that the need for repair of the catalogue comes,—internal repair as distinct from the repair of the physical card. As the terms used as Headings of Class Index Entries become obsolete, their cards should be replaced by ones having their more up-to-date equivalents as Headings. This process requires constant vigilance and industry. Otherwise, instead of the catalogue helping the people, it may prove to be harmful and misleading. Again, the need for such replacement of isolated entries from time to time makes it imperative that the physical form of the catalogue should be such that any given entry can be removed, corrected or replaced without disturbing the other entries. This would rule out the ledger form of the catalogue and make the Card Catalogue, the form *par excellence*."

¹ Ranganathan (S.R.): *Classified catalogue code*, 1934, Rule 311, Commentary.

2. The terms used to denote the classes in a scheme of classification should not be critical.

This may be referred to as the CANON of RETICENCE.

Common sense will usually lead one to the observance of this canon. But the inclusion of this common sense rule among the canons has been necessitated by the use of certain terms in the Decimal Classification by the pioneer classifier, Melvil Dewey.

HUMBUGS

(a) He introduced the term "Humbugs" to denote classes in metapsychology. This is a privilege or rather a freak of genius that can be tolerated only in Dewey even as the Johnsonian definition of oat as "A grain which in England is generally given to horses but in Scotland supports the people" was tolerated in his famous lexicon.

But the classifier must learn to subordinate his own opinions about classes and use only terms which are purely descriptive and not opinionative.

MINOR AUTHORS

(b) Another term frequently occurring in the Decimal Classification much against the Canon of Reticence is "Minor". "Minor Authors" is found scattered over all the pages of the Literature schedule. How is it the province of a classifier to adjudge men of letters as "Major" and "Minor". Even among literary critics, opinion is divided. What is worse, the valuation changes. According to the famous gentleman, whose name is used by the Library of the University of Oxford, Shakespeare was worse than a minor author. His plays were simply thrown out of that library. But a century or two later, the "worse than 'Minor' author" had shot up in public estimation as the "Majormost" author and the successors of Bodley had to pay out fabulous sums of money to secure for that library representative copies of the Quartos of Shakespeare. The purpose of the scheme of classification could very well have been served by replacing the critical word "Minor" by the colourless descriptive word "Other".

Then we pass on to canons to be observed by the users of classification scheme.

3. The denotation of each term in a scheme of classification should be decided by the enumeration of the classes in the chains which have the class denoted by the term as their common first link.

This may be referred to as the CANON of ENUMERATION.

This canon becomes necessary as there is no agreement or uniformity in the denotation of terms as used by different persons and by different schemes. Nor is it possible to force any such uniformity by the fiat of the order of any government or academy. Hence, the only course open to users of a scheme of classification is to find out the denotation of a term by a reference to the classes and the chains of sub-classes shown to be comprehended by it in the scheme.

ARITHMETIC

Examples:—

(i) (a) The enumeration of the sub-classes of the class denoted by the term "Arithmetic" shows that it comprehends only what is known as "Lower Arithmetic" in the Decimal Classification and the Congress Classification. But "Higher Arithmetic" otherwise known as "Theory of Numbers" is comprehended by the term "Arithmetic" in the Colon Classification. But "Theory of Numbers" is not comprehended either in "Arithmetic" or in "Algebra" in the Subject Classification. It does not appear to occur anywhere in that scheme.

GEOMETRY

(b) In the Decimal Classification, the enumeration of the sub-classes of the class denoted by the term "Geometry" shows that it includes what are known as "Pure Geometry", "Infinitesimal Geometry", "Systems of Geometry" and "Analysis Situs," but not "Descriptive

Geometry" and "Analytical Geometry." But in the Colon Classification the term "Geometry" is shown by enumeration to include all these, except "Analysis Situs" which is shown under Analysis as "Foundations". The enumeration in the Subject Classification and the Congress Classification agrees with that in the Colon Classification.

RADIATION

(ii) (a) The class in the Decimal Classification denoted by the term "Light" and the alternative term "Radiation" presents a hopeless deviation from accepted usage. It violates the Canon of Currency so much, that, but for the Canon of Enumeration, a classifier must experience many pitfalls. We have to read the enumeration of subclasses with the index, to escape these pitfalls. In the first place the index shows that "Ultra-violet Rays", which is a colourless invisible ray, is comprehended under the term "Radiation" or "Light", though the place shown for it by the index is denoted by the term "Colour" in the Schedule!—indeed an irony in the eyes of those who have even a smattering of modern developments in physics. But another radiation, "X-rays" is shown by the index to be comprehended not by the term "Radiation" but by the term "Electricity" in the sub-class "Induction spark in rarified gases"—a grievous violation of the Canon of Currency. "Infra-Red Rays" and "Cosmic Rays" do not find a place either in the enumeration under the term "Radiation" or in the index.

On the contrary, the enumeration of the sub-classes of the class denoted by the term "Light" in the Colon Classification and the Congress Classification shows that all the radiations mentioned above are comprehended by the term "Light".

The Subject Classification does not recognise so many rays and there is no enumeration of different kinds of radiation under the class denoted by the term "Light". But from the index entry one has to infer that the subclass "Light Rays" of "Light" includes also "X-rays". But no mention of any other radiation either in the enumeration or in the index is made.

PHILOSOPHY

(iii) In all the schemes, but the Colon Classification, the enumeration of the sub-classes of the class denoted by the term "Philosophy" includes Psychology. On the contrary Psychology is left out in the enumeration under the class Philosophy in the Colon Classification and is given a co-ordinate place with Philosophy.

POLITICS

(iv) The enumeration of the subclasses of the class denoted by the term "Politics" in the Colon Classification excludes Constitutional History. This is also confirmed by a special rule.¹ But in the other schemes, the enumeration under the class Politics explicitly mentions Constitutional History.

(v) Examples of such variations can be multiplied to any extent. Some cases will also be referred to and commented upon in chapters 6 to 8, where a comparative study of the schemes is attempted.

CONTEXT

4. The denotation of each term in a scheme of classification should be decided in the light of the different classes of lower order belonging to the same primary chain as the class denoted by the term.

This may be referred to as the CANON of CONTEXT.

This canon is necessitated by the fact that one and the same term denotes several different entities, in popular as well as technical usage. It may be stated that this canon is usually overlooked by beginners. It leads to many absurd placings. The tutorial hours in my School of Library Science are usually rendered most enjoyable to the teacher as well as the taught on account of the fund of humour so amply provided by the neglect of this canon by the beginners. The importance of this canon has to be rubbed in, for many hours in discussing the class numbers in the tutorial hours.

¹ Ranganathan (S.R.): *Colon classification*. Rule 822.

As the scheme of classification we teach in our school is the Colon Classification, the following concrete illustrations which occurred actually are taken from that scheme.

Examples:—

(i) The term "Accidents" naturally occurs in Mining Engineering, in Insurance, in the subclass Labour in Economics, and in Sociology. If we have a book which has the term "Accidents" as a prominent word in its title, we should not put it into any one of these classes at random. We must see that the context in which the term is used in the book agrees with the context in which it is used in the schedule, in fixing the class number of the book.

(ii) The term "Foundation" occurs under the class "Analysis" (Mathematical) as well as under the class "Buildings". But the denotation of the term is obviously different in the two cases. We must be guided by the Canon of Context in placing a book in whose title the substantive word is "Foundations".

(iii) The term "Morphology" occurs in General Biology, Botany, Zoology, Medicine, Crystallography and Philology. One can easily imagine the funny situation that will arise in a tutorial class when a "Textbook of Morphology" is classified by different freshmen differently.

(iv) A treatise on "Stone" may treat of its Geology or of its use as a building material. It may even be a book on the stone in the bladder. It is the province of the Canon of Context to establish correct correlation between the books under consideration and the different classes denoted by the term "stone" in the scheme of classification.

NOTATION

Notation, it may be recollected, is the system of ordinal numbers used to represent the classes in a scheme of classification. The term "numbers" brings to one's mind the ten Arabic numerals and permutations of them as in integers. But it requires only a slight effort to realise that neither of these restrictions is essential. To deal with this question, it would be convenient to introduce certain terms.

A **DIGIT** may be defined as a single or isolated or primary symbol that occurs in a notation.

The total number of digits used by a notation may be called its **BASE**.

If a notation uses only the Arabic numerals, its base is 10. If it uses only the capital letters of the Roman Alphabet, its base is 26. If it uses both of them, its base is 36 and so on.

The digits of a notation which belong to any one conventional group—such as, say, the Arabic numerals, the capital letters of the Roman alphabet, the operational symbols of mathematics, the associative symbols of mathematics and so on—may be said to be of one **SPECIES**.

PURE AND MIXED

A notation which uses one and only one species of digits may be said to be **PURE**.

Examples:—

346 is pure. So also H B F is pure.

A notation which uses two or more species of digits may be said to be **MIXED**.

Examples:—

D L : 2 is mixed. N 317 is mixed. H.E. 6471 is mixed.

A notation may build its numbers out of its digits, in one or more dimensions. In simple arithmetic, involving only integers and decimal fractions,

the numbers are built in one dimension, *i.e.*, along a line and that too along a horizontal line. In algebra and higher branches of mathematics, the digits in a number are not restricted to a line but may be arranged in two dimensions or a plane. It is possible to have a notation in three or more dimensions as well. Hence we may speak of LINEAR notation, PLANE notation, SOLID notation and so on.

Taking the linear notation, two modes of progression are possible in reading and writing the digits. They may progress from left to right or from right to left. The former mode may be called RIGHT HANDED notation and the latter, LEFT HANDED notation.

INTEGRAL AND DECIMAL

Taking the right handed notation, which is the more common, two further subdivisions can be recognised, by the effect that is produced by the addition of another digit at the right end of a number. Begin with the number 346 and let us add 5 to the right end. We get 3465. If we read the numbers as integers, in the former, the place value of 3 is 300, that of 4 is 40 and that of 6 is six. In the latter, the place value of 3 is 3000, that of 4 is 400 and that of 6 is 60 while that of the new comer 5 is only 5. In other words, the addition of a digit at the right end changes the place values of the digits that exist already.

On the contrary, let us imagine a decimal point to be understood to the left of the digit 3. Then, in both the numbers, the place value of 3 is $3|10$, that of 4 is $4|100$ and that of 6 is $6|1000$, while that of the newcomer 5 is $5|10,000$. In other words, the addition of a digit at the right end does not change the place values of the digits that exist already.

An INTEGRAL notation is one in which the place values of the digits of a number change when an extra digit is added at the end of a number.

A DECIMAL notation is one in which the place values of the digits of a number remain intact when an extra digit is added at the end of the number.

SCALE OF ABSOLUTE VALUES

Regarding the absolute ordinal values of the digits, they are conventionally fixed in the species of Arabic numerals, as of increasing order when we progress from 0 towards 9. The scale may be fixed similarly in the case of other species and in regard to the relative values of the digits of different species.

DECIMAL CLASSIFICATION

Example:—

(i) In the simplest form of Decimal Classification, only two species of digits are used—Arabic numerals and a dot. Thus it is impure; its base is 11. It is linear, right handed, and decimal. The need for fixing the absolute value of the dot does not arise, as it occurs in the fourth place and the fourth place only and no other digit ever occurs in the fourth place.

COLON CLASSIFICATION

(ii) In the Colon Classification, the following five species of digits are used:—

- (a) The 10 Arabic numerals;
- (b) The 26 capital letters of the Roman Alphabet;
- (c) The 24 small letters of the Roman alphabet (excluding *i* and *o*);
- (d) A: (colon); and
- (e) A—(dash).

Thus, its notation is mixed—more mixed than that of the simplest form of the Decimal Classification. Its base is 62. It is linear, righthanded and decimal. By rule, the absolute values are fixed to be of increasing order as we progress from a to Z in the following arrangement:—

a, b, . . . y, z, 0,—, :, 1, 2 . . . 8, 9, A, B . . . Y, Z.

There is another queer rule which provides that a number followed by a small letter occupies a lower place in the

scale than the number itself—a rule by which the so called “anterior” divisions are secured in “anterior” places. This will be explained in the chapter on Book Classification.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification, the following three species of digits are used:—

- (a) The 10 Arabic numerals;
- (b) The 26 capital letters of the Roman alphabet;
and
- (c) A dot.

Thus its notation is mixed—less than that of the Colon Classification but more than that of the simple Decimal Classification. Its base is 37. It is linear, right-handed and may be treated as decimal.

CONGRESS CLASSIFICATION

(iv) In the Congress Classification, the following three species of digits are used:—

- (a) The 10 Arabic numerals;
- (b) The 26 capital letters of the Roman alphabet;
and
- (c) A dot.

Thus its notation is mixed—just as mixed as that of the Subject Classification. Its base is 37. It is linear and right handed but *integral* and not decimal. The question of fixing the absolute values of the digits of the different species relative to one another does not arise as the scheme prescribes that capital letters and dots can come in only at particular places. For example, the first place is always to be a capital letter. The second place may be capital letter. But without explicitly stating a rule, in such classes the schedule is arranged as if the capital letter had greater value than an Arabic numeral. In certain subjects, the capital letter again appears when alphabetic arrangement is prescribed. It is prescribed after the third digit in certain subjects, after the fourth in certain cases and so on. Such a rigid prescription of the place where a capital letter can follow an Arabic numeral obviates the necessity for considering the relative absolute values of Arabic numerals and

capital letters. The dot usually precedes a capital letter and hence there is no need to fix its absolute value either.

EXPANSIVE CLASSIFICATION

(v) The notation of the Expansive Classification uses the following species of digits:—

- (a) The 26 capital letters of the Roman alphabet;
- (b) The 10 Arabic numerals; and
- (c) A dot.

Here also the notation is mixed, although the original intention of the author of the scheme was to make it a pure notation consisting of the capital letters only. It has a base of 37; it is linear, right-handed and decimal.

(vi) The notation of Classification Decimale of the International Institute of Bibliographie is the most mixed of all the notations. It uses the following symbols in addition to the 26 capital letters of the Roman alphabet and the 10 Arabic numerals:—

: — + = (. . .) ∞ “ . . . ”

thus making 10 species of symbols.

PURE vs. MIXED NOTATION

Sayers puts down the following as the twelfth canon of classification:—¹

"12. The notation should be pure; that is to say, it should be composed entirely of one kind of symbol."

This may be referred to as the CANON of PURITY.

But in his *Introduction*,² Sayers himself appears to endorse the statement of Richardson that an ideal notation is one "using mixed symbols, but with a predominatingly decimal base" and also that "every practical system sooner or later does make use of both letters and figures". As Bliss says,³ there is psychology as well as common sense back of this statement. A mixed notation of letters and figures combined preferably with a convenient punctuation mark is virtually as legible as a notation of figures alone. In this matter, the psychology of familiarity plays so great a part that we may definitely state that conformity to the Canon of Purity is not necessary at all.

¹ Sayers (W. C. Berwick): *A manual of classification*. 1926. P. 112.

² Sayers (W. C. Berwick): *Introduction to library classification*. 1935. P. 53.

³ Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. 1934. Pp. 54-56.

LONG *vs.* SHORT NOTATION

The question of long *vs.* short notation is even of less value than that of pure *vs.* mixed notation. In a sense the question itself is illusory, unless it is stated with special care. Remembering that by notation is meant a system of numbers used to represent the classes in a scheme of classification the term "Length of Notation" has no meaning, unless it happens that all the numbers of a system are of equal length. It is a matter of experience that in no scheme in use are all the class numbers of equal length. On the contrary, variation in length of class numbers is a fairly common feature.

Under such circumstances one may think of two well-defined basis for comparing the notation of two schemes of classification in regard to length of class numbers.

In the first place, we may examine the greatest order or intension of classes that can be represented in the schemes by a class number of given length (of a given number of digits). Let us call the greatest order the maximum order. If the maximum order of one scheme is greater than that of the other, the first scheme may be said to have a shorter notation than the latter. But this statement can only be made in respect of the classes of class numbers considered. For, the result may vary from one class of class numbers to another.

Example:—

(1) Let us consider class numbers of five digits.

(a) We have the following class numbers for comparison:—

Scheme	Class Number of five digits	Name of class
Decimal Classification	323·4	Relation between State and Individual Freedom of property Freedom of property
Colon Classification ..	W:252	
Congress Classification	JC605	

It is obvious that the classes represented by a class number of five digits are of greater intension in the Colon Classification and the Congress Classification than in the Decimal Classification. As a matter of fact, to reach the same intension, we must use a number of six digits in the latter Classification, *viz.*, 323·46.

(b) Consider the following tables:—

Scheme	Class Number of five digits	Name of class
Decimal Classification	{ 581·1	Plant physiology
Colon Classification ..	{ 589·1	Lichens
	124:3	Physiology of Lichens
Congress Classification	{ QK581	Anatomy, physiology
	{ QK720	etc. of Lichens
		Plant Physiology

It is obvious that in this case, the Colon Classification is able to express a class of greater intension than the Decimal Classification or the Congress Classification with a class number of five digits.

(2) Here is another example:—

Scheme	Class Number of five digits	Name of class
Decimal Classification	591·4	Anatomy of animals
Colon Classification ..	K:2:2	Anatomy of the digestive system of animals
Congress Classification	{ QL946	Anatomy of the tongue
	{ QL857	" mouth
	{ QL856	" digestive
	{ QL805	" system
		" animals

This table discloses the illusoriness of comparisons of this kind. With a number of five digits, the Congress Classification reaches a greater intension or the same intension as the Decimal Classification and greater intension or the same intension or even a smaller intension than the Colon Classification.

(c) Consider class numbers of six digits. We have the following table for comparison:—

Scheme	Class Number of five digits	Name of class
Decimal Classification	621.31	Electrical generation
Colon Classification ..	D664:1	Alternating current generation
Congress Classification	TK2765	Indicator dynamo
	TK2761	Alternating current generators
	TK2411	Electrical generators

This table shows that with a class number of six digits the Colon Classification reaches greater intension than the Decimal Classification. But with the same number of six digits, the Congress classification can reach a smaller or the same or a greater intension than the Colon Classification. This also shows the unreliability of this method of comparison for purposes of generalisation.

(d) Several other examples will be given in chapters 6 to 8.

Secondly we may take a specific class or specific class of classes which occurs in both of two schemes and compare the length of (the number of digits in) the class numbers representing them. That scheme, whose class numbers are shorter, can be said to have a shorter notation. Even here, the relative merit of two schemes will not be same but may vary according to the class of classes taken for consideration.

(i) Consider the following tables:—

(a) Class Number and Name of Class

Treatises on	Decimal Classification	Colon Classification	Congress Classification
Chemical Technology ..	660	F	TP145
Manufacture of acids ..	661.2	F3	TP213
Manufacture of sulphuric acid	661.2	F3616	TP215
Manufacture of nitric acid	661.2	F3503	TP217N5

Number of Digits in Class Number

Order	Decimal Classification	Colon Classification	Congress Classification
1	3	1	5
2	5	2	5
3	5	5	5
3	5	5	8

This table shows that the Colon Classification has a shorter number in the first two cases and the last, while its number is of the same length as the Congress Classification in the third. The Decimal Classification's position is the second in the first case. It shares the second place with the Congress Classification in the second case. If it has the acids subdivided, probably its number will be the longest in the third case, but may be shorter than that of the Congress Classification in the fourth case, though longer than that of the Colon Classification.

(ii) Consider again another table:—

(a) Class Number and Name of Class

Treatises on		Decimal Classification	Colon Classification	Congress Classification
Textile manufacture	..	677	M7	TS1445
Cotton manufacture	..	677·2	M71	TS1575
Cotton cording	..	677·21213	M71:13	TS1578
Cotton spinning	..	677·2122	M71:2	TS1577

Number of digits in Class Number

Order	Decimal Classification	Colon Classification	Congress classification
2	3	2	6
3	5	3	6
5	9	6	6
4	8	5	6

Here also while we find that the class number is generally shorter in the Colon Classification, it is easy to see how this method of comparing the length of notation of two or more schemes is also unreliable and leads to as contradictory results as the other.

Under such circumstances, there is only one method of comparing the length or shortness of notations and that is the statistical method. The statistical method tries to give some definite shape to such elusive problems by comparison of averages. But the statistical method has, in its anxiety to look round all the sides of questions, invented a number of averages. All these points and the application of these points to the problem of long *vs.* short notation are illustrated by the following discussion by Mr. K. M. Sivarman, my colleague and classifier. The discussion was published in the *Modern librarian* and the *South Indian teacher* and it is extracted here with very slight modifications.

COLON *vs.* DECIMAL CLASSIFICATION

A Statistical study of their notation

Occasionally a critic of the Colon Classification expresses the opinion that the notation of the scheme is long when compared with the notation of the Decimal Classification. The terms 'long' and 'short' are amenable to quantitative examination. Hence, in comparing the lengths of the notations, fallacies possibly implied in dependence upon vague feelings and general impressions can be avoided. With a view to testing the correctness of such general remarks, not founded on any quantitative examination, a statistical analysis was undertaken during the last month and the result is set down in this paper. The analysis shows that the length of the notation of the Colon Classification is not longer than that of the Decimal Classification, but, on the other hand, is definitely shorter. The meaning of the terms 'longer' and 'shorter' will get defined in the course of the paper.

MATERIAL

The sample taken for this analysis consists of the class numbers of books taken out on loan in February, 1934, from the Madras University Library, in subjects other than the class 'Literature'. It is proposed to deal with the class

'Literature' in another paper. Further, periodical publications have been excluded from the study.

METHOD

The loan slips of the books issued in February, 1934, were used for study. They already contained the Colon class numbers at the top. The number of digits in the class numbers were counted and this was noted prominently at the left hand top corner. The corresponding Decimal class numbers were written at the bottom and the number of digits in these class numbers were counted and noted at the right hand bottom corner. The slips were sorted in the usual way by the number of digits in the two schemes of classification and the following correlation table was obtained,

	No. of digits	Colon class number												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Decimal Class number	3	108	66	27	59	16	2	9	3	1				291
	4													
	5	2	60	122	54	60	44	74	11	16	9		1	453
	2	3	5	34	49	43	39	49	30	14		1	1	268
	7				9	16	33	45	31	25	11	2	1	174
	8		2	2	10	10	10	11	14	5	3			67
	9			1	1	1	4	2	5	9				23
	10					1		4	2	9	1		1	18
	11							2		3				5
	12											1		1
	Total	113	134	195	190	166	148	181	104	48	15	2	4	1300

FREQUENCY DIAGRAMS

The frequency distribution for the two schemes were plotted, representing the number of digits in the class numbers along the x -axis and the number of books having the given number of digits in their class numbers along the y -axis. The frequency diagrams, thus got and shown on another page visualise the distribution of books in the samples taken in accordance with the two systems of classification. The

taller and sharper curve corresponds to the Decimal classification, the shorter and flatter curve corresponds to the Colon classification.

CONSTANTS OF DISTRIBUTION

The following are the chief constants of distribution of the two schemes of classification:—

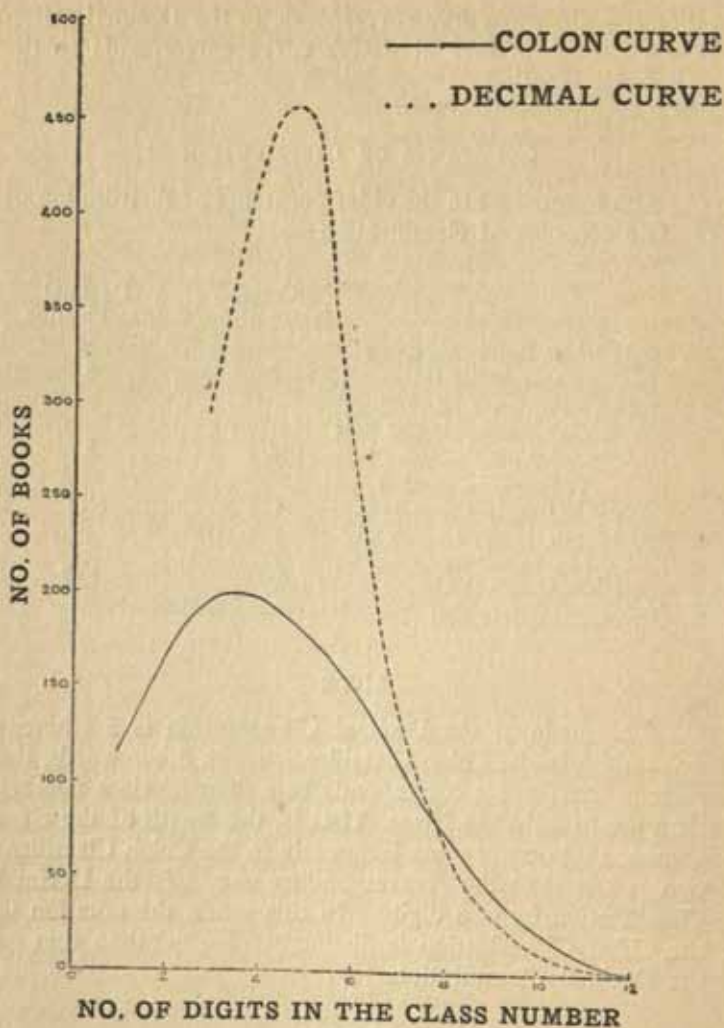
	Colon Classification	Decimal Classification
1. Mode (most frequently occurring number of digits)	3	5
2. Median (Number of digits which is not exceeded by half of the class numbers)	4	5
3. Mean (The average number of digits in the class numbers)	4.77	5.75
4. Standard deviation (A measure of the spread of the range of the length of notation)	2.35	1.67
5. Correlation co-efficient	+.56	

MODE

The mode in the Decimal Classification is 5 whereas it is only 3 in the Colon Classification. In other words, the peak in the former corresponds to a 'longer' class number than the peak in the latter. That is, the length of the class number that occurs most frequently in the Colon Classification is less than the corresponding one of the Decimal Classification by two digits. In this sense, the notation in the Colon Classification is distinctly 'shorter' than that of the Decimal Classification.

MEDIAN

Then let us take the median as the basis of comparing the lengths of notation in the two schemes. 4 is the median in the Colon Classification. That means 50 per cent. of the books in the sample have in their class numbers four or less than four digits. On the other hand, the median in the



Decimal Classification is 5. In this sense also the Colon Classification has got a 'shorter' notation.

MEAN

Perhaps, a more popular measure of the length of the notation is the mean, *i.e.*, the arithmetic mean of the number of digits in the class numbers of all the books in the sample. Here again the average in the Decimal Classification is one digit more than the average in the Colon Classification. In this also the length of the notation in the Decimal Classification is 'longer'.

STANDARD DEVIATION

Perhaps, the features disclosed by the standard deviations of the two schemes are more vital. They bring to the surface a factor which lies much deeper. The 'Colon curve' with its standard deviation of 2.35 is much more spread out than the 'Decimal curve' with its standard deviation of 1.67. Is this difference significant at all and if so, what is its significance? To answer this question, we should remind ourselves that the class number in either scheme may be taken to be a symbolic translation or representation of the subject-matter of the book. Further, in either scheme, the length of the class number is obliged ultimately to vary directly as the 'intension' of the subject-matter of the book and inversely as its 'extension'.

Now, with our knowledge of books, we may state that the distribution of the 'intension' of the subject-matter of the books in a random sample is more likely to be spread out and graduated in a manner that would correspond to the 'Colon curve'. In other words, the notation in the Colon Classification imitates more closely the variation of the 'intension' of knowledge which is to be found in the sample of books. The comparative flatness of the 'Colon curve' visualises it. In this sense the Colon Classification is a more natural one than the Decimal Classification.

On the other hand, it is clear that in the Decimal Classification, the class numbers lean more towards artificiality. They get unnaturally crowded within a narrow range in the neighbourhood of five digits. This is prominently

visualised by the steep and narrow shape of the 'Decimal curve'.

CORRELATION COEFFICIENT

The correlation coefficient is .56. Perhaps this low figure may also be taken as a measure of some fundamental difference between the two schemes. If they are not fundamentally different, remembering that they are both intended to serve a similar purpose and that they both use the digits as in decimal fractions, one should expect a much higher value for the correlation coefficient; something as high as .8 or .9. In what direction has one to look for this fundamental difference? One aspect of this difference is already indicated, *viz.*, the Decimal Classification leans more towards artificiality and the Colon Classification more towards a faithful expression of the nature of the books.

CONCLUSION

It is evident from this quantitative examination that only those people, with a limited experience, who have not had either the inclination or the opportunity to classify a large number and variety of books, would consider the notation of the Colon Classification as lengthy when compared with the notation obtained by the Decimal Classification. It has been shown that the number of digits in the class numbers of books used by half the number of readers, is four or less than four in the case of the Colon Classification, whereas it goes up to 5 in the Decimal Classification.

But, after all, what is the value that should be attached to the length of the notation? Here is the opinion expressed by Berwick Sayers in a paper read before the Third Conference of the Association of Special Libraries and Information Bureaux, as follows:—

" . . . The length of a notation should always be judged in the relation to its effectiveness. To object to a sign that consists of five or six symbols—letters or figures—is unworthy of present day librarianship. Minute classification must always have a fairly long notation."¹

¹ Sayers (W. C. Berwick): *Systems of classification, with particular reference to those used in special libraries*. Report and Proceedings of the Third Conference of the Association of Special Libraries and Information Bureaux. P. 68.

The function of the notation in classification is to facilitate the arrangement of books in a systematic and helpful manner. A librarian who chooses or advocates the adoption of a classification scheme because it has a simple notation shows a lamentable disregard for what is essential in classification.

Hence, let it not be understood that the preparation of this paper implies a plea for a short notation, although as a matter of fact, it happens that the Colon Classification has a 'shorter' notation than the Decimal Classification in spite of the former being more minute than the latter. The primary object of the paper is merely to indicate a more reliable and responsible way of comparing the lengths of the notation, if such a comparison is deemed to be necessary.

But, some of us, who have been closely associated with the development of the Colon Classification, are, in a sense, grateful to those critics who draw their missiles from vague feelings, preconceived notions and general impression; because it is probable that but for their provoking, though irresponsible, criticism of the length of the notation in the Colon Classification, a statistical study of the two schemes might not have been suggested. And, but for such a statistical study, one cannot appreciate the merits of the Colon Classification lying at much deeper levels—almost unguessable—which are pleasingly brought to the surface by the Standard Deviation. We are glad to be shown the nearness of the Colon Classification to 'naturalness' when compared with the Decimal Classification.

The above discussion enables us also to enunciate but one intelligible canon that has to do with the length of the class numbers of a scheme of classification. It may be stated as follows:—

The length of a class number in a scheme of classification should be proportional to the order or intension of the class it represents.

This may be referred to as the CANON of RELATIVITY.

We may perhaps use the word UNIFORMITY to express the opposite of RELATIVITY as applied to lengths of class numbers.

It would have been more appropriate to have called this canon the CANON of ELASTICITY. We speak of the elastic ribbon. But as some have popularised the use of this word in the sense of hospitality, I refrain from using it with a new significance. Hence the term CANON of RELATIVITY.

Examples:—

(1) Consider the following table, where Physics is taken as the universe.

Treatise on	Class Numbers			
	Decimal Classification	Colon Classification	Subject Classification	Congress Classification
Science ..	500	A	B000	Q158
Physics ..	530	C	B001	QC21
Light ..	535	C5	C100	QC355
Dispersion ..	535.4	C5.3	C110	QC431
Spectrum technique ..	535.84	C5.31	C110	QC465
Ultra-violet spectrum ..	?	C5M01.31	?	QC459
Zeeman effect ..	?	C5.38M96	?	QC675

The following table visualises the relation of the length of the class number to the order (intension) of the class represented by it in the different schemes of classification.

NUMBER OF DIGITS

Order	Decimal Classi- fication	Colon Classi- fication	Subject Classi- fication	Congress Classi- fication
0	3	1	4	4
1	3	1	4	4
2	3	2	4	5
3	5	4	?	5
4	6	5	4	5
5	?	8	?	5
5	?	8	?	5

It is obvious from the table how loyally the Canon of Relativity is observed by the Colon Classification, how it is observed by the Decimal Classification from the third order classes only, how meagrely it is satisfied by the Congress Classification and how it is not at all satisfied by the Subject Classification.

The class numbers of both of the last two classes is of the same number of digits (eight) because they are both of the same order. The order of the last class is one greater than that of the last but two, because it deals with a particular spectroscopic phenomenon; while the order of the penultimate class is greater than that of the last but two because it deals with the spectrum of a particular radiation and not of radiation in general.

(2) Here is another example:—

Treatise on	Decimal Classi- fication	Colon Classi- fication	Subject Classi- fication	Congress Classi- fication
Geography ..	551	U	O200	G115
Physical geography	551.4	U2	D000	GB53
Oceanography ..	551.46	U25	D101	GC11
Dynamics of the ocean		U256	..	GC201
Currents ..	551.47	U2562	D120	GC231
Currents in the Atlantic	551.471	U2562:95	D102.431	GC271
Currents in the Mediterranean	551.472	U2562:951	Q041.431	GC277

NUMBER OF DIGITS

Order		Decimal Classi- fication	Colon Classi- fication	Subject Classi- fication	Congress Classi- fication
First	..	3	1	4	4
Second	..	5	2	4	4
Third	..	6	3	4	4
Fourth	4	..	5
Fifth	..	6	5	4	5
Sixth	..	7	8	8	5
Seventh	..	7	9	8	5

The above table visualises the length of the class number in relation to the order (intension) of the class represented by it in the different schemes of classification. It is obvious from this table also that the Colon Classification shows the greatest degree of loyalty to the Canon of Relativity, that the Decimal Classification comes next in order while the Subject Classification and the Congress Classification respect the Canon least.

Other examples will occur in chapters 7 to 9. But it may be stated here that practically in all the subjects the observance of the Canon of Relativity is roughly of the same degree in the four schemes as the one that the two examples given here have disclosed.

4. THEORY OF KNOWLEDGE CLASSIFICATION

In library classification, the universe is that of books and the purpose is indicated by the laws of library science—¹

(i) Books are for use, (ii) Every reader his book, (iii) Every book its reader, (iv) Save the time of the reader, and (v) A library is a growing organism. The implications of these laws, in the field of classification, will be found elucidated in the *Five laws of library science*. The upshot of that elucidation is that, in a library,

(1) the most popular approach to books among the readers is the SUBJECT-APPROACH;

(2) hence, books are to be classified on the basis of the subject-matter or the KNOWLEDGE embodied in them;

(3) the more MINUTE the classification, the more helpful it is in the fulfilment of the laws of library science; and

(4) books will be added to a library continuously and without end.

Hence, it will be a convenience if we consider the Theory of Knowledge Classification before we take up the Theory of Book Classification.

The theory of knowledge classification is concerned with the elucidation and solution of the special problems that arise when the original universe classified is the UNIVERSE of KNOWLEDGE.

Knowledge may be defined as "the sum of information conserved by civilization". We speak

¹ Ranganathan (S.R.): *The five laws of library science*. (Madras Library Association Publication Series, 2). 1931.

of the *boundaries* of knowledge and of *extension* of knowledge by research. The boundaries of knowledge change with time. Thus, at any moment we may speak of future knowledge or inaccessible or potential knowledge.

Examples:—

From the standpoint of 1876, the year in which the Decimal Classification was put forward, the following related to future (inaccessible or potential) knowledge.

Highly composite numbers	Anthroposophy
X-rays	Existenz philosophie
Cosmic rays	Psycho-analysis
Raman effect	Gestalt psychology
Wave mechanics	We-psychology
Pile foundation	Dalton plan
Radio	Project method
Television	Visual instruction
Radium	Stratosphere
Heavy water	Fascism
Diphtherial bacteria	Passive resistance
Malarial protozoa	Non-co-operation
Air ports	Mandatory powers
Cinema production	Social credit
Surrealism	Scout movement
Hom-idyomo	Quasi-contract

Similarly, from the standpoint of the present, there no doubt exist in the potential future many fields of knowledge now unknown.

The UNIVERSE of KNOWLEDGE will be taken to include *all knowledge*, past, present and future, *i.e.*, *known* as well as *unknown* knowledge.

Thus the Universe of Knowledge is one in which—

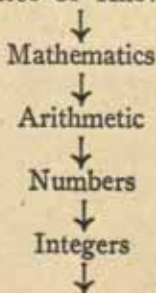
- (1) nothing is known of the total number of entities comprised except that it is indefinite and may be added to from time to time; and
- (2) some of the entities are unknown.

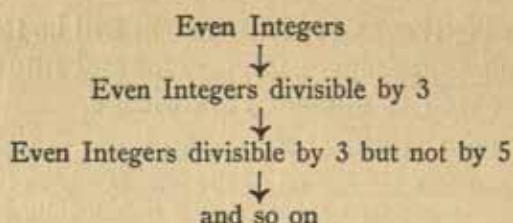
There is also a third feature recognisable in the universe of knowledge. This feature is bound up with the fundamental questions:—

- (1) Can we speak of entities at all in the Universe of Knowledge?
- (2) Will it not be more appropriate to look upon the Universe of Knowledge as an Amplified Universe, in which the entities are all lost sight of amidst a plethora of classes (pseudo-entities)?
- (3) In simpler terms, will it not be more appropriate to look upon the Universe of Knowledge as a Universe of Classes rather than a Universe of Entities proper?

This feature will become more clear if we examine an actual Chain of Classes in the Universe of Knowledge; for, we have agreed to say that an Entity is linked up to the Original Universe by a Chain of Classes. Consider the following chain:—

Universe of Knowledge





This chain can be continued *ad infinitum* by the use of further and further characteristics, of which there can be no end. Until we reach the last link of the chain, we cannot spot an Entity proper. The other links in the chain are only classes. Mathematics is a class; Arithmetic is a class; "Numbers" is a class; "Integers" is a class and so on.

SPECIAL FEATURES

The chain can be continued *ad infinitum*. That is, however far we go down the chain, we can increase the intension one step further and decrease the extension and thereby reach a link of the next order.

This means that the LAST LINK of the chain can *never* be reached in actual practice in a scheme of classification of the Universe of Knowledge. That is, all the links, which are reachable, are only classes (pseudo-entities) and the entities (proper) will never be spotted or reached.

Hence, for all practical purposes, we shall have occasion to deal only with the classes of the Universe of Knowledge but never with its Entities (proper). Nor does this present any difficulty, since, as we saw at the end of the first chapter, the Entities themselves do not figure in a scheme of classification.

Another statement that can be made is this. Every chain explicitly described in a scheme of classification of the Universe of Knowledge is an Incomplete Chain. We can now bring together all the relevant peculiarities of the Universe of Knowledge.

A Scheme of Classification of Knowledge

(1) must provide for an indefinitely large number of classes—tending to infinity, we may say; and

(2) must provide for the creation of any number of new classes as and when need arises and for their location in the scheme without violence to the principle of filiation.

The most difficult and at the same time the most vital of these requirements is the last one. If that requirement is not fulfilled, the scheme of classification will cease to be a scheme and will land itself in chaos.

THE IMPORTANCE OF NOTATION

Now the filiation location of a new class in a scheme is to be secured by the ordinal number (class number) which is constructed to represent it. Thus, in a sense, the great burden of locating new classes, without reducing a scheme of classification to chaos, is thrown upon the notation of the scheme—assuming, of course, that all the canons of the general theory of classification are to be implicitly observed. This is what is implied in the statement of Sayers,¹ "A good notation cannot make a bad classification good, but a bad notation may destroy a large part of the usefulness of a good one. This last fact has been the reason why some librarians have apparently chosen their classifications only by their notations". It accounts again for the apparently undue prominence that is given to the notation in the very names of the chief modern schemes of classification. Witness, for example, the two American schemes—Decimal Classification and Expansive Classification—giving the substantive part of their names to the words "Decimal" and "Expansive", which simply describe the nature of the notation. So also the British Classification

¹ Sayers (W. C. Berwick): *An introduction to library classification*. 1935. P. 51.

was first named Adjustable Classification and the Indian Classification is called the Colon Classification, where, again, the substantive words in the names—"Adjustable" and "Colon"—relate to the notation.

WHY NOTATION IS GLORIFIED

Let it be repeated here that if notation is unduly glorified in these names, it is not because "Librarians have chosen their schemes exclusively by their preference for this or that form of notation and have quite ignored the fact that the primary virtues of classification are scientific order, consistence of division, mutual exclusiveness of terms and generalness of application".¹ What follows will illustrate how loyalty to these primary virtues would become impossible in a scheme of knowledge classification and library classification but for a highly efficient notation. That is why the chief schemes are named after their notation and why it is that, "If you consulted the files of the professional library magazines, you might be forgiven for concluding that the only thing that mattered in a classification was its notation: because nearly every discussion of classification has been a wrangle about the merits of the notations of rival classification schemes."

As conformity to the canons of the general theory of classification is largely dependent on notation, if the Universe is infinite and not wholly known, we shall begin with the study of notation and search for any new canons of classification that may become necessary when the general theory is applied to the Universe of Knowledge.

NEW CANONS

Three additional canons must be observed in the construction and use of a scheme of classification of the Universe of Knowledge, as a result of the universe consisting of an infinity of entities some of which are unknown or may become known only in future.

¹ Sayers (W. C. Berwick): *A manual of classification*. 1926. P. 87.

✓ HOSPITALITY IN ARRAY

1. The Class Numbers belonging to an Array should be so constructed that any number of new Class Numbers can be added to the Array, without disturbing the existing class numbers in any way.

This may be referred to as the CANON of HOSPITALITY IN ARRAY.

This canon is a corollary from the Canon of Exhaustiveness enunciated in chapter 2, in discussing the general theory. The efficiency and enduring capacity of a scheme of classification will depend mostly on the devices it employs to secure compliance with this Canon of Hospitality in Array. If a scheme does not provide for Infinite Hospitality in Array, it is bound to break down sooner or later.

DECIMAL CLASSIFICATION

(i) In the Decimal Classification, this canon is sought to be fulfilled by a principle, which is enunciated as follows:—

"When more than nine divisions are needed the difficulty is commonly obviated by grouping on single numbers the subjects most closely allied or by assigning 1—8 specifically to most important subjects and grouping minor subjects on 9 as 'Other'."¹

This "Other" device is not however freely used. On the contrary all the nine places are found filled up in many Arrays.

✓ ARRAY OF FIRST ORDER

(a) Out of the 10 Arrays of the First Order, only the three arrays shown below have followed this principle. The other seven arrays break the Canon of Hospitality in Array.

- 290 Non-Christian religions
- 490 Other languages
- 890 Literature in other languages

¹ Dewey (Melvil): *Decimal classification and relative index*, 1933, Edn. 13. P. 16.

ARRAYS OF SECOND ORDER

(b) Out of the 81 Arrays of the Second Order only the eighteen shown below have followed the principle. The other sixty-three Arrays break the Canon of Hospitality in Array.

149	Other philosophical systems
179	Other ethical topics
199	Other modern philosophers
259	Other ministrations
289	Other Christian sects
299	Other non-Christian religions
369	Other associations
439	Other Teutonic languages
499	Malay-Polynesian and other languages
629	Other branches of engineering
668	Other organic chemical industries
689	Other trades
719	Other topics in landscape gardening
879	Other Italic literatures
889	Other Hellenic literatures
899	Malay-Polynesian and other literatures
939	Ancient history of other countries
949	Other countries of Europe

✓ ARRAYS OF HIGHER ORDERS

(c) The percentage of Arrays of the Third and Higher Orders which break the Canon of Hospitality in Array is far greater and only a negligibly small number of them satisfies the Canon.

✓ COLON CLASSIFICATION

(ii) In the Colon Classification, five devices or principles are used to secure compliance with the Canon of Hospitality in Array.

✓ OCTAVE PRINCIPLE *Device*

(a) The "Other" principle of the Decimal Classification has been extended into what is known as the "Octave Principle". According to this, when the classes

of any Array are numbered with Arabic numerals, only numbers 1 to 8 are to be used. 9 is not used ordinarily to individualise any class. The number next in order after 8 is 91 and not 9. In the second octave also, only numbers 91 to 98 are used. 99 is not used ordinarily to individualise any class. The number next in order after 98 is 991 and not 99. And so on. This principle is almost universally followed. Sometimes the classes of a second octave may admit of being labelled by a common term. In that case that common term may find itself put against 9 in the first octave. In the few cases, where this octave principle is deviated from in the First Octave—for example in the Array of the First Order formed in X Economics on the basis of the Economic Characteristic, 9 is Labour—a special device is employed. It will be explained and illustrated in chapter 8. 9 was reserved for "Applications" in certain Arrays in the first edition, as the "Octave Principle" was not consciously and explicitly laid down, when it was published. But this and other deviations are being set right in the forthcoming second edition.

Examples:—

- Y158 Slums
- Y1591 Groups arising from Titles of Distinction
- Y1592 Groups arising from Caste

SUBJECT DEVICE

(b) But a much more powerful device used for the accommodation of new classes in an Array is the Subject Device by which any number of co-ordinate classes can be accommodated in any Array.

Examples:—

(1) In the Array of the First Order of D6 Mechanical Engineering, based on the Secondary Work Characteristic, we find

- D6:9 Other machinery (By Subject Device)

(Illustrative)

- D6:9D201 Excavating machinery
- D6:9M14 Printing machinery
- D6:9MJ38 Flouring machinery

(2) In the Array of the First Order of M Useful Arts, we find "Further divisions by Subject Device".

(Illustrative)

MB1	Calculating machines
MC53	Gramophones
MJ38	Flouring of grains
MN8	Musical instrument making

(3) In the Array of the First Order based on View Characteristic in R3 Metaphysics, we find

9 Other special classes

(To be divided by the Subject Device)

(Illustrative)

R39G6	Genetic view
R39Y	Humanistic view

(4) In the Array of the First Order based on Education Characteristic in T Education, we have

9 Other special classes

(To be divided by the Subject Device)

(Illustrative)

T9U215	Education of mountain community
T9Y131	Rural education
T9Y152	Education of the aristocracy

(5) In the Array of the Second Order based on the Point of View Characteristic in V History, we have

258 Other rights

(To be got by the Subject Device)

(Illustrative)

V:258Q	Freedom of belief
V:258X	Freedom of trade
V:258Y18	Freedom of Association

CHRONOLOGICAL DEVICE

(c) Another very sharp device used by the Colon Classification for securing conformity to the Canon of Hospitality in Array is the Chronological Device.

Examples:—

(1) The authors in any form of literature in any language are individualised by the Chronological Device and

hence any number of them can be accommodated in an Array. We have, in English Drama, *v.g.*,

- O:2J64 Shakespeare (born in 1564)
- O:2L51 Sheridan (born in 1751)
- O:2M56 Bernard Shaw (born in 1856)
- O:2N00 Richard Hughes (born in 1900)

(2) The grammar of artificial languages is individualised by the Chronological Device and any number of them can be accommodated in the Array of the First Order in P Philology.

Examples:—

- P9M87 Esperanto (Invented in 1887)
- P9N23 Hom-idyomo (Invented in 1923)

(3) In the Array of the Second Order based on Economic Characteristic in X Economics, which has X:3 Distribution as the immediate universe, the classes are individualised by the Chronological Device.

Examples:—

- X:3M24 Socialism (First enunciated in 1824)

(4) In the Array of the Third Order which has C84 Hypothesis about Energy in C Physics, the different hypotheses are individualised by the Chronological Device.

Examples:—

- C84K86 Gravitation theory (First enunciated in 1686)
- C84M65 Electromagnetic theory (First enunciated in 1865)
- C84N01 Quantum theory (First enunciated in 1901)

GEOGRAPHICAL DEVICE

(d) Sometimes the Geographical Device also is used to secure conformity to the Canon of Hospitality in Array.

Examples:—

(1) The languages, other than those belonging to the Indo-Germanic, the Semitic and the Dravidian families are individualised by the Geographical Device and thus the Array of Language Divisions can accommodate any number of languages.

Examples:—

4 Other Asiatic languages

6 Other African languages

(2) In the Array of the Second Order which deals with the psychology of individual races, the classes derived from S7 Race Psychology, are got by the Geographical Device.

Examples:—

S742 Psychology of the Japanese

S755 Psychology of the Germans

ALPHABETIC DEVICE

(e) As a last resort the Alphabetic Device is used to secure conformity to the Canon of Hospitality in Array. This is only used very sparingly.

Examples:—

The Array of Class Numbers under J37 in J Agriculture is extended as follows:—

J37F1 Fig

J37J1 Jackfruit

J37T1 Tamarind

SUBJECT CLASSIFICATION

(iii) In the Subject Classification, the Canon of Hospitality in Array is sought to be served by leaving a finite number of gaps between any two consecutive class numbers. These are about 10,000 gaps in the whole schedule of classification. It is obvious that this puts a very definite limit to the extent to which the Canon can be satisfied by the Scheme. Anticipating that this limit will be too hampering, the scheme makes an additional provision in the following words¹ "If any new or other subject is found unrepresented in the tables, . . . as a general covering head . . . the place for it can be made at any point by treating the existing numbers as decimals and adding the units from 0 to 9 as found necessary."

However, no rule of procedure has been laid down by which the intercalation of numbers, made independently

¹ Brown (James Duff): *Subject classification*, 1914. P. 14.

by different users of the scheme, may agree. This point will be dealt with more fully when we discuss the third canon. There is also another difficulty which will be referred to when we discuss the second canon.

CONGRESS CLASSIFICATION

(iv) In the Congress Classification also, the Canon of Hospitality in Array is sought to be satisfied by leaving gaps in between consecutive class numbers. The number of vacant numbers left in the Congress Classification is many times greater than that in the Subject Classification. In spite of this, there is only limited provision for accommodating new classes. This is realised by the Congress Classification itself and hence there is the make-shift arrangement of using the decimal point to provide additional class numbers. "A decimal, therefore, does not necessarily imply sub-arrangement, for it may have been employed, as in DC36:9 merely because no whole number happened to be available at that particular place."²

How often this make-shift arrangement is vitiated by other factors will be referred to in discussing the second and third canons.

An array of class numbers which does not admit of extrapolation at the right end may be called a CLOSED ARRAY.

An array of class numbers which admits of extrapolation at the right end may be called an OPEN ARRAY.

(v) It has been seen that in the Decimal Classification, 3 arrays of the First Order, 18 arrays of the Second Order and just a few arrays of the Higher Orders are kept as OPEN ARRAYS by the 'OTHER' PRINCIPLE. The remaining 7 arrays of the First Order, 63 arrays of the Second Order and most of the arrays of the Higher Orders are CLOSED ARRAYS.

² Library of Congress. *Classification. Class D. Universal and Old World History*. 1916. P. 6.

(ii) It has been seen that in the Colon Classification, practically all the arrays are kept as OPEN ARRAYS by the OCTAVE PRINCIPLE, the SUBJECT DEVICE, the CHRONOLOGICAL DEVICE, the GEOGRAPHICAL DEVICE, and the ALPHABETIC DEVICE.

(iii) The integral notation of the Subject Classification and the Congress Classification does not admit of keeping the arrays OPEN in those schemes.

HOSPITALITY IN CHAIN

We now pass on to the enunciation of the second special canon to be observed in the construction and use of a scheme of classification of the Universe of Knowledge, as a result of the universe consisting of an infinity of entities some of which are now unknown and may become known only in future.

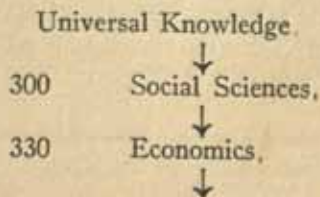
2. The class numbers belonging to a Chain should be so constructed that any number of new class numbers can be added at the end of the Chain without disturbing the existing class numbers in any manner, to accommodate new subordinate classes which can be formed on the basis of a single Train of Characteristics or two or more Trains of Characteristics.

This may be referred to as the CANON of HOSPITALITY IN CHAIN.

The meaning of the term "Train of Characteristics" will be brought out by the following examples:—

DECIMAL CLASSIFICATION

(i) Consider the following Chain in the Decimal Classification:—



331	Labour
	↓
331·8	Labouring classes
	↓
331·81	Duration of work

This chain can be extended in the Decimal Classification by three different trains of characteristics, *viz.*,

- (1) The train relating to Hours, days, etc., for work and rest;
- (2) The train relating to Industries; and
- (3) The train relating to Countries.

But the classes formed on the basis of these three trains of characteristics are put in a single Array as follows:—

331·8	Labouring classes
331·81	Duration of work. Rest
	(<i>First Train of classes</i>)
331·811	Length of day
	8-hour day, 10-hour day, etc. Shifts of work
331·812	Night work
	See also 331·41 Night work of women
331·813	Sunday work
331·814	Overtime. Supplementary hours
	See also 331·65 Abuse of supernumerary time
331·816	Vacation. Leave of absence
331·817	Holidays
	Weekly rest, Sundays, labour festivals, May 1, festivals of patron saints

(*Second Train of classes*)

331·818	In special industries
	2·99 Divided like 620·699
	For occupations not included in 620·699 use 331·8181 divided like main classification

(*Third Train of classes*)

331·819	In special countries. Divided like 930·999
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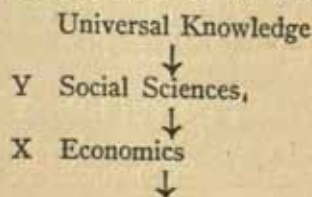
In the first place, this arrangement offends against the Canon of Exclusiveness. If we have a book which deals with "Overtime in Agricultural Industry in India," is it to be put in the class 331·814 Overtime or 331·8183 Duration of Work in Agriculture or 331·8194 Duration of Work in India? It may be said that each library should have its own convention.

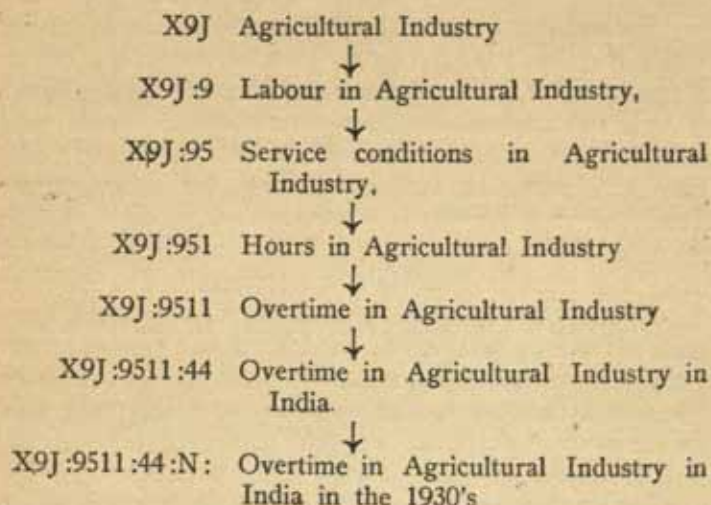
LIMITED HOSPITALITY

Apart from this, whatever place is prescribed by convention to the book in question, it is obvious that it requires to be placed in a class of greater intension (higher order). While the Decimal Classification has recognised the existence of these three distinct Trains of Characteristics for lengthening the Chain whose last link is 331·81 Duration of Work, it is its notation that prevents the lengthening of the Chain on the basis of all these three Trains of Characteristics simultaneously. In other words, the notation of the Decimal Classification is too limited in its capacity to allow of the subdivision of the class in question in every possible manner. To put it in another way, the limited capacity of the notation of the Decimal Classification restricts the extent to which the Canon of Hospitality in Chain can be respected by the scheme. It may also be added that it is this limited capacity of its notation that has made it break the Canon of Exclusiveness.

COLON CLASSIFICATION

(ii) How a more efficient notation can get over the difficulty created by the notation of the Decimal Classification can be illustrated by describing the way in which the problem is faced by the Colon Classification. Consider the following corresponding chain of the latter.





COMPARISON OF HOSPITALITY

The following tabular form shows the corresponding links in the chain in the two schemes:—

Classes	Decimal Classification	Colon Classification
Social Sciences ..	300	Y
Economics ..	330	X
Labour ..	331	X:9
Hours ..	331:81	X:951
Overtime ..	331:814	X:9511
Hours in Agricultural Industry ..	331:8183	X9J:951
Labour Hours in India ..	331:81954	X:951:44
Hours of Agricultural Labour in India ..	?	X9J:951:44
Hours of Agricultural Labour in India in the 1930's ..	?	X9J:951:44:N3
Overtime in Agricultural Industry ..	?	X9J:9511
Overtime in Agricultural Industry in India ..	?	X9J:9511:44
Overtime in Agricultural Industry in India in the 1930's ..	?	X9J:9511:44:N3
Overtime of Labour in India ..	?	X:9511:44
Overtime of Labour in India in the 1930's ..	?	X:9511:44:N3

This comparative table brings out the facility with which the Colon Device of the Colon Classification makes it gain a great advantage over the Decimal Classification. It is the absence of anything corresponding to the Colon Device that makes the Decimal Classification offer a far poorer Hospitality in Chain than the Colon Classification, and incidentally get also on the wrong side of the Canon of Exclusiveness.

THE DIFFERENCE EXPLAINED

The position is this. Economics can be subdivided with the aid of four distinct Trains of Characteristics. They may be called the Train of Business or Industries Characteristics, the Train of Economic or Economic Aspect Characteristics, the Train of Geographical Characteristics and the Train of Chronological Characteristics. In the Colon Classification, the chains based on each of these Trains of Characteristics are put down in four independent schedules in a filiatory order appropriate to each. Any chain in any of the four schedules can be lengthened according to its own requirements and possibilities quite independently of any chain in any other schedule. The classes in each of these four schedules correspond to the standard pieces in a Meccano apparatus. A class number in Economics can be constructed by picking out one number from each of one or more of these schedules and combining them in a prescribed order, with colons taking the place of bolts and nuts to keep the parts together. In this way, class numbers can be formed for all possible topics in Economics, whatever be the combination of the four Trains of Characteristics that may be required. This is the function of the Colon Device. In fact, the Colon Device is described as the device for separating, by the colon, the parts of a class number which relate to the different Trains of Characteristics forming the basis of classification.¹ It is this feature which makes the Colon Classification a synthetic scheme of classification and it is this Colon Notation that makes an unusual richness of Hospitality in Chain a special feature of the Colon Classification.

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rule 61.

DEWEY ON MINUTE CLASSING

It is possible that even so late in the day as now there may be somebody who damns it all with the epithet "purely of academic interest" and says "It is all very well to demonstrate such possibilities of Hospitality in Chain. But of what practical use can it be? Whoever wants such minute classification as the comparative table brings out?" The best answer to such a question is best given in the words of the pioneer of the profession.¹

"Minute classing. On first publication in 1876, a common criticism was that 1,000 heads could never be successfully used, however desirable so close classification might be. As soon, however, as actual experience proved it as easy to use 1,000 heads in the new system as 100 in the old, the obviously great practical value of close classing led one user after another to urge strongly publication of more subdivisions. Minute as are many now given there are none that sum have not asked for and almost none that others have not declared needless. Subdivisions are made in such a way that one may use all, or any part and ignore the rest without difficulty or confusion, thus allowing each to use minute subdivisions where he wishes or needs them, without being forced into refinements in subjects where he has few books or little interest. Since the degree to which any scheme shall be applied is optional with each classifier and close analysis is useful to every one in defining content or in clarifying differences between related subjects, even elaborate schemes are printed in full if no essential objection has been brought against them by the best qualified critics. . . . On many topics minute subsections are printed . . . for use in indexing periodicals and society transactions, and in keeping notes.

"The advantage of close classing is unquestioned, if the user knows just what it is. With this plan it is not only practicable, but comparatively easy. If there are only 10 books on a given topic, it is useful to have them in groups among themselves, for otherwise they would have only acci-

¹ Dewey (Melvil): *Decimal classification and relative index*, 1932. Edn. 13. Pp. 17-18.

dental order, which is of service to no one. A reader wishing a specific book should go not to shelves, but to catalog, where he can find its place quickest. If he wishes a specific subject, he is sent instantly to its exact place by the Subject index. If he wishes to study the library's resources at the shelves, he will be *greatly helped by minute classing*. A teacher showing his pupil the material on any subject would, if there were only 20 books, surely *put together* those covering same points, even if there were only 2. Much more should librarians group closely their collections, that readers may gain something of the advantages of an experienced guide."

HOSPITALITY COMPARED AGAIN

Examples of the far richer Hospitality in Chain of the Colon Classification as compared with the Decimal Classification as a result of its Colon Device can be multiplied to any extent but we shall here give just one more example before leaving the subject. Compare the chain that is implied in the following enumeration of links in the two schemes of classification:—

Class	Decimal Classification	Colon Classification
Applied Sciences ..	600	M
Agriculture ..	630	J
Manure ..	631.8	J:2
Methods of application of manure ..	631.816	J:2.9
Green manure ..	631.87	J:22
Agriculture of cereals ..	633.1	J38
Agriculture of wheat ..	633.11	J382
Manure for cereals ..	?	J38:2
Green manure for cereals ..	?	J38:22
Method of applying green manure for cereals ..	?	J38:22.9
Manure for wheat ..	?	J382:2
Green manure for wheat ..	?	J382:22
Method of applying green manure for wheat ..	?	J382:22.9

This comparative table also brings out the same contrasts between the Decimal Classification and the Colon

Classification in regard to the Canon of Hospitality in Chain and the Canon of Exclusiveness.

DIFFERENCES IN PRACTICE

In the Decimal Classification 631 Farmsted, which has 631·8 Manure as a subclass, and 633 Field Crops appear in one Array as co-ordinate classes. It is obvious that we can have books that deal with the special manures suited to particular crops. Such books have to be placed either in the class 631·8 Manure or in a division belonging to 633 Field Crops, according to some convention. But, wherever it is placed, it would be a misfit, as the book requires a class of greater intension (higher order) than either of the two classes. On account of the absence of an equivalent of the Colon Device, the Decimal Classification is not able to create a class of the requisite intension, *i.e.*, it is not able to extend either chain in the desired way, as the Colon Classification does. Similarly, in the Decimal Classification, 631·81 History, Nature and Uses of Manure and 631·82 to 631·88 Different Kinds of Manure, occur as coordinate classes in a single Array. Thus we have 631·816 Method of Application of Manure and 631·874 Green Manure. But we can have books dealing with the application of Green Manure. The Decimal Classification is not able to provide a class of proper intension (order) for such books as the Colon Classification does, because the former has no device equivalent to the Colon Device which manages it in the Colon Classification.

The table suggests also other comparisons of a similar nature, which establish the advantage the Colon Classification has over the Decimal Classification in regard to the Canon of Hospitality in Chain and the Canon of Exclusiveness.

DIFFERENCES EXPLAINED

The position is this. Agriculture can be subdivided with the aid of three distinct Trains of Characteristics. They may be called the Train of Crop Characteristics, the Train of Primary Farming Characteristics and the Train of Secondary Farming Characteristics,—the schedule belonging to the third Train of Characteristics varying with

the different divisions belonging to the second Train of Characteristics. In the Colon Classification, the chains based on each of these Trains of Characteristics are put down in independent schedules in a filiatory order appropriate to each. Any chain in any of the schedules can be lengthened according to its own requirements and possibilities quite independently of any chain in any other schedule. The classes in each of these schedules correspond to the standard pieces in a Meccano apparatus. Class number of the requisite intension (order) can be constructed for a class of any intension (order) in Agriculture, whatever be the combination of the classes belonging to the three Trains of Characteristics that may be required. It is a main function of the Colon Device to secure this. It is by the fulfilment of this important function that it enriches the Hospitality in Chain of the Colon Classification far more than what is possible in any other scheme.

THE ESSENCE OF COLON NOTATION

From the point of view of the designing of notation, the chief invention in the Colon Device is that of the colon as an ordinal number which lies between 0 and 1— which is greater than 0 but less than 1.

AUTO-BIAS DEVICE

In the forthcoming Second Edition of the *Colon classification*, yet another ordinal number lying between 0 and 1—greater than 0 but less than colon—will be found introduced to serve yet another device known as the Auto-bias Device by which the Hospitality in Chain will be enriched still further. We may indicate the scope and use of this new Device briefly by one example.

In Y1 Sociology, among the classes based on the Group Characteristic, we find the following among others.

Y1 SOCIOLOGY

Divisions based on Group Characteristic

- 1 *Groups arising from age and sex*
- 11 Children
- 12 Youths
- 13 Old persons

- 15 Women
- 5 *Groups arising from birth or status*
- 51 Royalty
- 52 Aristocracy
- 53 Middle class
- 54 Military class
- 55 Aliens
- 58 Depressed class, slums
- 591 Groups arising from titles of distinction
- 592 Groups arising from caste (special to India)
- 5922 Twice-born. Dwijas
- 5923 Brahmans
- 5924 Kshatriyas
- 5926 Sudras
- 5927 Harijans

GENESIS OF AUTO-BIAS DEVICE

The genesis of the Auto-bias Device is as follows:—

A book on women will get the number Y115. A book on middle class people will get the number Y153. What about a book on middle class women? Is it to be placed in the class Y115 Women or in the class Y153 Middle Class? Of course we may say, "Each library may fix one of these places by convention". Suppose it is agreed that such a book is to be placed in the class Y115 Women. Then surely it will happen that all general books on Women as well as books that deal with Rural Women, Aristocratic Women, Middle Class Women, Women of Military Class, Harijan Women and Brahmin Women will get huddled together without distinction. The fact is that such books require to be placed in classes of greater intension (higher order) than Y115 Women. That means, it must be possible for the class Y115 Women to be subdivided as the class Y15 Groups Arising from Birth or Status. The Auto-bias Device is invented to make this possible. This Device will give the number Y115—53 for Middle Class Women. The "dash" is the symbol for the Auto-bias Device. The Device is used to lengthen the chain (to subdivide a class) which ends with a particular class in a specific schedule by further subdividing that class like some other class in the same

schedule. Y115 Women is a class that requires to be subdivided as the class Y15 Groups arising from birth or status, which lies in the same schedule. And we have seen how this subdivision is effected by linking up the class number Y115 with the number 53, by a dash.

INTEGRAL *vs.* DECIMAL NOTATION

(iii) While the Colon Classification differs from the Decimal Classification in making its notation more efficient by the Colon Device and the Auto-bias Device, it absolutely imitates the Decimal Classification in making its class numbers decimal fractions—in other words in adopting the Decimal Notation. But, so far as the Subject Classification and the Congress Classification are concerned, not only they do not adopt the Colon Notation or any full equivalent of it to secure such rich Hospitality in Chain, but they deny themselves even the limited benefits that the Decimal Notation can give in providing Hospitality in Chain. The great difference between Integral Notation and Decimal Notation lies in their capacity to provide Hospitality in Chain. In the Decimal Notation, we can interpolate between any two consecutive class numbers of a given order an infinity of class numbers of progressive subordinate orders by simply adding digit after digit to the right of the class number. But in the Integral Notation, there is no means of providing Hospitality in Chain except by leaving gaps between two integral numbers used for representing two consecutive coordinate classes. It is this device that the Subject Classification and the Congress Classification employ to secure Hospitality in Chain. But it goes without saying that the Hospitality in Chain provided in that way must be limited by the capacity of the gap that is left and this capacity is comparatively small in the Subject Classification, and though relatively greater in the Congress Classification, cannot provide for Infinite Hospitality in Chain.

ANOTHER HANDICAP

There is another way in which Hospitality in Chain is still further reduced in the Subject Classification and the Congress Classification. A gap that is left between the

class numbers of two consecutive coordinate classes is intended to accommodate not only the new subordinate classes but also the new coordinate classes that may have to be interpolated between them. In that way any given gap has to satisfy not only the Canon of Hospitality in Chain but also the Canon of Hospitality in Array.

SUBJECT CLASSIFICATION

In the Subject Classification, the categorical table and the provision for the further division of any class geographically or linguistically goes some way in satisfying the Canon of Hospitality in Chain. Reference has also been already made of the suggestion of the intercalation of five digit numbers in connection with providing Hospitality in Array. The Hospitality in Chain also is expected to have a share of this intercalation. But as already remarked, apart from the mention of this possibility, the details of this device have not been gone into and no attempt has been made to secure uniformity of treatment. Hence, the suggestion is not applied in the comparative studies here.

CONGRESS CLASSIFICATION

(iv) In the Congress Classification further amplification of the given integral numbers by the Alphabetic Device is frequently resorted to, to secure greater Hospitality in Chain as well as in Array.

Examples:—

- (1) In DK History of Russia, we have
 - (a) Ethnology. Races
 - DK33 General works
 - DK34 Special, A-Z
 - e.g.*, ·K14 Kalmucks
 - DK35 Cossacks
 - (b) Biography of Historians
 - DK38·5 Collective
 - DK38·7 Individual, A-Z
 - e.g.*, ·K8 Kunik
 - (c) Diplomatic History
 - DK68·A2 To 1800 Chronicles
 - DK68·A3-Z 1801—
 - (d) Local History
 - DK511 Provinces, governments, etc.
 - B2 Baku
 - C35 Biography, A-Z
 - L2-25 Lithuania
 - W2 Warsaw.
 - (e) Buildings of Petrograd
 - DK573 General works
 - DK574 Special, A-Z
- (2) In GN Anthropology, we have
 - (a) GN37 Special museums, A-Z
 - (b) Psychological Anthropology
 - GN295 Other special, A-Z
 - e.g.*, ·T9 Twins
 - (c) GN419 Ornaments
 - A1-A5 General
 - A6-Z5 Special
 - 1 Head dresses
 - 3 Tattooing

- (d) Industries
 - GN434 Others, A-Z
 - e.g.*, ·F3 Featherwork
 - S6 Skin dressing
- (e) GN447 Articles for special purposes, A-Z
 - e.g.*, ·D77 Drilling instruments
 - K7 Knives
 - T9 Traps
- (f) Prehistoric Archæology
 - GN799 Other special topics, A-Z
 - e.g.*, ·F5 Fishing
 - N3 Navigation
 - S4 Sculpture
 - W3 Weapons

(3) In HV Social pathology, philanthropy, etc., we have

- (a) Cripples
 - HV3018 Occupations for cripples
 - HV3019 By trade, A-Z
- (b) Special Class. By occupation
 - HV3174 Other A-Z By profession
 - A5 Actors
 - P7 Professional men
- (c) Alcoholism in the United States
 - HV5289 Collections
 - A1-5 Documents
 - A1-49 Serial
 - A5 Special, by date
 - A7-Z Non-official
- (d) Drug Habits
 - HV5822 Other, A-Z
- (e) Penology. United States
 - HV9474 Federal prisons, A-Z

MNEMONIC NOTATION

The Canon of Consistent Order, prescribed for classes in an Array, has its counterpart in the following canon to be satisfied by the Notation:—

3. The digit or digits used to represent a specified Entity in a Class Number should be the same in all Class Numbers which have that Entity represented in them, wherever such insistence on consistent representation does not violate other more important requirements.

This may be referred to as the CANON of MNEMONICS.

In one of the chapters of his Manual, devoted to notation, Sayers remarks,¹ "There is a very general quality in modern classification notations which is ingenious, and, within limits, of great value to the classifier. This is its mnemonic quality; its power of assisting the memory and of reducing the work of reference to tables and indexes to the minimum. By mnemonic notation we mean a notation which has always the same significance wherever it appears in the classification." This passage quoted contains at once the neatest definition of Mnemonic Notation as well as a pithy description of the benefits of the same.

VALUE OF MNEMONICS

Bliss comments on the value of mnemonics² as follows:—"Notation, as a kind of symbolic language, depends extensively on memory of meanings. In learning to read and write a new language we gradually learn the words and their meanings and remember more and more of them. In like manner librarians and the users of libraries gradually learn the order of the classes and remember the class-marks, tho they continue to make use of the catalogs, shelf-lists

¹ Sayers (W. C. Berwick): *A manual of classification*. 1926. P. 96.

² Bliss (Henry Evelyn): *Organisation of knowledge in libraries* 1934. Pp. 58-59.

and index to schedules. The more systematic the system is, the more readily they will learn and the more efficiently they will remember. This is the natural and rational ground for a system of *mnemonics*, or symbols that may be readily and systematically remembered."

TYPES OF MNEMONICS

We may recognise two types of Mnemonics.

By SCHEDULED MNEMONICS is meant the Mnemonics that are secured by preparing, as a preliminary measure, certain schedules of classes, which may recur as subdivisions of several classes or by referring all recurrent subdivisions of a given type to the one schedule of those subdivisions which is given in a most convenient and appropriate place in the scheme.

Examples of Scheduled Mnemonics will be found hereunder in the discussion of the schemes of classification.

By NON-SCHEDULED MNEMONICS is meant the Mnemonics that are secured by adopting certain conventions with regard to the different possible significances of some of the digits in use.

Examples of Non-Scheduled Mnemonics will be found below in the discussion of the Colon Classification.

DECIMAL CLASSIFICATION

(i) (a) In the Decimal Classification, the following Scheduled Mnemonics occur:—

GEOGRAPHICAL DEVICE

(1) The Geographical Schedule which is covered by the numbers 940 to 999 in 9 History is prescribed for mnemonic subdivision wherever geographical division is required.

Example:—

Under 371·839 Student Organisations. By country, we find the following note
"Divided like 940-999."

This corresponds to the Geographical Device of the Colon Classification.

SUBJECT DEVICE

(2) The entire schedule is prescribed for mnemonic subdivision wherever such a prescription is warranted.

Example:—

Under 375·01-355·9 Subjects of Study,
we find the following note

"Divided like the classification 010-999."

(3) The main classes only are prescribed for mnemonic subdivision in certain cases.

Example:—

Under 371·84 Student life and Customs by Subjects,
we find the note "Divided like the main classification, e.g., 371·845 Scientific; 371·848 Literary".

(4) Some part of the classification only is sometimes prescribed for mnemonic subdivision.

Example:—

In several classes in 330 Economics, division as in 620 to 699 is prescribed.

The above three cases correspond to the Subject Device of the Colon Classification.

LANGUAGE MNEMONICS

(5) An appendix gives a schedule of languages for use in mnemonic subdivision wherever necessary.

MNEMONICS MISSED

(b) Opportunities for Mnemonics are also missed by the Decimal Classification in several places:—

Examples:—

In the following examples the class numbers of the Colon Classification also are given in parallel columns to show the mnemonic construction of that scheme. The Mnemonic digits are shown in black type.

LITERARY AUTHORS

(1) In the schedule of authors in 800 Literature, an author does not get represented by the same digit in all Form divisions in the Decimal Classification.

Class	Decimal Classification	Colon Classification
Oliver Goldsmith as poet ..	821'64	O:1L28
Oliver Goldsmith as essayist ..	824'66	O:6L28

CEREALS

(2) Compare the digits in the following class numbers in which "Cereals" is represented to find out mnemonics:—

Class	Decimal Classification	Colon Classification
Adulteration of cereals ..	614'312	L:523:J38
Farming of cereals ..	633'1	J38
Diet of cereals ..	612'39273	L:533:J38
Trade in cereals ..	338'1	X9J38

MARINE

(3) Compare the digits in the following class numbers in which "Marine" is represented to find out mnemonics:—

Class	Decimal Classification	Colon Classification
Marine Biology ..	574'92	G:5255
Marine Zoology ..	591'92	K:5255
Marine Botany ..	581'92	I:5255
Marine Corps ..	359	MV45
Marine Engines ..	621'12	D64:5255
Marine Insurance ..	368'2	X895
Marine Law ..	347'7	Z925
Marine Libraries ..	027'644	2:55
Mariner's occupation ..	613'64	MD5255

TRANSPORT

(4) Compare the digits in the following class numbers in which "Transport" is represented to find out mnemonics:—

Class	Decimal Classification	Colon Classification
Air Transport Service ..	629.1382	X43
Architecture of Transport Buildings	725.3	N1.9D4
Transport facilities for industrial plant	658.214	X9.20X.4
Transport in mines ..	622.6	D3.4
Transport of goods ..	658.7885	X9.4
Transport business ..	658	X4

RESULT OF NEGLECT OF MNEMONICS

(5) How such missing of opportunities for mnemonics creates unnecessary situations in the application of the Decimal Classification is illustrated by the following statement by the Head of the Decimal Classification Section of the Library of Congress.¹ "One policy of ours should be mentioned here, because it must be puzzling at times. Take 338.1 Production of Agricultural products, considered from an economic standpoint. Books on that general subject, not limited geographically, we class in 338.1. If limited to the U.S., we class in 338.10973. Now, wheat is an agricultural product; so books on wheat are classed in 338.1 since no subdivision by products has yet been made. When we have a book on wheat in the U.S., we still class it in 338.1, not 338.10973. Why? Because some day we expect to have a definite number under 338.1 for wheat, and when that time comes we want to be able to add figures 338.1 on the cards without first removing 0973. You may want to do the same thing, in anticipation of future expansions. Or you may prefer, either permanently or

¹ American Library Association: Catalog Section. *Comp. Cataloger's and classifier's yearbook*. No. 6. 1937. P. 59.

temporarily, to put all wheat in the U.S. with general agricultural products in the U.S."

AN AVOIDABLE SITUATION

How unnecessary and ridiculous this situation is, will be realised if we remember that in 630 Agriculture 633·1 is Cereals and 633·11 is Wheat. Now in the number 338·1, 338 stands for production and 1 stands for Agricultural Products. If the Canon of Mnemonics is enforceable sufficiently in the scheme, it is so obvious that 338·1311 should be taken as the class number for the Production of Wheat not only by the official editor of the Decimal Classification but by any and every classifier using the Decimal Classification. Then, Production of Wheat in the United States of America can receive its permanent number even now as 338·13110973 without waiting for the time to come for adding figures to 338·1 to represent Production of Wheat. Surely classifiers using the Decimal Classification should not be made to depend for such trivial extensions on the official editors. The thought of the official editors too should be released from such trivial cases and allowed to dwell and dream upon more far reaching and fundamental improvements of the scheme.

IF MNEMONICS ARE OBSERVED

Let us illustrate how the same situation would be met in the Colon Classification. In that scheme, we find that X Economics, is to be divided first by the Business Characteristic, then by the Economic Characteristic, then by the Geographical Characteristic and lastly by the Chronological Characteristic. In the Schedule based on Business Characteristic, we find 9 Other Business (To be divided by the Subject Device). And Wheat being an agricultural commodity, one would expect to find the number for Wheat specified in J Agriculture; and so it is. The number for Wheat in Agriculture being J382, the number for Wheat Business in Economics is X9J382. The number for Production in Economics being 2 as shown in the Schedule based on the Economic Characteristic, and the number for the United States of America being 73 as shown in the Geographical Schedule, we get for Production of Wheat

in the U.S.A. the number X9J382:2:73. Any classifier can arrive at this, and only this, number for the subject. There is no need either for the official editor or for any classifier to postpone the creation of this number till "some day when we expect to have a definite number under 338.1 (X9J:2) for wheat."

This ridiculous situation is given by the Head of the Decimal Classification Section as typical of thousands of similar avoidable situations. They are not avoided in the Decimal Classification because it has not set up the necessary apparatus to exploit the Canon of Mnemonics to the maximum possible extent.

The unerring way in which one and the same Class Number can be got by every trained classifier with the aid of prescribed apparatus and without aid from the official editor, will be illustrated further at the end of the next subsection where we consider the Colon Classification.

COLON CLASSIFICATION

(ii) (a) In the Colon Classification, Scheduled Mnemonics are secured in five ways:—By the Colon Device, the Geographical Device, the Chronological Device, the Subject Device and the Bias Number Device. The mnemonic digits are shown in black type in the examples given.

Examples:—

(a) By Colon Device

Class		Class Number
(1) Gall bladder	..	L292
Anatomy of gall bladder	..	L292:2
Physiology of gall bladder	..	L292:3
Inflammation of gall bladder	..	L292:415
Embryology of gall bladder	..	L292:73
(2) Inflammation	..	L:415
Inflammation of eyes	..	L183:415
Inflammation of Joints	..	L191:415
Inflammation of Tonsils	..	L219:415
Inflammation of Stomach	..	L24:415
Inflammation of Pericardin	..	L31:415
Inflammation of Bronchi	..	L44:415
Inflammation of Kidneys	..	L51:415
Inflammation of Meninges	..	L711:415
(3) Rural community	..	Y131
Pastimes of Rural community	..	Y131:3MY
Opium habit of Rural community	..	Y131:413
Underpopulation in Rural Areas	..	Y131:51
Residences of Rural community	..	Y131:81
Ornaments of Rural community	..	Y131:85
Apparel of Rural community	..	Y131:88
(4) Ornaments	..	Y1:85
Ornaments of Children	..	Y111:85
Ornaments of Youth	..	Y112:85
Ornaments of Women	..	Y115:85
Ornaments of Musicians	..	Y141N8:85
Ornaments of Aristocracy	..	Y152:85
Ornaments of Aristocratic children	..	Y152-11:85
Ornaments of Aristocratic women	..	Y152-15:85
Ornaments of primitive people	..	Y172:85
Ornaments of Muslims	..	Y19Q7:85
Ornaments of Muslim women	..	Y19Q7-15:85

(b) By the Geographical Device

Class	Class Number
Flora of India ..	I:12:44
Fauna of India ..	K:12:44
Indian Sculpture ..	N244
Psychology of Indians ..	S744
Geography of India ..	U:44
History of India ..	V44
Double taxation in India ..	X7:32:44
Evolution of the ornaments of women in India ..	Y115:26:6:44
Indian Criminal Law ..	Z5:44

(c) By the Chronological Device

Class	Class Number
G. K. Chesterton as a Poet ..	O:1M74
G. K. Chesterton as a Dramatist ..	O:2M74
G. K. Chesterton as a Novelist ..	O:3M74
G. K. Chesterton as a Prose writer ..	O:6M74
Collection of G. K. Chesterton's critical essays..	O:9M74

(d) By the Subject Device

Class	Class Number
X-rays ..	C5M95
X-ray diagnosis ..	L:4:4025M95
X-ray therapy ..	L:4:625M95
Making X-ray apparatus ..	MC5M95
Economics of X-ray apparatus industry ..	X9MC5M95

(e) By the Bias Number Device

Class	Class Number
Psychology ..	S
Mathematics for psychologists ..	B0S
Statistics for psychologists ..	B280S
Endocrinology and Psychology ..	L60S
Psychology in Shakespeare's plays ..	O:2J64:90S
Psychology of family ethics ..	R420S
The psychological aspect of teaching ..	T0S
Psychology of travel-mindedness ..	U80S
War mentality ..	W:9140S
Economic wants and Psychology ..	X:10S
Psychology of Borstal treatment ..	Z5::5410S

UNSCHEDULED MNEMONICS

(ii) (b) The following are some examples of the Unscheduled Mnemonics that are observed in the Colon Classification:—

(1) The digit 5 is used as mnemonic for Aesthetics, Emotion, Women, Water, Liquid, Ocean, Foreign Lands, Aliens, External environment, Not intrinsically sound, Crime, and so on.

I am sure some kind of association can be perceived among many of these ideas sought to be represented by the digit 5.

It does not mean that 5 is not used to represent any other idea. Suppose we call the other ideas represented by it "Miscellaneous". Then an analysis of the various occurrences of the digit 5 in the schedules of the Colon Classification shows that about 80 per cent. of the occurrences fall under the mnemonic category and the remaining 20 per cent. under the category "Miscellaneous".

Examples:—

R5	Aesthetics	Z9945	Maritime warfare (law)
S:5	Emotions	X:5	Commerce
S55	Psychology of women	T35	Education of aliens
Y115	Women, as a social group	W:45	Relation of the State with aliens
B75	Hydromechanics	Y155	Aliens as a social group
C25	Properties of liquids	Z955	Aliens in International Law
D525	Ships	I:5	Ecology
L35	Blood	L:5	Public health
L515	Urine	S65	Psychology of criminals
L:555	Hygiene of water	T65	Education of criminal classes
MY25	Aquatic sports	Y1:45	Penology
U25	Oceanography	Z5	Criminal law

(2) So also the digit 4 is used as mnemonic for Pathology, Disease, Transport, Interlinking, Synthesis, and so on.

(3) So also the digit 6 is used as mnemonic for Financing, Money, Mysticism, Abnormal types, Phylogeny, Evolution, and so on.

(4) Similarly, the digit 7 is used as mnemonic for Accounts, Value, Personality, Ontogeny, and so on.

(5) Similar mnemonics are associated with other digits also.

(6) When a given digit is to be used with two mnemonic meanings in the same schedule, it is used with the first meaning in the first octave and with the second meaning in the second octave. The class which is likely to attract more books is usually put in the first octave.

Example.—In J Agriculture, 7 is used for Harvesting (the last or the economic stage of the growth of an economic plant, when its economic value assumes a manifested form) in the first octave of the Problem Schedule and 97 is used in the second octave of the same schedule for Ontogeny, Embryology, Growth, etc.

(ii) (c) We shall demonstrate how new placings are arrived at in the Colon Classification with the aid of its devices and the scheduled and non-scheduled mnemonics, by citing a few cases that arose after the *Colon classification* was published. It is a matter for gratification that, in all these cases, a few of the librarians that had had training in the school of Librarianship of the Madras University independently arrived at the same Class Numbers. These instances are taken from a paper submitted to the Second All-India Library Conference held at Lucknow in 1935.¹

1. HILBERT SPACE

The first placing to which I shall refer relates to Function-spaces or Spaces of many dimensions. In the words of M. H. Stone "The systematic study of the possible internal relationships with which a general class or space may be endowed and of the various types of space characterised by such internal properties was begun by Frechet and Hansdorff; to the efforts of these mathematicians and their numerous followers, we now owe an independent and fertile mathematical discipline". Such function spaces belong to the foundations of analysis and hence they should form a class under B31. As the digit 3 when applied to the canonical divisions of Mathematics specialises in Analy-

¹ Ranganathan (S. R.): *Some new placings in Colon classification*. (Vide *Proceedings of the Second All-India Library Conference, Lucknow. 1935. P. 28.*)

sis, Function, and Transcendental operations, we have fixed the number for function-space as B313 by adding the mnemonic digit 3 to B31. This placing was necessitated by the receipt of Stone (Marshal Harvey): *Linear transformations in Hilbert space and their applications to analysis*, 1932. Now, the Hilbert space is but one of a great variety of function-spaces. The basic article on Hilbert space was published in 1908. Hence, by the application of the Chronological Device, we get for Hilbert space the number B313N08.

2. PERIODOGRAM ANALYSIS

The second placing in Mathematics refers to Periodogram Analysis and it is a branch of B28 Statistics. The problem is to find a place for it among the subdivisions of B28. The outstanding elements in periodogram analysis are the crests and troughs, i.e., the maxima and the minima. A reference to the problem divisions of the Function Theory will show that the digit 7 is mnemonic for maxima-minima principles. Hence, the number B287 has been assigned to Periodogram Analysis. There is also another appropriateness in this application. One of the most vital applications of the Periodogram Analysis is to the study of Business Cycles—the alternations between depressions and booms, of which we recently had such a bitter experience. Now Business Cycle comes in the problem division 7 of Economics.

3. CRYSTALS

The first new placing in Physics relates to Crystals. Following the Dewey tradition, we had given places for Crystals in Geology and Chemistry. But in recent years, particularly under the lead of Bragg, much work is being done on the pure physics of crystals. It is the classification of the works published by this school of workers that have led to the new placing in question.

Crystal refers to a state of matter. It is one of the possible states of solid matter. Hence, Crystal should be a subdivision of 1 Solids of the canonical division C2 Properties of matter in C Physics. Again, that which distinguishes the crystal state from the glass state is that the

former has differential directional properties. The digit that specialises in direction is 6. Cf. B46 Vector Analysis, B6 Geometry and the Problem Number 6 Polarisation under C5 Light. These mnemonic considerations led us to assign the number C216 to Crystals.

4. MOLECULAR RAYS

Another curious state of matter was brought to our notice by Ronald G. J. Fraser's *Molecular rays*. It is the first English treatise on the subject. The concept of molecular rays originated with the brilliant pioneer work of Dunoyer, published in *Le Radium* in 1911. From these beginnings in 1911, an elaborate and increasingly important technique has been developed chiefly at the hands of Stern and his collaborators, who have been pursuing this subject in the Hamburg Institute for Physical Chemistry. A perusal of Mr. Fraser's book will show that molecular rays constitute a state of matter into which a gas can be thrown. In fact, according to him, "There is no sharp limit separating the conditions for the production of a molecular ray on the one hand and a gas jet on the other; the one passes continuously over the other as the pressure at the source is raised." These considerations show that Molecular Rays should be a subdivision of 8 Gases. Further the term "ray" in the nomenclature and the fact that the molecular rays obey many of the laws such as those of reflection, refraction, etc., known to be obeyed by the rays of light suggests C285 as the proper number for the Molecular Rays, as 5 is the mnemonic digit for Radiation as shown in C5 Radiation.

5. ULTRA-SOUND DETECTS A MISTAKE

According to the printed schedule of the *Colon classification* C5 Light is to be divided on the basis of two characteristics, *viz.*, Wave length characteristic and Problem characteristic. But C3 Sound is divided only on the basis of the Problem characteristic. Is it not anomalous that such a differential treatment should be given to two topics, both of which are vitally based on wave motion? But within one year of the publication of *Colon classification* this anomaly was violently brought to my notice by the publication of T.1 of Bd. 17 of *Handbuch der experimental physik* under the title *Schwingungs und Wellenlehre ultra-*

schallwellen. A complete section of this book is devoted to Ultra-sound. We also learnt that Sir C. V. Raman's laboratory in Bangalore had just then begun to work on Ultra-sound. This led us to set the anomaly right and open under C3 Sound a section based on Wave length characteristic. The number C35 has been assigned to Ultra-sound.

6. BHAKTI (DEVOTION)

Narada's *Bhaktisutras* and the allied works presented a problem. It was finally decided to place them under the problem division 4 Religious practices, 41 Personal, 419 Other topics. The problem was, by what digit this division was to be amplified to denote Bhakti. It was felt that the mystic element predominated in Bhakti. As 6 is the digit that specialises in Mysticism and in related ideas, it was decided to denote Bhakti by 4196.

7. TYPES OF BANKS

It has been found necessary to have special divisions to denote different types of banks. Accordingly the following divisions have been opened:—

- 69 Types of Banks
- 691 Mortgage Banks
- 6911 Land Mortgage Bank
- 6912 Pawn Banks
- 692 Industrial Banks
- 694 Central Banks, Reserve Banks
- 6942 Federal Reserve
- 695 Commercial Banks
- 6995 Bank of International Settlement

Several of the end-digits belong to the category of non-scheduled mnemonics.

8. A SOCIAL ILL

Again in the Problem division of Sociology, we have 4 Social Pathology. It has been found necessary to open new divisions in its second octave, 49 Other Ills, which is to be divided by the Subject Device. Here is an example of the use of such a subdivision. The book entitled *Creditors and how to escape them, etc.*, gets classified as

Y1:49Z296, the number for Debtor and Creditor in Z Law being Z296.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification, Scheduled Mnemonics are provided for the geographical divisions and the language divisions. In addition, the categorical table provides a rich source of Scheduled Mnemonics.

CONGRESS CLASSIFICATION

(iv) The Congress Classification pays no heed whatever to Mnemonics. It has no such Scheduled Mnemonics. For lack of them, it is encumbered with hundreds of pages of repetitious details. The repetition of geographical divisions almost in every other page with entirely different numbers to represent them is most irritating. So also with other repetitions.

Examples:—

Let us take the Schedule for Politics. It runs through 374 pages.

(a) Of these, above 100 pages are due to the repetition of geographical areas some forty or fifty times, each time with different significant digits, besides the prescription of the Alphabetic Device for geographical division in more than a hundred places.

(b) Again the problem divisions such as Crown, Legislature, Executive, Judiciary and so on, and their subdivisions are repeated practically under every country, with different significant digits. A mnemonic schedule for these would have eliminated more than 100 pages.

(c) With the full economy procurable by Scheduled Mnemonics, the number of pages in the volume could have been reduced to far less than 50.

SUBJECT-INDEX ILLUSION

Neglect or only partial fulfilment of the canons of classification—general and special—has vitiated many schemes with imperfection and confusion. The fond opinion that a scheme so vitiated can be rendered efficient by

an elaborate index has been rightly called the Subject-Index Illusion by Bliss.

"The index idea has been overworked", he says, "The index has been trusted too much. Like the famous "gold dust twins" it was recommended to do all the house work. It would put the library in order, no matter how disarranged. It did not matter much what order, or disorder the subjects were in, the index would locate them. That is the wrong way in classification; it leads straight to what we have called "the subject-index illusion". It is a poor substitute for a good classification, and not much better for a poor one. It is destructive not only of classification; it is self-destructive . . . No index, however convenient and necessary, can convert an arbitrary and disordered arrangement into a systematic classification".¹

The use of the Colon Device, the Geographical Device, the Chronological Device, and the Subject Device not only helps the three special canons to be satisfied by a scheme of classification of the Universe of Knowledge, but it also leads to considerable saving in the matter of Terminology.

WHY IGNORE HISTORIES OF LITERATURE

In the Decimal Classification, for example, each author in the class 800 Literature has to be mentioned in the Schedule against a class number. The result is that we have nearly fortyfive pages of Schedule of Authors and yet only a few so called "Major Authors" are individualised and as for the "Minors" who are far greater in number, the schedule fails to class them properly. But in the Colon Classification, the Literature Schedule is the shortest one occupying less than a quarter of a page. This is because, its use of the Colon Device and the Chronological Device constitute an apparatus, with the aid of which together with that of a suitable History of Literature, the class number of any author belonging to any form in any language can be constructed by the classifier as and when need arises. The scheme does not propose to repeat in its schedules or

¹ Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. 1934. Pp. 200-201.

indexes the names or the information readily found in Histories of Literature.

The position is different however with library catalogues. For the benefit of readers, a library should write out a class-index card—not for all authors—but for such authors as are represented on its shelves.

WHY REPRODUCE SLICES OF DICTIONARIES?

Again, take a subject like Medicine. Is it necessary to load the schedule or the index with the names of diseases like:—

(1)—

Nephradenoma	Nephrolith
Nephralgia	Nephrolysis
Nephrapostasis	Nephromalacia
Nephrationia	Nephromegaly
Nephrauxe	Nephroparalysis
Nephrectasia	Nephropathy
Nephrectomy	Nephrophthisis
Nephrelcosis	Nephroptosis
Nephremia	Nephropyelitis
Nephremphraxis	Nephropyosis
Nephria	Nephrorrhagia
Nephritis	Nephrosclerosis
Nephrocele	Nephrosis
Nephrocolic	Nephrospasia
Nephrocystosis	Nephrotuberculosis
Nephroerysipelas	Nephrotypoid
Nephrohydrosis	Nephrotyphus
Nephrohypertrophy	Nephrozymosis

(2) —

Adrenalitis	Antiaditis
Alveolitis	Aortitis
Amnionitis	Aponeurosis
Angitis	Apophysitis
Angiocarditis	Appendicitis
Angiocholitis	Arthritis
Angiodermatitis	Gastritis
Annexitis	Tonsilitis

LAW OF PARSIMONY

Is the Classification Schedule to ignore the presence of dictionaries and reproduce large slices of dictionaries? Does not the Law of Parsimony imply that such a course is wasteful and that it is desirable to recognise the existence of other informative books and to economise the schedule and the index by providing the necessary apparatus for drawing the maximum possible help from such books?

To show how the classification schedule of a synthetic scheme of classification can take advantage of the existence of dictionaries and other reference books to construct the class numbers of DERIVED COMPOSITE TERMS from out of FUNDAMENTAL CONSTITUENT TERMS which alone are to be specified in the schedule, we shall illustrate from the Colon Classification:—

Taking Nephraux, we find from the dictionary that it is hypertrophy of kidneys. In the schedule for L Medicine, we find, under the divisions based on Organ Characteristic, 51 Kidneys and, under the division based on Problem Characteristic, 412 Hypertrophy. Thus we get the number L51:412 for Nephraux.

To take another example, we find from the dictionary that Aortitis is inflammation of aorta. From the divisions based on the Organ Characteristic in L Medicine, we get 34 Aorta and from the divisions based on Problem Characteristic we get 415 Inflammation. Thus we construct the number L34:415 for Aortitis.

EXTENT OF SAVING

As these examples show, the Colon Device leads to the maximum possible satisfaction of the Law of Parsimony in the matter of Terminology. The saving can be explained symbolically as follows:—

FUNDAMENTAL CONSTITUENT *vs.* DERIVED COMPOSITE
TERMS

Suppose there are *a* divisions on the basis of characteristic A, *b* divisions on the basis of characteristic B and *c* divisions on the basis of characteristic C in any subject. Then it is possible to form *abc* classes by combining them

in all possible ways. As the schedules give the FUNDAMENTAL CONSTITUENT TERMS of the subject and as the meaning of any DERIVED COMPOSITE TERM can be got from a good dictionary, there is no need to load the schedule or the index with the *abc* DERIVED COMPOSITE TERMS indicated by the *abc* classes. The enumeration of the $a+b+c$ FUNDAMENTAL CONSTITUENT TERMS is sufficient. Now it is a matter of elementary algebra that $a+b+c$ is considerably smaller than *abc*.

A NUMERICAL EXAMPLE

To realise how much saving this implies in the actual length of the schedule and in the shifting of a large part of the burden of terms to the dictionary or other appropriate reference book which already exists, let us take, for example, that there are 100 divisions on the basis of the First Characteristic, 200 divisions on the basis of the Second Characteristic, and 300 divisions on the basis of the Third Characteristic. As a result of the Colon Device, only 600 FUNDAMENTAL CONSTITUENT TERMS need figure in the schedule and in the index. The 6,000,000 DERIVED COMPOSITE TERMS need not figure there. The classifier should use the schedule along with a good dictionary or other suitable reference book to construct the class numbers to represent any of these 6,000,000 DERIVED COMPOSITE TERMS as and when need arises. There is surely a great difference between 600 and 6,000,000!

THE ONLY SENSIBLE COURSE

Surely it is impossible to put in all the terms of the infinite Universe of Knowledge in the schedule. The only sensible course is to confine ourselves to the FUNDAMENTAL CONSTITUENT TERMS and leave the DERIVED COMPOSITE TERMS to be managed by individual classifiers with the aid of reference books, as and when need arises.

PRESCRIPTION OF APPARATUS

If a new COMPOSITE TERM gets coined in any field of knowledge demanding a new class,

Firstly, the meaning of that term is to be got from the books concerned;

Next, that meaning is to be expressed in terms of the FUNDAMENTAL CONSTITUENT TERMS occurring in the schedules of classification applicable to the field of knowledge concerned; and

Lastly, the expression so formed is to be represented by the appropriate class number from the schedules concerned with the aid of the appropriate devices or apparatus prescribed in the scheme.

A HELPFUL AND HARMLESS EVASION

Apart from Parsimony, such a provision in a scheme of classification, also invests the scheme with an element of evasion, which is of advantage to the scheme without resulting in any disadvantage to the users of the scheme. The DERIVED COMPOSITE TERMS are likely to take time to get settled and may also be unsettled and changed from time to time by usage and by the committees on terminology in different subjects. But the FUNDAMENTAL CONSTITUENT TERMS will be relatively more stable. Hence, by mooring itself to the FUNDAMENTAL CONSTITUENT TERMS and by merely providing the necessary apparatus to deal with the DERIVED COMPOSITE TERMS, a synthetic scheme of classification escapes many of the ordeals of terminological flickerings and fights leaving them to be negotiated by and reflected in the catalogues of individual libraries just to the extent warranted by the books on the shelves. The scheme can say "Terms may come and terms may go. But my representation of the classes behind them goes on for ever, even without my naming them."

TO SUM UP

We started with the statement that the crux of the Special Theory of Classification peculiar to the Universe of Knowledge which has an infinity of entities and classes, some of which are unknown, is that of providing filiatory accommodation for new classes. When a new class comes up for a place, one of two things happens.

Either

(1) There does not exist already in the scheme any class which is coordinate with it and with which it can share an Immediate Universe in common.

Or

(2) There exists already in the scheme an array of classes which are coordinate with it and with which it can share an Immediate Universe in common.

CREATE A NEW ORDER

1. In the former case the new class will have to be accommodated by lengthening that one of the existing chains of classes, whose last link can contain the newcomer as a subclass. It goes without saying that the last link in question will be of lower order than the newcomer. Further, according to the principle of filiation that the scheme should satisfy, the new class should come immediately after that last link. This will be possible only if the notation is such that an ordinal number, intermediate in order between the class number of the last link and that of its immediate right hand neighbour, can be constructed and used as a class number to represent the newcomer.

HOSPITALITY IN CHAIN AND NOTATION

This feature should persist to an unlimited extent between any two consecutive numbers of the scheme. This has led to the Canon of Hospitality in Chain. It can be secured only to a very limited extent by the Integral Notation, to a greater extent by the Decimal Notation, and to a still greater extent, if the Decimal Notation is coupled with the Colon Notation.

HOSPITALITY IN ARRAY AND NOTATION

2. In the second case, firstly a place has to be found for the newcomer in the Array concerned. This has led to the Canon of Hospitality in Array. This can be secured to an unlimited extent by several devices such as the "Other" device of the Decimal Classification or the "Octave" principle of the Colon Classification, the Chronological Device, the Subject Device, the Geographical Device and the Alphabetic Device. An Integral Notation and one which does not use these devices would fail us frequently.

WHY MNEMONICS

Secondly, to find a place in the Array for the newcomer without violating the Canon of Helpful Order and

the Canon of Consistent Order, it is necessary that the Notation should satisfy the Canon of Mnemonics as closely as possible.

ADVANTAGE OF THE THREE CANONS

A scheme of classification of the Universe of Knowledge, which satisfies these three additional canons well, can grow systematically and can make its schedule brief and compact, relying upon the classifiers to exploit the books of reference to construct the derived composite terms necessary for denoting the majority of the classes, as and when need arises, from the fundamental constituent terms which alone figure in the schedule.

AUTOMATIC CREATION OF NUMBERS

A scheme should have in it the necessary apparatus to construct class numbers for new classes satisfying the filiation of the scheme in a unique manner. That is, the same class number should be arrived at by anybody following the prescribed rules for the use of the apparatus. This does not mean that *every* new class can be dealt with in that way. All that is meant is, that the closer the adherence to the three canons is, the greater will be the types of classes that can be assigned class numbers in an automatic way and the smaller will be the types that should be decided only by the official editors or revisers of the scheme. As the Colon Classification satisfies the canons far more closely than the other schemes, its use is far more independent of the official editors or revisors than any other scheme. It is this fact that is brought out so pointedly by the following observation made in the *Library Association record* in regard to the Colon Classification:—
"A new subject creates its own number in the notation."¹

¹ *Library Association record*. Fourth Series. V. 1. 1934. P. 98.

5. THEORY OF BOOK CLASSIFICATION

In the first three chapters we developed a general theory of classification. The second and third chapters enunciated the main canons—eighteen in number—which it is desirable that any scheme of classification applicable to any universe should satisfy. In the fourth chapter we studied the Universe of Knowledge as a preliminary to our chief objective—elucidation of the special features of the theory of Book Classification. In discussing the Universe of Knowledge we saw that classification of that universe had to face some special problems on account of

(1) its being a universe with an infinity of classes; and

(2) many of its classes (pseudo-entities) being unknown.

A consideration of these features of the Universe of Knowledge led us to three additional canons, which are special to the Theory of Knowledge Classification and which it is desirable that every scheme of classification of the Universe of Knowledge should satisfy in addition to the eighteen general canons.

EMBODIED KNOWLEDGE

Now books are concrete entities which embody knowledge. We may say that books are “embodied knowledge”. Hence we should expect, in the first place, that all the peculiarities of the Universe of Knowledge will be found reflected in the Universe of Books. In particular, the Universe of Books is a growing universe—growing towards infinity—and capable of accreting to itself new entities from time to time. Hence the Special Theory of Book Classi-

fication will also involve the three additional canons that took shape in the Special Theory of Knowledge Classification.

But we must also expect some additional peculiar features in the Universe of Books, deriving from the special fact of embodiment. To this extent a scheme of Book Classification will have to modify the Scheme of Knowledge Classification, which it adopts as its basis.

SEVEN PECULIARITIES

So far as the theory of classification is concerned, we may point out seven peculiarities special to the Universe of Books and not found in the Universe of Knowledge.

The seven special features may be briefly named as follows:—

- (1) Partially comprehensive books;
- (2) Artificial composite books;
- (3) National and local variations;
- (4) Books from special points of view;
- (5) Classics and commentaries and sub-commentaries on them;
- (6) Common subdivisions; and
- (7) Individualisation of books.

We shall introduce the peculiarities of the Universe of Books, as usual, by enunciating the additional canons necessitated by them and entering into a discussion of these canons in terms (with the aid) of the concrete practices that obtain in current schemes of classification.

PARTIAL COMPREHENSION

The following is the first additional canon to be considered:—

1. In a Scheme of Book Classification there should be, in association with each array of classes, a set of classes of the same order as that of their immediate universe and hence coordinate with it,

but differing from the immediate universe in that this set of classes comprehends the classes of the array only partially, whereas the immediate universe comprehends them totally.

This may be referred to as the CANON of PARTIAL COMPREHENSION.

We will begin the discussion of this canon with a concrete example. Take Pure Mathematics as the immediate universe and suppose its array of the First Order to consist of the five classes: Arithmetic, Algebra, Analysis, Trigonometry and Geometry. So far as the Universe of Knowledge is concerned, it is sufficient if a Scheme of Knowledge Classification specifies Pure Mathematics in the earlier order and the above-mentioned five classes in the next lower order, as forming the array derived from it. For we have only one of six possibilities; either the subject is Pure Mathematics or it is any one of its five subdivisions. It cannot be anything else in the subdivision of Pure Mathematics within the Universe of Knowledge. In other words, it is enough if the scheme provides for one all-comprehensive class and for each of the separate classes in the array as follows:—

Pure Mathematics
Arithmetic
Algebra
Analysis
Trigonometry
Geometry

But this is not sufficient in the Universe of Books. For it is possible to have books on any combination of the five classes of the array taken any number at a time. In addition to a book on Pure Mathematics, which comprehends all the five classes, we may have, theoretically speaking, books which deal with each of the following partial comprehensions of the five classes of the array:—

Combination of two classes

1. Arithmetic and Algebra
2. Arithmetic and Analysis

3. Arithmetic and Trigonometry
4. Arithmetic and Geometry
5. Algebra and Analysis
6. Algebra and Trigonometry
7. Algebra and Geometry
8. Analysis and Trigonometry
9. Analysis and Geometry
10. Trigonometry and Geometry

Combination of three classes

11. Arithmetic, Algebra and Analysis
12. Arithmetic, Algebra and Trigonometry
13. Arithmetic, Algebra and Geometry
14. Arithmetic, Analysis and Trigonometry
15. Arithmetic, Analysis and Geometry
16. Arithmetic, Trigonometry and Geometry
17. Algebra, Analysis and Trigonometry
18. Algebra, Analysis and Geometry
19. Algebra, Trigonometry and Geometry
20. Analysis, Trigonometry and Geometry

Combination of four classes

21. Arithmetic, Algebra, Analysis and Trigonometry
22. Arithmetic, Algebra, Analysis and Geometry
23. Arithmetic, Algebra, Trigonometry and Geometry
24. Arithmetic, Analysis, Trigonometry and Geometry
25. Algebra, Analysis, Trigonometry and Geometry

This enumeration of the twenty-five theoretical possibilities might be boring to those who know algebra. But it has been given to make the matter concrete for those who have had no algebraical discipline. Now the latter class of people may take the former on trust, when they say "We knew that there would be 25 classes of partial comprehension, from the formula $(2^n - n - 2)$ for the number of partial comprehensions of n classes. If you care, you may verify this formula in the particular case considered by substituting 5 for n . We get $2^5 - 5 - 2 = 32 - 7 = 25$. Q.E.D."

A TALL ORDER

If an array has n classes in a Scheme of Knowledge Classification, the corresponding Scheme of Book Classification must add $2^n - n - 2$ extra classes to that array to provide for books of partial comprehension. Such extras must be added in relation to each array. It may be that all the theoretical extras are not requisitioned in practice. But some already are. For example, P. V. Seshu Ayyar's *Elementary mathematics* comprehends Arithmetic, Algebra and Geometry but not Analysis and Trigonometry. Hence, to satisfy the Canon of Partial Comprehension, a Scheme of Book Classification must comprise the apparatus necessary to create any number of these extras, as and when need arises. A tall order!

A PROBLEM FOR RESEARCH

A tall order indeed! For no scheme of Book Classification has so far succeeded in satisfying this canon to any extent whatever. Or there is perhaps one trivial exception. The Congress Classification now and again specifies a class under the name "General special" and this term is defined to denote books of partial comprehension or "non-comprehensive books"¹—just one extra class in the place of the $2^n - n - 2$ extras required. All the existing Schemes of Classification evade this canon because of the limitations of their notation. Unless some new device is invented, any attempt to force the notation, as it is now, to accommodate so many extras of the nature described will lead us to ridiculously cumbersome class-numbers which may prove rather a hindrance than a help.

This is a challenge to the library profession, a first-class research problem for gifted students!

CALL THE CATALOGUE TO AID

Though the library profession is at present incapable of finding the necessary device to make the notation satisfy this canon without breaking under its own weight, its bankruptcy is not so complete that it cannot at any rate offer

¹ Library of Congress. *Classification. Class D. Universal and old World history.* 1916. P. 5.

some make-shift arrangement. It has contrived to tide over the difficulty by calling the catalogue to its aid.

In fact, the situation is met in this way:—Although the extension of the extra classes required is smaller than that of the all-comprehensive immediate universe, they are all given the class-number of the immediate universe. No doubt this is imperfect and may puzzle users. For, if they pick out at random books having the class number of the immediate universe on their backs, some will give information on all the topics expected, whereas others will prove disappointing in this respect.

A CONCRETE EXAMPLE

Let us take a concrete case to show how the aid of the catalogue is resorted to. Suppose a reader wants a short account of Algebra. Let us assume that books exclusively devoted to Algebra are all out on loan at the moment. In such circumstances he would naturally pick out a book falling within the comprehensive class Pure Mathematics. Now unless all the books in that class are *actually all-comprehensive*, the chances are very great for his picking out a book which is *only partially comprehensive* and *actually omits Algebra* altogether.

To avoid such disappointments, the library profession has provided the catalogue with what is known as the Cross Reference Entry,¹ and has adopted the convention that fully comprehensive books need not be given cross reference entries but partially comprehensive books, on the other hand, must be cross-referred in the classified part of the catalogue, under the class-number of each of the comprehended sub-classes. When the catalogue is so provided with cross references the reader need not depend on chance for his being successful in getting a book that treats of Algebra from among the books which have on their backs the class number of Pure Mathematics, the fully comprehensive immediate universe. Reference to the catalogue under the head-

¹ Ranganathan (S. R.): *Classified catalogue code*. 1934. Rule 2 and its subdivisions.

ing "Algebra" will show him exactly which of these books give information on Algebra.

WHEN TO CROSS-REFER

The following examples will illustrate the value of this Cross Reference Entry convention in the case of partially comprehensive books which could not be successfully tackled by classification:—

Example:—

We don't write cross reference entries for each of the authors whose criticism is found in Charles Wells Moulton's *Library of literary criticism* 8 V., because it is a fully comprehensive book of reference.

But every author studied in Andre Chevrillon's *Three studies in English literature: Kipling, Galsworthy, Shakespeare* gives rise to a cross reference entry. That is because this book is only partially comprehensive, treating of only three authors.

ARTIFICIAL COMPOSITE BOOKS

PATHOLOGICAL PARTIAL COMPREHENSION

The second peculiarity of the Universe of Books which is a trial to a Scheme of Book Classification and its Notation is the existence of Artificial Composite Books.¹ Here also we have partial comprehension, but it may be called pathological partial comprehension. In the cases we have so far dealt with it is only classes of a single array, that have been partially comprehended. But an Artificial Composite Book is called Artificial because it comprehends classes from more than one array and at the same time its comprehension is not sufficiently full to be given a place in a generalia class or a class of sufficiently low order. Such Artificial Composite Books are not common in countries where the art of publishing and book-production is sufficiently advanced and subjects itself to certain helpful standards. But, in contemporary India, we have a shoal of such nuisances to baffle classification.

¹ Ranganathan (S. R.): *Classified catalogue code*, 1934. Rule 08412.

The following extract from a paper entitled '*Vagaries in Indian book production*'² by K. Natarajan corroborates this statement:—

"Such instances are very common in books belonging to certain series. For example Brahmananda Sarasvati: *Advaita siddhanta vidyotana* and Nrisimhasrama: *Nrisimhavij-napana* have been issued as a single volume in the Princess of Wales Saraswati Bhavana Texts' Series with distinct title pages and sequences of pagination and in addition with a common title page".

AID OF THE CATALOGUE AGAIN

It is not fair to blame the library profession, if it cannot invent devices to make its notation stand the strain of such anomalous and freakish books. It is legitimate, indeed only sensible, for the classification not to stand on prestige in such cases but to call in the aid of the catalogue. The book is given the class number appropriate to the first constituent class comprehended in the book and the other constituent classes are provided with cross reference entries. A reference may be made to the *Classified catalogue code* for details and examples.¹

Thus no special canon is warranted by the second peculiarity of the Universe of Books.

LOCAL VARIATION

The third peculiarity of the Universe of Books which involves modification and adaptation of the Scheme of Knowledge Classification leads to the following additional canon:—

2. The schedules of a Scheme of Book Classification should provide for variations due to special interests (*e.g.*, national and local).

This may be referred to as the CANON of LOCAL VARIATION.

² *Modern librarian*, V.5. 1935. P. 141.

¹ Ranganathan (S. R.): *Classified catalogue code*. 1934. Rules 621 and 622 and their subdivisions & Rules 623 and 624.

The need to consider local variation is not very pronounced in the Universe of Knowledge. But when it comes to the classing and arranging of actual books in a library to meet the requirements of readers with the maximum possible conformity to the Laws of Library Science, the Canon of Local Variation is seen to be valuable.

PROVISION FOR NATIONALITIES

The term "Local" should be interpreted liberally so as to refer to a geographical area of any size. Thus this canon will provide, for example, for interests peculiar to the Americas, or New World interests; interests peculiar to a continent (such as European and Asiatic interests); interests peculiar to a country (such as English interests, Indian interests, Japanese interests); interests peculiar to a district or county; interests peculiar to a town or a village. In practice, however, except in what are known as "local collections" in local libraries, the special interests will be largely of a national nature. It is this fact that has led Bliss to say, "Adaptation to nationality should in a standard system be liberal even to radical alteration. This may in some cases be modified by alternative locations reserved or provided. For history and literature, these provisions are especially requisite. The ingeniously adaptable *Colon Classification* in its "Geographical Divisions" provides first for the "Mother country" and next for the "Favoured country" . . . This exemplifies the need in an international standard for more extensive adaptability in providing for nationalities".¹

COLON CLASSIFICATION

(i) (a) In the Colon Classification, 2 is set apart for the "Mother country". But in practice, when a library specialises in local collections so far as they are concerned 2 is used for the locality in question, whether it is district, county, town or village. This results in considerable shortening of class numbers and gives priority to local collections in shelf arrangement.

¹ Bliss (Henry Evelyn): *A system of bibliographic classification*. 1935. P. 8.

3 representing "Favoured country", may be similarly adopted.

(b) This special use of "2" and "3" will provide for local variations in almost every subject and not merely in Geography or History, since the geographical characteristic figures as a basis of classification at some stage or other in most subjects as a means of amplifying a common subdivision digit and in a few subjects even as a fundamental characteristic.

FAVOURED LANGUAGE

(c) The Colon Classification has also provided for Local Variation in the arrangement of books in Literature, by defining Favoured Language and by providing a special rule for Literature in the Favoured Language. We have the following specification:—

"The Favoured Language of a library is the language in which the majority of the books of the library are written.

"Normally the language of the country is likely to be the Favoured Language. But under the peculiar conditions of India, and of Madras in particular, the Favoured Language of many libraries, at present, is likely to be English."¹

"In the case of the literature in the Favoured Language the Language Number may be taken as understood and need not be actually written."²

These two rules secure both saving of digits in class numbers and priority in shelf-arrangement for the Literature in the Favoured Language.

PHILOSOPHICAL SYSTEMS

(d) The Canon of Local Variation is met by the Geographical Device and by the provision of special places for philosophical systems. We have in the Array of the First Order in Philosophy

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rule 0331.

² *Ibid.*, Rule 7102.

- R6 Indian philosophy
- R7 Greek philosophy
- R8 Other systems (To be divided by the Geographical Device)

Indian and Greek Philosophies were given special places in the belief that they constitute the most elaborately worked out systems.

In particular libraries, R6 or R7 may be used for Local Systems and the Indian or Greek System thus ousted may be accommodated in R8.

LOCAL SYSTEMS OF MEDICINE

(e) In some cases the CHRONOLOGICAL DEVICE is used to secure Local Variation. For example, books on certain systems of Medicine peculiar to India may be separated from general books on Medicine by providing as follows:—

- LA Ayurvedic system
- LB Siddha system
- LC Unani system

The actual date (century) of origin of these systems is not known. Hence they have been taken arbitrarily in the order given. Any other system that may be current elsewhere may be similarly fixed and the Canon of Local Variation duly satisfied. Any local system of medicine can be divided like L Medicine with the necessary modifications in the schedules applicable to medicine.

The Colon Classification is practically the first scheme to show such great respect to the Canon of Local Variation. According to the *Library Association record*, "The supreme advantage of this synthetic type of classification scheme is that it may be utilised in various ways to suit the preferred principles of book classification. . . . Special collections can be formed at will at any point in the scheme."¹

DECIMAL CLASSIFICATION

(ii) Dewey himself had recognised that the Decimal Classification was little mindful of the Canon of Local Variation.

¹ *Library Association record*, Fourth series, V.1. 1934, P. 98.

tion. In a letter dated November 13, 1930, he wrote to me: "Naturali the sistem 1st publisht in 1876 was from the standpoint of our American libraries. Thru the 12 editions it has constantli broadened. But we need speciali to cover *Asia* mor adequateli & hope we shal hav yur aktiv cooperation in making the decimal sistem stil mor wydli useful."

The following extract² will show that an attempt was made to make the Decimal Classification fulfill the Canon of Local Variation:—

"In November, 1929 correspondence with Dr. Dewey was initiated by Wm. Alanson Borden, who was engaged in library work in India, 1910-1913. Mr. Borden had evolved an outline classification by which the libraries of any country could give to that country the place of chief prominence under those subjects in which locality was a feature of special importance, *i.e.*, religion, language, literature, history and geography. He wished, however, to take his subdivisions from D C and therefore laid the matter before Mr. Dewey. D C having already been adopted on every continent and in many countries and being used more than all other systems combined, was obviously the vehicle by which Mr. Borden's idea could best be carried throughout the world and thereby accomplish his purpose. Before Mr. Borden's death in November, 1931, the main features of the combination had been agreed on and on Mr. Dewey's death the following month the determination of minor details only was left to D C editor to bring about the most serviceable results possible for a world-wide constituency."

VIEWPOINT

The fourth peculiarity of the Universe of Books which involves modifications and adaptation of the Scheme of Knowledge Classification on which a Scheme of Book Classification is based leads to the following additional canon:—

3. In a Scheme of Book Classification there should be some device for differentiating books on

² Dawe (Grosvenor) *Comp.: Melvil Dewey: seer, inspirer, doer, 1851-1931*. 1932. Pp. 167-168.

a given subject treated from different points of view or from the point of view of different subjects, or adapted to special interests, special professions or special classes of readers.

This may be referred to as the CANON OF VIEWPOINT.

The importance of this canon will be demonstrated by the examples tabulated at the end of this section. In the meantime, we may examine the devices employed to satisfy it by the Schemes of Classification with which we are dealing.

DECIMAL CLASSIFICATION

(i) In the Decimal Classification, as originally published there was no provision to satisfy this canon. But the later editions recommend the adoption of the special devices introduced by the Institut International de Bibliographie in adapting and amplifying the Decimal Classification into the Classification Decimale. Dewey himself has singled out:

"The most important of these devices are 3 Relation Sign and 6 Place Sign and their use in libraries where they have been tried has proved that it is entirely practicable even for marking books.

"The wide and ever growing range of application of certain subjects makes it impossible to subdivide satisfactorily by assigning definite numbers, but use of colon to show relation between two subjects provides an automatic method which can be used with any subject for unlimited subdivision (For illustration see note under 150 Psychology)."¹

The illustrations given under 150 Psychology are reproduced in the table of examples given at the end of this section.

COLON CLASSIFICATION

(ii) In the Colon Classification, the Eighth Device known as the Bias Number Device has for its function the

¹ Dewey (Melvil): *Decimal classification and relativ index*. Edn. 13, 1932. P. 41.

fulfilment of the canon under consideration. Here are the rules bearing on the device:—¹

"The Bias Number Device is employed for bringing together such of the books in a class as are written with a special bias to some other class or from a special point of view that can be associated with some other class, or for the use of a special class of readers whose primary interest of study is in some other class, or as have some other special relation to some other class. The class to which the book belongs may be termed the 'Basic Class' and its number may be termed the 'Basic Number'. The other class may be termed the 'Bias Class' and its number may be termed the 'Bias Number'.

"The Bias Number Device consists in amplifying the 'Basic Number' by the addition of the digit 0 followed by the appropriate 'Bias Number'.

"Both the 'Basic Number' and the 'Bias Number' are to be worked out as fully as may be appropriate to the book."

Examples of the application of these rules will be found in the table of examples given at the end of this section.

AN EXTREME CASE

The Bias Number Device may be used even more than once if warranted. Consider a book on the statistical study of the words used by Shakespeare. This is a book on Shakespearean criticism. Hence, its Basic Number is 0:2J64:9. The criticism is primarily from the point of view of words. Hence, the first Bias Number is P::3. But even the class represented by 0:2J64:90P::3 has a greater extension than the book under consideration. To reduce the extension, we have to use B28, the number for Statistics, as an additional Bias Number. Thus we get for the class

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rules 68, 681 & 682.

number of the book 0:2J64:90P:: 30B28 in which the Bias Device is applied twice.

JUSTIFICATION

This notation is, no doubt, very long. But the intension of the class represented is also unusually great. According to the Canon of Relativity, one cannot help having a long class number to individualise classes of such great intension. This extreme example should not lead one to infer that class numbers are *generally* long in the Colon Classification. The mistaken nature of such a presumption has been demonstrated in chapters 3, 7 and 8. The advantage of having to go to such lengths to individualise classes of great intension is, however, great from the point of view of the users of the library. If a man wants *the one book* in the whole library which contains a statistical study of the use of words in Shakespeare, he has to search through a hundred volumes, or perhaps even a thousand volumes, in Shakespearean Criticism if the Bias Number Device is not used twice. But if it is used in the manner suggested, he will instantly find *the one volume* standing alone in its proper filiationary place. When a classifier has once examined the book and found out what it is about, a fully worked out class number records it permanently for the benefit of all the readers who may search for that topic.

REALLY UNAVOIDABLE

To show that in any scheme of classification that attempts to individualise classes of such intension, the class number is bound to be unusually long, we give here, the class number for the same book, according to the Decimal Classification amplified by the Relation Sign of the Classification Decimale:—

822.33D:428.3:311

This contains the same number (17) of digits as the Colon Classification Number.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification the "do-all" categorical tables will go a long way to satisfy the canon of Viewpoint.

CONGRESS CLASSIFICATION

(iv) In the Congress Classification, there is no special device employed to satisfy this canon. But in various places special numbers are given for special points of view with the usual disregard for the canon of Mnemonics.

Examples¹ illustrating fulfilment of the Canon of Viewpoint

Ser. No	Class or Book	Decimal Classification	Colon Classification
1	Psychology applied to Education ..	115:37	S0T
2	Psychology applied to Business Management	150:658	S0X:8
3	Psychology applied to Medicine ..	150:61	S0L
4	Psychology applied to Fine Arts ..	150:7	S0N
5	Ethics in relation to Fine Arts ..	170:7	R40N
6	Art in its ethical aspect ..	700:17	N0R4
7	Wright (T.W.): <i>The adjustment of observations ... with applications to geodetic work</i>	311:526	B280B91:2
8	Guha Roy (K.K.): <i>Statistical methods and their application to agronomy</i>	311:630	B280J
9	Pearl (R.): <i>Introduction to medical biometry and statistics</i>	311:614:1	B280L:51
10	Macdonald (M.E.): <i>Practical statistics for teachers</i>	311:370	B280T
11	Mayo-Smith (R.): <i>Statistics and economics</i>	311:330	B280X
12	Davies (G.R.) and Crowder (W.F.): <i>Methods of statistical analysis in the social sciences</i>	311:301	B280Y

CLASSICS

The fourth additional canon needed for the Special Theory of Book Classification may be enunciated as follows:—

4. A Scheme of Book Classification should have a device which will bring together all the editions of a classic and next to them all the editions

¹ The first six examples are taken from Dewey (Melvil): *Decimal classification and relative index*. Edn. 13. 1932.

of their commentaries and next to each commentary all the editions of its subcommentaries (commentaries of the second order) and so on.

This may be referred to as the CANON of CLASSICS.

This canon has been fully recognised and observed only in the Colon Classification Scheme. That the Colon Classification should have devised a special apparatus to fulfil this canon is due largely to its being of Indian origin. The universe of ancient Sanskrit books, belonging to any subject whatever, abounds in hierarchies of commentaries on a basic text (Classic). It had been a common and accepted practice in Ancient India to start with the enunciation of the fundamentals of a subject in the most general terms in a basic text (Classic) and to elucidate the most far-reaching implications of the fundamentals along all possible—sometimes even opposite—directions, stage by stage, in a chain of commentaries and subcommentaries. Different New Schools of Thought have been formulated in different chains of commentaries and have become crystallised in course of time.

Examples:—

(1) (a) A basic text for the grammar of Classical Sanskrit is P15:Cx1 Panini *Astadhyayi*. The following are three of the chains of commentaries depending upon it:—

- | | | |
|------|-------------|---|
| (i) | P15:Cx1 | Panini <i>Astadhyayi</i> |
| | P15:Cx12 | Patanjali <i>Mahabhasya</i> |
| | P15:Cx121 | Kaiyyata <i>Mahabhasya-pradipa</i> |
| | P15:Cx1211 | Nagoji Bhatta <i>Mahabhasya-pradipoddyota</i> |
| (ii) | P15:Cx1 | Panini <i>Astadhyayi</i> |
| | P15:Cx16 | Bhattojidsita <i>Siddhanta Kaumudi</i> |
| | P15:Cx161 | Bhattojidsita <i>Manorama</i> |
| | P15:Cx1611 | Haridiksita <i>Sabdaratna</i> |
| | P15:Cx16111 | Balambhatta <i>Bhava-prakasika</i> |

- (iii) P15:Cx1 Panini *Astadhyayi*
 P15:Cx1K10 Annambhatta *Vyakaranamitakshara*

(b) Another basic text for the grammar of Classical Sanskrit is P15:Cx7 Narendracarya *Sarasvata-sutras*. The following are two of the chains of commentaries depending upon it:—

- (i) P15:Cx7 Narendracarya *Sarasvata-sutras*
 P15:Cx71 Anubhutiśvarupacarya *Sarasvata-prakriya*
 P15:Cx71J90 Kasinatha *Sarasvata-bhasya*
 (ii) P15:Cx7 Narendracarya *Sarasvata-sutras*
 P15:Cx72 Ramacandrasrama *Siddhanta-candrika*
 P15:Cx721 Lokesakara *Tattvadipika*

(2) The basic text for the *Vedanta* Philosophy is the Classic R66:5 *Brahmasutras*. As is well known, six Schools of Vedanta have branched off from this basic text.

(i) The R66 *Advaita* or Monistic School is developed in a number of chains of commentaries all of which have R66:5x1 Sankara *Brahmasutra-bhasya* as the first link. Here are two chains depending upon this first link.

First Chain

- R66:5x1 Sankara *Brahmasutra-bhasya*
 R66:5x11 Padmapada *Pancapadika*
 R66:5x111 Prakasatman *Pancapadiakavivarana*
 R66:5x1111 Akhandanandamuni *Tattvadipana*

Second Chain

- R66:5x1 Sankara *Brahmasutra-bhasya*
 R66:5x12 Vacaspatimisra *Bhamati*
 R66:5x121 Amalananda *Kalpataru*
 R66:5x1211 Appayyadiksita *Parimala*

(ii) The R67 *Visistadvaita* or Modified Monistic School is developed in the following chain of commentaries:—

- R67:5x2 Ramanuja *Sribhasya*
 R67:5x21 Sudarsana *Sribhasya-vyakhya*
 R67:5x212 Lakṣmana *Gurubhava-prakasa*

(iii) The R68 *Dvaita* or Dualistic School is developed in the following chain of commentaries:—

R68:5x1	Anandatirtha	<i>Brahmasutra-bhasya</i>
R68:5x11	Jayatirtha	<i>Tattvaparakasika</i>
R68:5x111	Vyasatirtha	<i>Tatparya-candrika</i>
R68:5x1111	Raghavendrathirtha	<i>Tatparya-candrika-prakasa</i>

(iv) The R6892 *Dvaitadvaita* or Dualistic-Monistic School is developed in the following chain of commentaries:—

R6892:5x1	Nimbarka	<i>Vedantaparijata-saurabha</i>
R6892:5x11	Srinivasacarya	<i>Vedanta-kaustubha</i>

(v) The R6893 *Suddhadvaita* or Devotional-Monistic School has the following chain:—

R6893:5x1	Vallabhacarya	<i>Anubhasya</i>
R6893:5x11	Gosvami	<i>Sri-Purusottamjee Bhasya-prakasa</i>

(vi) The R6891 *Bhedabheda* or Difference-Identity School is developed in the commentary

R6891:5x1	Bhaskaracarya	<i>Brahmasutra-bhasya</i>
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(3) Again, we have as a classic in Ayurvedic surgery LA:4:7x2 *Susrutasamhita*. A well known commentary on it is

LA:4:7x21	Chakrapanidatta	<i>Bhanumati</i>
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The canons of the general theory of classification require that all the books on all the various schools of thought deriving from a given enunciation of fundamentals be arranged in a filiiary order. Thus the Canon of Classics is only a corollary from the canons of the general theory of classification.

THE APPARATUS

The purpose of the Classic Device¹ of the Colon Classification is simply to secure conformity to this Canon of Classics. The device is enunciated as follows:—

“The Classic Device is employed for bringing together the different editions of a classic in a class, the different editions of each of its commentaries, the different editions of each of the subcommentaries of each of its commentaries and so on and of securing that the group of subcommentaries of a commentary is in juxtaposition to the commentary, that the group of commentaries of a classic is in juxtaposition to the classic and that the group formed of each classic and its associated commentaries is in juxtaposition to the groups of the other classics of the same class.

“The Classic Device consists in putting the digit x after the number representing the ultimate class to which the book should be otherwise assigned, and amplifying the digit x by the Favoured Category Device or the Chronological Device to individualise the classic concerned. The amplified x may be termed the *Classic Number*. The commentaries are indicated by amplifying the corresponding classic Number by the Favoured Category Device or the Chronological Device. This amplifying number may be termed the *First-order Commentary Number*. The subcommentaries of a commentary are indicated by amplifying the corresponding First-order Commentary Number in a similar way. This amplifying number may be

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rules 65 and 651 and the commentaries on them.

termed the *Second-order Commentary Number* and so on."

The examples already given illustrate the application of this device to Indian Classics. "There are also some cases of occidental classics—such as Burke's works in Politics, some of the classics of International Law, the Greek and the Latin Classics—which may be more conveniently grouped by the Classic Device.

"One result of the application of the Classic Device is that the classic becomes a class by itself and hence its different editions come together, with the Book Number differentiating them. In the case of a classic, several editions are likely to appear even at distant dates. But for this device, they will get scattered and intermingled with other ordinary books in the same class. Such an intermingling is bound to be revolting to the mind of the readers. It is certainly not desirable that Aristotle's *Poetics* or Dandin's *Kavyadarsa* should be indiscriminately clubbed with the ordinary modern books on literary criticism. Nor will it be happy to interpolate Sankaracarya's works on Indian Philosophy with the modern text-books on Indian Philosophy.

"It not infrequently happens, particularly in works in the Sanskrit language, that the classic gets many commentaries which themselves become classic and get many editions and many subcommentaries. All the Laws of Library Science will be best served if and only if the whole family of commentaries and subcommentaries are grouped together and placed next to the different editions of the classic itself. Usually the commentaries and the subcommentaries carry forward the theories contained in the classic. This carrying forward is done step by step in the hierarchy of commentaries and subcommentaries. Hence the happy grouping of a classic with its commentaries and subcommentaries, brought about by the Classic Device, incidentally arranges the books in the proper evolutionary order. This adds greatly to the convenience of the readers—nay, it is even educative.

"It may be stated here that the use of the digit *x* in the Classic Device is not in any way in conflict with the use of the same to indicate *collected works*. As a matter of fact the one use is but a natural and consistent extension of the other."

It may be stated here that a work attains the status of a classic and requires to be converted into a class by itself by the Classic Device, if

- (i) it has elements of permanent value; and
- (ii) it is saturated with the personality of the author; and/or
- (iii) it stimulates other books on itself.

COMMON SUBDIVISIONS

The sixth peculiarity of the Universe of Books which involves modification and adaptation of the Scheme of Knowledge Classification on which a Scheme of Book Classification is based leads to the following two canons:—

5. A Scheme of Book Classification should have a schedule of Common Subdivisions with the aid of which books belonging to the same knowledge-class may be differentiated and further classified on the basis of the form of exposition adopted by the book.

This may be referred to as the CANON of COMMON SUBDIVISIONS.

6. The Notation of the schedule of common subdivisions should be tolerably distinct from that of the schedule of the Knowledge Classification which forms the basis and should also satisfy the canons set down for the Notation both by the General Theory of Classification and by the Special Theory of Knowledge Classification.

This may be referred to as the CANON of DISTINCTIVENESS.

It is best to begin a discussion of these two canons by setting down the schedules of Common Subdivisions of the current Schemes of Classification. It may be remarked that the common subdivisions are found merged in the categorical tables in the Subject Classification from which they are here extracted though not fully. Further, the Congress Classification has, as usual, no distinct or mnemonic notation for the common subdivisions, though they are fully employed.

Common Subdivisions	Decimal classification	Colon classification	Subject classification	Expansive classification
Bibliography ..		<i>a</i>	.1	.2
Profession ..	069	<i>b</i>	.763	
Professional qualification ..		<i>b1</i>		
Professional training ..	071	<i>b3</i>	.66	
Research ..	072	<i>b4</i>	.632	
Professional associations ..		<i>b7</i>		
Laboratories ..	072	<i>c</i>	.69	
Museums ..	074	<i>d</i>	.57	
Exhibitions ..	064	<i>d</i>	.56	
Instruments ..	078	<i>e</i>	.167	
Formulae ..	0832	<i>e</i>	.102	
Maps ..	084	<i>f</i>	.40	
Diagrams ..	02	<i>g</i>		
Guide books ..		<i>g</i>	.3	
Memorial volumes ..		<i>j</i>	.628	
Cyclopaedias ..	03	<i>k</i>	.2	.5
Dictionaries ..	03	<i>k</i>	.2	.5
Concordances ..	03	<i>k</i>	.53	
Learned societies ..	06	<i>l</i>	.6	.8
Periodicals ..	05	<i>m</i>	.7	.7
Yearbooks ..		<i>n</i>	.55	.6
Directories ..	05	<i>n</i>	.52	.6
Calendars ..		<i>n</i>	.23	
Almanacks ..	059	<i>n</i>	.24	
Conferences, Congresses, Conventions ..	063	<i>p</i>	.702	
Bills ..		<i>q</i>		
Acts ..	00037	<i>q</i>	.785	
Codes ..		<i>q</i>	.74	
Reports (periodical) ..	00039	<i>r</i>	.786	
Statistics ..	00031	<i>s</i>	.101	
Commissions, Committees (ad hoc) ..	061	<i>t</i>	.766	
Surveys ..		<i>u</i>	.286	
History ..	09	<i>v</i>	.10	.4

Common Subdivisions	Decimal classi- fication	Colon classi- fication	Subject classi- fication	Expan- sive classi- fication
Biography	.. 092	tw	.41	.3
Collections	.. 08	x	.8	.9
Selections	.. 08	x	.967	
Scope	.. 011	y1		
Syllabus	.. 02	y2	.850	
Catechism	.. 0761	y5	.663	
Case study	.. 092	y7		
Experimental study	.. 072	y8		
Digests	.. 02	z	.3	
In the form of fiction	..	z3	.941	
Parody	.. 0883	z4	.948	
Adaptation	..	z5		
Symposia	.. 08	z7		
Essays	.. 04	z7	.954	
Lectures	.. 04	z7	.67	
Criticism	..	.9		

WHY?

The need for Common Subdivisions, or Form Divisions as they are also called, is set forth as follows by W. F. Wright¹:—"In whatever detail the classification scheme may be drawn up, however, there always comes a time when further subject division, although it is highly desirable, is impossible. In one particular library, for instance, in the subject "Steam Engines and Engineering," after very close subdivision and the placing out of works in this section to 79 specific heads there still remain 280 works which cannot be further subdivided by subject. Such grouping occurs in all libraries which have a comprehensive collection of works on any important subject. Obviously it is laborious for any reader to have to wade through such groups of works. If he is interested in the economics of the subject then tables and catechisms will be of no use to him; if he is studying its history then he should be able to find at once works already written on the subject from this point of view. To place directly at his disposal exactly what he wants resort is had to further division according

¹ *Library world*. V. 39. 1937. Pp. 204-205.

to the form in which the works are presented. In the example cited the works are divided into ten form classes so removing 130 from the main group of "general treatises" and putting together and making immediately available works treating the subject from the particular aspect in which the reader is interested.

"Division of works according to their form may be called 'second-stage' classification."

"Form headings, then, because they are a part of all classification schemes and are repeated under all headings of importance in every scheme, play a major role in classification. The value of any scheme is considerably affected by the way in which the form headings are drawn up and by the ease with which allocation of matter to them can be effected."

How?

This idea is behind the following rules of the Colon Classification:—

"Subdivisions which occur in many classes may be termed Common Subdivisions.

"There are certain subdivisions which may occur in many classes, for example, we may have to provide for the subdivisions:—bibliography, biography, collected works, conference, history and so on in the case of many classes. Subdivisions of this nature which are likely to occur in many classes shall be called Common Subdivisions. It will be convenient if the same Common Subdivision is always represented by the same symbol in all cases. The mnemonic table of Common Subdivisions is built up with this object in view and has been included among the preliminary tables.

"It is not maintained that every one of these Common Subdivisions will be applicable to every class. All that is intended is that they may be applicable to many classes. For example, Bv is History of Mathematics, Pv is His-

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rules 2 to 23 and their commentaries.

tory of Philology, Xv is History of Economics, C5M95v is History of the Physics of X-rays, PIII:Jlv is History of the Phonology of Modern English.

"In certain subjects, some of the symbols used in this table will be given a special meaning. For example, in Literature *c* will stand for 'Index of titles' and *e* will stand for 'Index of first lines'. In Philology *z* will stand for 'Comparative genetic study'. Such special use of the symbols of the Schedule of Common Subdivisions will be indicated in subsection '8' of the chapters dealing with the respective subjects.

"Any class number may, if possible, be amplified by the addition of a Common Subdivision Number, which shall consist either of a single Common Subdivision digit or of that digit further amplified.

"The Class Number is to be worked out to the fullest extent admitted by the book before it is amplified by a bare or amplified Common Subdivision Number.

"The manner in which each Common Subdivision digit is to be amplified is given in the succeeding rules of this chapter. In most of these Rules the terms *Chronological Device* and *Geographical Device* will appear. Their meaning will be found in Chapter 6 of this Part."

The table of common subdivisions given in the preceding pages shows the extent to which the Canon of Common Subdivisions is satisfied by the four schemes.

DISTINCTIVENESS

(i) With regard to the Canon of Distinctiveness, the Decimal Classification seeks to satisfy it by beginning all common subdivisions with a zero. The Colon Classification begins them with lower case letters except in the case of criticism and the Subject Classification begins them with a dot. In the Expansive Classification, distinctiveness is got by change of species. The first-stage part consists of letters and the second-stage part, of numerals.

EXHAUSTIVENESS

(ii) With regard to the Canon of Exhaustiveness, it is not possible to anticipate and exhaust all possible forms and common subdivisions. All that can be done is to make provision for new forms to be accommodated in a filiatory manner as and when they take shape. The 13th edition of the Decimal Classification has begun to do this by decimal interpolation. The other schemes admit of the same device.

INDIVIDUALISATION

(iii) In the amplification of a class number by certain common subdivisions—*e.g.*, societies, periodicals, directories, conferences, commissions, surveys, history, biography, and so on—the Colon Classification differs from the other schemes in one respect. In the other schemes there is no special provision, for example, for individualising the several periodicals, commissions, surveys and so on in the same subject. In the Colon Classification we find a definite set of rules,¹ for individualising them. The Geographical and the Chronological Devices of the Scheme play a large part in this individualisation in conformity to the Canon of Helpful Order, the Canon of Hospitality in Array and the Canon of Mnemonics. A few examples will make this clear:—

Sec. No.	Work	Decimal Classification	Colon Classification
1	<i>Transactions</i> of the Bose Research Institute (Calcutta) (Founded in 1917)	506	Am44:N17
2	<i>Current science</i> (India) (Commenced in 1933)	505	Am44:N33
3	<i>Rendiconti</i> d. R. Accademia Nazionale d. Leinci (Rome) Klasse d. Scienze Fisiche, Matematiche e Naturali (Founded in 1603).	506	Am52:K03

¹ Ranganathan (S. R.): *Colon classification*. 1933. Chap. 2.

Ser. No.	Work	Decimal Classi- fication	Colon Classi- fication
4	<i>Comptes rendus d.L' Academie d. Sciences (Paris) (Founded in 1666)</i>	506	Am53:K66
5	<i>Naturwissenschaften. (Germany) (Commenced in 1913)</i>	505	Am55:N13
6	<i>Philosophical transactions of the Royal Society (London) (Founded in 1660)</i>	506	Am56:K60
7	<i>Proceedings of the Royal Society</i>	506	Am56:K601
8	<i>Scientific American (Commenced in 1845)</i>	505	Am73:M45
9	<i>Report of the Indian Education Commission of 1882</i>	370'61	T144:M82
10	<i>Interim report on the review of education in British India by the Indian Statutory Commission (of 1928)</i>	370'61	T144:N28
11	<i>Report of the Travancore Education Reforms Committee (of 1932)</i>	370'61	T14422:N32
12	<i>The next step in education being a report of a Committee (of 1926) consisting of Haldane and others</i>	370'61	T156:N26
13	<i>Report of the Mosley Educational Commission (of 1903) to the United States of America</i>	370'61	T173:N03
14	<i>Altekar (A.S.): Education in Ancient India. 1934</i>	370'954	Tv44:H8
15	<i>Basu (B.D.): History of education in India under the rule of the East India Company. 1922</i>	370'954	Tv44:M5
16	<i>McKee (W.J.): New schools for young India. 1930</i>	370'954	Tv44:N2
17	<i>Ward (H.): Education system of England and Wales. 1935</i>	377'954	Tv56:N3
18	<i>Report of the National Academy of Sciences (United States) (Founded in 1863)</i>	506	A173:M63r

Ser. No.	Work	Decimal Classification	Colon Classification
19	<i>Register of fellows, associates and students of the Institute of Chemistry of Great Britain and Ireland (Founded in 1877)</i>	540.6	E156:M77n
20	<i>History (1877-1914) of the Institute of Chemistry of Great Britain and Ireland</i>	540.6	E156:M77vN1

DECIMAL v. COLON

A comparison of the Class Numbers according to the Decimal Classification and the Colon Classification will show the greater analysis to which the Common Subdivisions are subjected in the latter. The Class Numbers of the Decimal Classification are of greater extension than the titles represented by them; whereas the extension and the intension of the class numbers of the Colon Classification exactly fit the titles. In other words, whereas the Colon Classification represents the *ultimate classes* of the works, the Decimal Classification stops considerably short of their *ultimate classes*.

The last three examples further show that in the Colon Classification common subdivisions can be repeatedly applied, if warranted, until the requisite intension is reached to give full satisfaction to the Canon of Hospitality in Chain.

In fact, to quote the *Library Association record*, the Colon Classification "has aimed to secure the expressiveness of Brussels with the briefest notation."¹

THE CONGRESS CLASSIFICATION

So far as periodicals are concerned, the Congress Classification attempts to go a little further than the Deci-

¹ *Library Association record*. Fourth Series. V. 1. 1934. P. 98.

mal Classification. It usually divides periodicals as follows:—

- | | |
|----------------------|----------|
| 1 American & English | 3 German |
| 2 French | 4 Other |

EXCLUSIVENESS

(iv) With regard to the Canon of Exclusiveness, we depend on careful definition of the terms used to denote the Common Subdivisions. But as Wright points out, none of the schemes, except the Classification Decimale of the International Institute of Bibliography, gives full and explicit definitions. But much can be inferred with the aid of the Canon of Context. In the case of the Colon Classification, the specifications for amplifying the Common Subdivision digits found in the rules of chapter 2 indicate the definition in the majority of cases.

PERMANENCE

(v) With regard to the Canon of Permanence, reference has already been made, while discussing this Canon in chapter 2, to the difficulty caused by the form divisions "Societies" and "Periodicals". As stated there, the violation of this Canon involved in their use, is due to the force of blind tradition that crept in from the first edition of the *Decimal classification*.

It is rather disappointing that the otherwise excellent exposition of the standard headings by Wright¹ simply recommends the perpetuation of the inconvenient old tradition, without recognising the violence it does to the Canon of Permanence.

To set this matter right, the forthcoming edition of the *Colon classification* has modified the definition of these common subdivisions so as to read as follows:—

"Rule 2 l: The term *Society* is used to denote a Learned Society or an Institution founded and maintained for the pursuit of one or more branches of knowledge. The digit *l* (the symbol for societies) is to be used in the case of a book or a report which gives an account of a Society. But

¹ *Library world*. V. 39. 1927. P. 237.

in the case of occasional publications and periodicals issued by a Society on the subject-matter falling within its sphere, the digit *l* is not to be used. Such publications are to be treated as ordinary books or periodicals as the case may be. The class numbers of such books are not to be amplified by *l* while the class numbers of the periodicals are to be amplified by *m* (the symbol for periodicals)".

Rules 2/1, 2/2, 2/3, 2/4 are consequently deleted.

For fixing the epoch in order to construct the Chronological Number amplifying *m*, the last sentence of Rule 2*m* is modified so as to read:—

"The year in which the periodical was commenced is to be used as the epoch if it is not published by a Society. If it is published by a Society, the year in which the Society was founded is to be used as the epoch. If the Society publishes two or more periodicals on the same subject, the Chronological Number of the first periodical needs no alteration; but the digit 1 is to be added to the Chronological Number in the case of the second periodical, the digit 2 in the case of the third periodical and so on. The purpose of the last mentioned provision is to keep together all the periodicals published by a Society on one subject."

PERMANENCE AND RETICENCE

There is one practice of the Congress Classification in regard to common subdivisions which calls for special notice. Specifications like the following frequently occur:—

General works	Elementary text-books
General treatises	Popular works
Comprehensive works	Minor works
Advanced text-books	Descriptive works

The first four common subdivisions do not appear to be quite distinct from one another and hence, if used in the amplification of one and the same class, would violate the Canon of Exclusiveness. If they are intended to possess shades of difference, these are not rendered explicit.

The last five common subdivisions come into conflict with the Canon of Reticence as well as the Canon of Per-

manence. A term like "Minor" is certainly critical. The fixing of standard implied by these terms is bound to vary with time and place. What is regarded as elementary by one library may be advanced for another. Even in the same library the standard will vary with time. Time was when the first three books of Euclid's *Elements* were advanced, though they are now elementary.

FOURTH-STAGE CLASSIFICATION

There is no doubt that distinctions like the above may be helpful in a *particular library* at a *particular time*. But it is not proper that a convenience, which involves change more frequently than a Scheme of Classification, should be served by the Class Number, which should be relatively more permanent. The right thing is, not to requisition the services of classification, not even those of the "second stage" classification (common subdivisions), but to improvise a temporary "fourth stage" classification.¹

A method of doing this by temporary extra symbols has been indicated by the author in another book. A better plan is to recognise that matters of this nature fall within the sphere of the Reference Staff rather than that of the classifier. The Reference Staff and the Shelf Section Staff should be left to deal with this "fourth stage" classification, manipulating the temporary extra symbols and, wherever necessary, dividing the resources into different sequences according to the standards obtaining for the time being, and changing the temporary extra symbols and the sequences as the standards change.²

ANTERIOR POSITIONS

It was Bliss who suggested the name Anterior Subdivisions for the Common Subdivisions. He justifies this appellation as follows³:—"It seems more convenient to

¹ In anticipation of the latter part of this chapter, it may be mentioned here that "third stage" classification is concerned with the individualisation of books having the same ultimate class.

² Cf. Ranganathan (S. R.): *Library administration*. 1935. (Madras Library Association Publication Series, 5). Chap. 8.

³ Bliss (Henry Evelyn): *A system of bibliographic classification*. 1935. P. 15.

collocate the general treated generally with the general treated specially, and to follow that with the special treated generally, than it would be to interpose the large mass of miscellaneous and auxiliary material between the general and the closely related subordinate special items.... Many classifiers will agree with the reasons stated above and will place these (miscellaneous and auxiliary) items anterior to the general subject and its specific subdivisions.... In the order of books or cards correlatively to the notation, it seems more convenient to have the reference, auxiliary, and miscellaneous items of general scope precede the special and to avoid placing them between the general subject and the special treatment of it, followed by the general treatment of its special branches.... The anterior position for them (reference, miscellaneous and auxiliary items) is the more distinctive as well as the more convenient."

DECIMAL CLASSIFICATION

(i) In the Decimal Classification, commencement of the Common Subdivision numbers with the digit 0 interpolates them between the main class and its subordinate classes. It fails to secure "anterior positions" for the common subdivisions.

COLON CLASSIFICATION

(ii) But in the Colon Classification, the rule which says that "Any number followed by a small letter shall have precedence over the number itself"¹ is calculated precisely to secure "anterior position" for the common subdivisions.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification application of the categorical numbers does not procure anterior places for class numbers amplified by Common Subdivisions. They come only between the general and the subordinate classes.

CONGRESS CLASSIFICATION

(iv) In the Congress Classification there is no uniformity of practice with regard to the position of classes of

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rule 0241.

Common Subdivisions. Some classes occupy anterior positions and some posterior.

Examples:—In the subject QC Physics, QC20—QC25 represent general works.

(a) The following Common Subdivisions occupy anterior positions, as their class numbers show:—

- QC1 Periodicals, Societies, etc.
- QC3 Collected Works
- QC5 Dictionaries
- QC6 Philosophy. Relativity
- QC7 History
- QC15 Biography of Physicists. Collective
- QC16 Biography of Physicists. Individual

(b) The following Common Subdivisions occupy posterior positions, as their class numbers show:—

- QC30 Study and teaching
- QC31 Outlines, syllabi, etc.
- QC32 Problems, exercises, etc.
- QC33 Experiments
- QC35-41 Laboratory manuals
- QC51 Laboratories
- QC53 Instruments and Apparatus
- QC61 Tables, Formulae, Symbols
- QC71 Essays, Lectures, Addresses, etc.

BOOK NUMBERS

A seventh additional canon is necessitated in the Special Theory of Book Classification, on account of the seventh peculiarity of the Universe of Books. There may exist in a library many books, many volumes of a book and many copies of one and the same book or of one and the same set of volumes embodying knowledge of a given class. These books cannot be differentiated among themselves and arranged in a definite order by any further subdivision of Knowledge. They will, therefore, have to be subdivided, not on the basis of subject-matter, viewpoint or expository form, but on the basis of other appropriate characteristics or trains of characteristics. Hence the canon:—

4. A Scheme of Book Classification should be provided with a Scheme of Book Numbers to individualise books all of which have the same class of knowledge as their Ultimate Class.¹

This may be referred to as the CANON of INDIVIDUALISATION.

To make this canon easily intelligible, the definition of ultimate class is here reproduced:—

By the ULTIMATE CLASS of a book is meant the class of the least extension and the greatest intension in the basic Scheme of Knowledge Classification in which it may be placed.

In conjunction with this definition of Ultimate Class the canon under consideration implies that:—

The Book Number takes up the individualisation of books at the point where the Class Number has to leave it as beyond its power.

or in other words

The Book Number represents "Third-stage" Classification, the Second-stage having been represented by Common Subdivisions as already stated.

There are different views and different practices with regard to this canon.

COMMONSENSE VIEW

There is first the commonsense view recorded by Brown in the following words: "Perhaps the most sensible and straightforward way to distinguish books from each other is to rely entirely upon the class number or symbol, plus the lettering on the books themselves. For whatever purpose required it seems much simpler to arrange books on shelves, in charging systems, in catalogues, or anywhere else, in a plain and easy sequence of author's names in alpha-

¹ Ranganathan (S. R.): *Colon classification*. 1933. Rule 03.

betical order, under each division or subdivision of a class or subject."¹

As against this, we have the following opinion of Bliss: "Some librarians . . . regard all such notation (Book Number) unnecessary. On the contrary it appears that the lack of internal notation (Book Numbers) in one of the great American libraries makes designation and location of its books very difficult, slow and uncertain."²

Our own experience inclines us to uphold the view expressed by Bliss.

Sayers does not appear to express an opinion on this matter. But from the fact that he devotes some pages to the construction of Book Number in both his books, we may, perhaps, infer that the Canon of Book Number has his support.

Assuming the need for Book Numbers, we may say that two different practices are current. The first practice uses the author's name, and the second, the date of publication, for individualising books having the same ultimate class.

The first practice occurs in different forms.

AUTHOR MARKS

The first form is described by Sayers in the following words:—"When the whole question of author marks has been considered, we think something may be said for using the first three letters of the author's name, without any further refinements; at least where the books are not charged by combined class-marks and author numbers."³ But it is obvious that this simple type of Book Number cannot individualise

- (1) different copies of the same book;
- (2) different editions of the same book;

¹ Brown (James Duff): *Subject classification*. Edn. 2. 1914. P. 26.

² Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. 1934. P. 68. (Words within brackets are mine).

³ Sayers (W. C. Berwick): *Introduction to library classification*. 1935. P. 65.

- (3) different volumes of a multi-volumed book; and
- (4) books by different authors the first three letters of whose names are identical.

Thus, this practice does not satisfy the Canon of Individualisation to the fullest extent.

AUTHOR NUMBERS

The second form of using the author names to construct the Book Number depends on the "Invention of translation systems by which a name is represented by its initial, with remaining letters translated into numbers, *e.g.*, Freeman, F85."¹

CUTTER NUMBERS

The most widely used of these translation systems is that of the Cutter-Sanborn Numbers. Here is an example of such numbers.²

Ab2	Abbot	Sal	Saint
Al2	Aldridge	Swl	Swain
G16	Gardiner	Sch51	Schneider
G42	Gilman	Sch86	Schwartz
G76	Graham		

MERRILL NUMBERS

Another translation system is that of the Merrill Numbers of which the following is a sample.³

01	A	10	Bix
02	Agre	11	Bou
03	Als	12	Brim
04	Ap	13	Bum
06	B	14	C
07	Ban	15	Carr
08	Bax		

¹ Dewey (Melvil): *Decimal classification*. Edn. 13. 1932. P. 32.

² Sayers (W. C. Berwick): *Introduction to library classification*. 1935. P. 63.

³ Sayers (W. C. Berwick): *Introduction to library classification*. 1935. P. 64.

The Jast Numbers and the Brown Numbers also satisfy the same purpose.

But in all these cases, most of the objections already enumerated with regard to the use of the first three letters of author's names continue to hold good.

BISCOE NUMBERS

With regard to the second practice of constructing Book Numbers, which depends upon the date of publication, the Biscoe Numbers were invented in 1885. The Biscoe table is as follows¹:—

A	Before Christ	J	1830 to 1839
B	0 to 999	K	1840 to 1849
C	1000 to 1499	L	1850 to 1859
D	1500 to 1599	M	1860 to 1869
E	1600 to 1699	N	1870 to 1879
F	1700 to 1799	O	1880 to 1889
G	1800 to 1809	P	1890 to 1899
H	1810 to 1819	Q	1900 to 1909
I	1820 to 1829	R	1910 to 1919

A book is numbered with the letter and the year number, centuries being ignored. When more than one book in the same class calls for the same number, these numbers are differentiated by adding lower case letters.

This system certainly satisfies the Canon of Individualisation more fully than the system of author numbers. But even here there is apparently no provision for individualising the different volumes of a multi-volumed book.

BOOK NUMBERS OF THE COLON SCHEME

Another form of the second practice is that developed in the *Colon classification*.² In this form, "the Book Number may consist of one or more of five parts, *viz.*, the Language Number, the Date Number, the Accession Part of the Book Number, the Volume Number and the Supple-

¹ Brown (James Duff): *Subject classification*. Edn. 2. 1914. P. 29.

² Chapter 03.

ment Number. These parts are to be written in the order given above without interspace between the parts."¹

This rule implies that six different characteristics are used to construct the Book Number. While the use of these six characteristics ensures complete satisfaction of the Canon of Individualisation in every possible case, in most cases the Book Number consists of only two digits.

An additional result aimed at by this system of Book Numbers is that books having the same Ultimate Class are first separated and grouped by their language and the books within each language group are then arranged chronologically. This arrangement provides additional convenience to readers. Whenever the special circumstances of a library require the arrangement of books in parallel sequences according to language, this system of Book Numbers is of great help in the formation of such linguistic sequences and the merging of them into one sequence at pleasure, with the aid of the Principle of Parallel Movement.²

Further description of this system of book numbering may be found in Chapter 03 of *Colon classification*.

Apart from the question of complete individualisation, any system of Book Numbers which arranges books by date of publication will give greater satisfaction to the majority of readers than arrangement by author.

TO SUM UP

By Library Classification is meant minute classification of books on the basis of their subject-matter or the knowledge embodied in them, to facilitate the subject-approach which, as the Five Laws of Library Science have established, is most popular among readers.

A Scheme of Book Classification is a Scheme of Knowledge Classification provided with a scheme of common subdivisions (Second Stage Classification) and a scheme of book numbers (Third Stage Classification) capable of

¹ Rule 032.

² Ranganathan (S. R.): *Library administration*. 1935. Section 81, para. 15.

individualising every book in the Universe of Books. All the Three Stages of Classification should obey the Canons of Classification.

The Notation of the Scheme of Common Subdivisions (Anterior classes), the Notation of Book Numbers and the Notation of the Scheme of Knowledge Classification forming the core of the Scheme of Book Classification in question should be easily and automatically distinguishable one from the other either by the use of distinct symbols, or by the use of separating symbols, or by well-planned spacing.

Provision should also be made for other contingencies like Local Variation, Differences of Viewpoint and Filiation of Classics and their auxiliaries or commentaries.

No scheme has so far adapted its Notation to individualise classes of Partial Comprehension to the necessary extent, while the Congress Classification alone has provided a single place for all Partially Comprehensive classes under the term "General special," which closely follows the term "General".

PART II
COMPARATIVE STUDY

6. COMPARATIVE STUDY

LAY-OUT

This chapter is chiefly concerned with the lay-outs of five current schemes of classification. We will begin with a few introductory remarks about their origin.

THE DECIMAL CLASSIFICATION¹

Melvil Dewey the author of the Decimal Classification was born December 10, 1851 at the Adams Center, in Jefferson County, New York. His father ran a general store and made boots. While yet a boy, Melvil learned enough from the shoemakers to make a pair of shoes and boots for himself 'doing every bit of the work, from crimping to the final finish'. All kinds of jobs fell to his share—tidying the store, making shoes, cleaning the yard, picking up stones, ploughing the garden, cleaning the cellar and woodshed, spreading ashes on the meadow, splitting and piling wood, chopping up old boards, washing windows and cleaning the sewing machine. These odd jobs were punctuated with reading and chess.

With his accumulation of a little over ten dollars that he had gradually saved by running errands, shovelling coal and shoe-making, he walked eleven miles, while still under fifteen, to buy a book on which his heart had been set for several years—Websters' unabridged *Dictionary*.

ROMAN NOTATION ATTACKED

At 17, he became a teacher on 1:50 dollars a day. His first recorded commitment to Arabic numerals belongs to these pre-Amherst days. On April 13, 1870 he attacked the Roman Notation in the following words:—"The system itself is awkward in construction and almost *incapable of*

¹ This account is taken from Dawe (Grosvenor) *Comp.: Melvil Dewey, seer, inspirer; doer; 1851-1931. 1932.*

being used in rapid computations. On the other hand, we have, in the Arabic or Indian notation, a method of writing numbers, accurate, simple, and probably as nearly perfect as man can invent. *That*, awkward and ambiguous used only enough to compel everyone to be familiar with it; *This*, simple and accurate, in almost universal requisition. Why shall we not use it, then, exclusively."

DECIMAL CLASSIFICATION PROPOSED

Shortly after this he joined Amherst College. His strong subject was Mathematics. From 1872, he began to work in the library as a part-time assistant. His Decimal Classification plan was formally presented to the Faculty in May, 1873, while he was still a student. After his graduation, July 9, 1874, he became Assistant Librarian.

CAREER

Leaving Amherst on April 10, 1876, he settled down in Boston and during the next seven years loaded himself with too much responsible but unremunerative work. The Spelling Reform Association, the Metric Bureau, the American Library Association and the Library Journal were founded in 1876. He also took a leading part in the foundation of the British Library Association (1877), the Readers and Writers Company (1879) and the Library Bureau (1882). These multifarious activities brought him into the limelight. In 1883 he was called to Columbia College, where he stayed till 1888 as Librarian and Professor of Library Economy trying out all his theories. In January 1889, Dewey took up the duties of the Secretary of the Board of Regents of the University of the State of New York and also those of State Librarian at Albany. But the whole Albany period was characterised by a prolonged struggle with the authorities till it culminated in his premature resignation in September 1905 and his retirement to Lake Placid Club, where he stayed till his death on 26th December, 1931.

PUTNAM'S ESTIMATE

"Mr. Dewey eats, drinks, sleeps and talks library and library work throughout the twenty-four hours, the week,

the month and the year. His physical whereabouts at any one time is immaterial. He carries his business with him to his home; he brings it back with him in the evening and in the morning to his office. He is, in effect, as much engaged with it at Lake Placid as he is at Albany; it is as much his play as it is his work. He is the clearest example in our profession of a man who cannot shake off his business. . . . There is no man living to-day to whom more than to him is due the prodigious activity of the past quarter of a century in the promotion of libraries, and in the diffusion of interest in them. There is no one who has done more to stir with enthusiasm for practical library service competent people who are needed in it. His name is more widely known abroad than that of any other living American librarians, for his contributions to library technique and to the general acceptance of public libraries as a motive force in popular education."

GENESIS OF THE SCHEME

Dewey himself made the following statement in the *Library journal*. V.45. 1920:—

"In visting over 50 libraries, I was astounded to find the lack of efficiency, and waste of time and money in constant recataloguing and reclassifying made necessary by the almost universally used fixt system where a book was numbered according to the particular room, tier and shelf where it chanced to stand on that day, instead of by the class, to which it belonged yesterday, to-day and forever. Then there was the extravagant duplication of work in examining a new book for classification and cataloguing by each of 1,000 libraries instead of doing this once for all at some central point.

"For months I dreamed night and day that there must be somewhere a satisfactory solution. In the future were thousands of libraries, most of them in charge of those with little skill or training. The first essential of the solution must be the greatest possible simplicity. The proverb said "simple as a, b, c," but still simpler than that was 1, 2, 3. After months of study, one Sunday during a long sermon by Pres. Stearns, while I looked steadfastly at him

without hearing a word, my mind absorbed in the vital problem, the solution flashed over me so that I jumped in my seat and came very near shouting "Eureka"! It was to get absolute simplicity by using the simplest known symbols, the Arabic numerals as decimals with the ordinary significance of nought, to number a classification of all human knowledge in print."

This was in 1873.

FAVOURABLE FACTORS

While the scheme was still in manuscript, John Eaton, Commissioner of Education of the United States, who had a flair for publicity, included it in a special volume on *Public libraries in the United States* as part of his *Annual report* for the Centennial Exposition of 1876.

The Library Conference held at Philadelphia in the same year as a preliminary to the foundation of the American Library Association also very appropriately provided a platform for discussing the scheme and directing attention to it.

The Decimal Classification first appeared separately in 1876 as a thin pamphlet of 42 pages. It has now reached the 13th edition (1932) and runs to 1647 pages. From the fourth to the tenth edition, the editorial work was shared by Miss May Seymour, one of Dewey's students in 1887 and his chief assistant all through her later life. Since her death (June 14, 1921) her place has been taken by Dorcas Fellows, who had been closely working with her for over twenty-five years. The 13th edition, though technically posthumous, was as much the result of Dewey's immediate direction as if it had appeared during his life time; for the manuscript had been nearly completed before his death. Although during his later years, Dewey no longer sat at the desk and actually worked out the expansions himself, to the end of his life he gave effective supervision.

As already described in chapter 3, the Decimal Classification Numbers now appear on the Congress Cards and provision has been made for the perpetual revision of the scheme by an editorial office housed in the Library of Congress.

THE EXPANSIVE CLASSIFICATION¹

Charles Ammi Cutter, the author of the *Expansive Classification*, was born March 14, 1837 at Boston. His father was a dealer in fish oils on T Wharf in Boston. With a frail body and myopic eyes, which prevented him from taking part in boyish sports, all his time was spent in study and he entered Harvard College at the early age of fourteen and prepared for the church.

CAREER

After graduation in 1860, Cutter worked for eight years as an assistant in the cataloguing department of the Harvard College Library, which was then the largest American Library. The card catalogue prepared by him for this library is believed to have been the first public card catalogue in America. In 1868 Cutter became the Librarian of the Boston Atheneum which was a proprietary library of the best Boston families and a fine collection. This post he held till 1893. The most widely used of his works, the *Rules for a dictionary catalogue*, belongs to this period. On leaving the Boston Atheneum, Cutter became the first Librarian of the newly established Forbes Library at Northampton, Mass. He had a free hand in everything—book selection, book purchase, classification and cataloguing. He organised it on the most liberal lines and secured a greater daily attendance and a greater circulation per capita than any other library. Its books went everywhere. Cutter died September 6, 1903, having developed this library for ten years.

GENESIS OF THE SCHEME

About 1877, soon after the first conference of the American Library Association, Cutter began to re-arrange the Boston Atheneum Library. At first he was attracted by the Decimal Classification which had been published in the preceding year. But he gave it up saying, "I did not like (and I still do not like) Mr. Dewey's Classification". On the ground that its notation would not afford sufficient

¹ Cutter (William Parker): *Charles Ammi Cutter*. (American Library Pioneers, 3). 1931.

minuteness of classification, he started with the twenty-four letters of the Roman alphabet and ten classes with numeral notation. A fellow-librarian criticised it as having a 'cabalistic look'.

Eventually he fixed upon a letter notation for his main schedules and numerical notation for form and local lists. The Expansive Classification takes its name from the fact that it is developed in seven stages—the first, a very simple one, for the smallest library; the second, rather more complicated, for a slightly larger library, and so on. The first six expansions were printed in 1891-93. It is in use in about a hundred libraries in the United States. The seventh expansion has not been completed.

THE CONGRESS CLASSIFICATION

Unlike all other schemes, the Congress Classification is the creation not of a single person but of a team of workers in the Library of Congress. This Library, the National Library of the United States, was founded in 1800. During its first sixty-four years it had a very ordinary history. In 1864, Ainsworth Rand Spofford became its Librarian. In 1865 he introduced the card catalogue. By 1870 the library had attracted to itself several other collections and had taken up the whole copyright business of the United States. It began to grow up by leaps and bounds and a new building was occupied in 1897. When Herbert Putnam took charge on April 5, 1899, the library had a huge mass of books (750,000 volumes) ill-arranged on the century-old Jefferson's classification.

Dr. Herbert Putnam (1862-), a Harvard man, had already done solid organising work in the Minneapolis Athenaeum Library and Public Library (1884-1892) and reorganisation work in the Boston Public Library (1895-1899).

GENESIS OF THE SCHEME

One of his first acts was to make a new classification. As a trained administrator, he put himself at the head of a committee with Charles Martel, his classifier, and William

Parker Cutter, of the Order Section. This Committee made an extensive tour of libraries using either the Decimal Classification or the Expansive Classification. The Committee met the authors of the Schemes and suggested to them certain changes. Cutter agreed to them. But Dewey absolutely refused to make any change on the ground that it would inconvenience the large number of libraries already using his scheme. On the recommendation of Mr. Martel, the Committee decided to use the lay-out of the Expansive Classification. Unfortunately Charles Cutter died soon after this decision.

Martel planned to use two letters for the main divisions and decimal fractions for the subdivisions. But A. R. Spofford, the former librarian, who still continued on the staff as an assistant, bitterly opposed the inclusion of any decimal notation! He carried his point and the rigid integral notation came in to spoil what would otherwise have been the best scheme in existence, backed by all the prestige, man-power and resource of the most library-minded government in the world.

The schedules, which were issued from 1904, are now published in 28 volumes with quarterly supplements; these with the indexes, make a total of about 6,000 quarto pages.

THE SUBJECT CLASSIFICATION¹

James Duff Brown, author of the Subject Classification, was born November 6, 1862, at Edinburgh. After serving in bookshops for about three years, on Christmas Day, 1878, he joined the staff of the Mitchell Library, Glasgow, where he gained his library experience. In 1888 he assumed charge of the newly established Clerkenwell Public Library in London. The sixteen years he spent in that library were the most productive years. He introduced many innovations—open access was one of them—which have come to stay. He started the *Library world*. He was one of the first in his country to write systematic books

¹ This account is taken from Brown (James Duff) and Sayers (W. C. Berwick): *Manual of library economy*. 1920.

on Library Science. The *Manual of library economy* which came out in 1903 was encyclopædic in its range and still holds the field, thanks to Sayer's revision of it.

In 1904 he became the first Borough Librarian of Islington. The imprint of his personality and genius was still visible in that library when I had the privilege of studying its working in 1924. After a long illness which had set in as early as 1911, he died February 25, 1914.

GENESIS OF THE SCHEME

Although the Subject Classification took its final shape only in 1906, it had been conceived much earlier. In 1894 Brown placed before the British Library Association a new scheme of classification devised by him in collaboration with John Henry Quinn, the Librarian of Chelsea. Its inadequacy was soon discovered and Brown published a more expanded scheme in 1894 under the title *Adjustable classification*. When he found that even this scheme could not make headway against the Decimal Classification, which was slowly conquering England, he invented the Subject Classification and published it in 1906. It reached its second edition in 1914. A revised edition is now being undertaken by James Douglas Stewart, a nephew of Brown and Librarian of Bermondsey, who helped in preparing the first two editions.

THE COLON CLASSIFICATION

Having taught mathematics for seven years, the author spent a year in Great Britain in 1924-25 to acquaint himself with modern library methods, as required by the University of Madras, which had just then appointed him as its first librarian. After reading up the splendid literature on Library Science collected at the School of Librarianship of the University of London and doing intensive apprentice work in Croydon Public Libraries, he made an extensive tour of Great Britain, visiting all kinds of libraries and making a comparative study of their practice. This was of considerable educative value and suggested the formulation of an eclectic system of library economy.

THE GENESIS OF THE SCHEME

As for classification, he found the Subject and the Congress Schemes in use in just a few libraries and spent some time in examining them from the point of view of shelf-arrangement and their reaction on the classifiers and the readers. He found the Decimal Classification extensively used, but in almost every library considerably mutilated. He had always believed that there was nothing more pestering to a librarian than the recurring need to re-adopt a scheme already arbitrarily modified. Years later, this belief was corroborated by Melvil Dewey himself. In referring to the *Five laws of library science*, Dewey wrote to the author on September 5, 1931, "The most praktikal advys I fynd in the book is page 401, 'don't mutilate the skeme' and ending with 'wyzest thing is to adopt a tryd skeme as it is without modifying it here and ther.' As the author of the Decimal Classification now mor wydli used than all others combynd, I have naturali given special attention to this and I am firmlly convinst that 1 of the most serious mistakes is to waste tym & muni in 'improving' a classification skeme." Still, there was the fact that almost every library was "improving" the Decimal Classification. Why? There must be some fundamental reason for this.

A GREATER ZERO INVENTED

These experiences led the author to think that a change was necessary in the basic principles on which schemes of classification are founded. The first principle hit upon was the synthetic or Meccano principle. But notation proved a stumbling-block. One night the idea struck him that the class numbers were all merely *ordinal* numbers, not *cardinal* numbers, and that new ordinal numbers might be invented, though they would have no cardinal value. This immediately led to the corollary that the invention of an ordinal number lying between zero and unity—a greater zero so to speak—was all that was required to meet the situation. A single dot, the simplest symbol, having been put to another use by Dewey, the double dot or the colon was taken to represent the new zero.

A WARNING ACTS AS MAINSPRING

With this clue, it was but the work of a few days to design the lay-out, and construct the schedules of a few subjects as samples. At this stage, Mr. Sayers, whose lectures on Classification were a source of inspiration to the author, encouraged construction of a new scheme but gave a warning that struck home to the author's mind and had a steadying effect. He said in effect that schemes of classification might look all right in the Arrays of the lower Orders but as one penetrated to higher Orders—which were the *vital* ones—all kinds of surprises and insuperable difficulties would appear.

EXPERIMENTATION

With this warning, the author took an interleaved copy of the printed catalogue of the Madras University Library—a list of about 30,000 volumes—and experimented with the new scheme. Many surprises did appear. During the return voyage in July 1925, he was the only Indian on board the ship and he found it quite easy to spend the two weeks of the voyage in complete isolation revolving the “surprises and insuperable difficulties” in his mind. No books and no notes to consult and nobody to talk to—an ideal condition to grapple with ideas—and it did produce the desired result. Some tentative solutions were made. The moment he landed in Madras and resumed charge of the library, he began to handle by himself almost all the 30,000 volumes and in about a year the Colon Device took form. Tentative rules were framed. In those days, fortunately, the author had full freedom to dream, to do, to undo and re-do. The staff also was young and most loyal and participative. On the basis of the tentative rules, most of the volumes were classified and arranged on the shelves. Then open access was introduced and for months and months the reaction of the arrangement on the readers was carefully observed. Notes were taken of all untoward reactions and various adjustments were made. The other Devices began to appear in the mind in a nebulous form.

SUCCESS OR RUIN

But 1929 to 1931 were the most important years. The “surprises and insuperable difficulties” appeared at very

great depths and had to be dealt with. Months and months of concentration led to their slow but partial solution. The strain was becoming unbearable. Consciousness of the risk being taken in using the confidence of the Library Committee and committing the University often weighed upon the mind. This strain was further increased by the well-meant and wise advice that Dewey gave in one of his letters. He wrote "It is much wors to giv the tym and muni which everi librari so urjentli needs to devyz still another skeme. None will ever be made that is not justli subject to meni criticisms. The librari that adopts sum 1 skeme in print can blame all its shortcomings on the author. But if it makes a skeme of its own it is almost sure to spend a larj part of the tym needed for the presing work of the librari in devyizing, revyizing, and constantli arguing, and in trying to defend the inevitabl mistakes". This made the author say to himself "Either success or ruin. No half-way hereafter".

CRISIS AND SUCCESS

The crisis came one evening. The library had been closed at 5-30 P.M. It was 8 P.M. Still the author could not leave his seat. Many, many refractory problems began to surge through the mind like phantoms—now utter chaos—now some clearness—and so on. All of a sudden, everything arranged itself. The one Colon Device brought in its train seven other Devices. Once this was hit upon, everything came to the conscious level and could be handled and manipulated objectively—except the non-scheduled mnemonics, and the auto-bias device which became tractable only after the first edition was printed.

HELPFUL FACTORS

A favourable factor was that the author could count among his personal friends and former colleagues most of the members of the faculties of the constituent colleges. They were experts in their subjects and gave help ungrudgingly in the final shaping of the schedules in the various subjects. There also came another godsend. The Library School was started in 1929. Teaching the subject from year to year led to further clarification, progressive polishing and delicate adjustment of the many details.

The first edition came out in 1933 with 127 pages of rules, 135 pages of schedules and an index of 106 pages. The second edition is now under preparation and may come out in 1939.

First Order Arrays or Lay outs of

Decimal Classification	Colon Classification
0 Generalia	Generalia
1 Philosophy	A Science (General)
2 Theology	B Mathematics
3 Sociology	C Physics
4 Philology	D Engineering
5 Pure Science	E Chemistry
6 Useful Arts	F Technology
7 Fine Arts	G Natural Science (General)
8 Literature	H Geology
9 History	I Botany
	J Agriculture
	K Zoology
	L Medicine
	M Useful Arts
	N Fine Arts
	O Literature
	P Philology
	Q Religion
	R Philosophy
	S Psychology
	T Education
	U Geography
	V History
	W Politics
	X Economics
	Y Social Sciences (General)
	Z Law
Subject Classification	
A Generalia	
<i>Matter and Force</i>	
B-D Physical Science	
<i>Life</i>	
E-F Biological Science	
G-H Ethnology, Medicine	
I Economic Biology, Domestic Arts	
<i>Mind</i>	
J-K Philosophy and Religion	
L Social and Political Science	
<i>Record</i>	
M Language and Literature	
N Literary Forms, Fiction, Poetry	
O-W History and Geography	
X Biography	

Five Schemes of Classification

Congress Classification	Expansive Classification
A General Works	A General Works
B Philosophy	B Philosophy
C History-Auxiliary Sciences	C Christianity
D History and Topography (excluding America)	D Historical Sciences
E America (General) and U. S. (General)	E Biography
F United States (local) and America outside of U. S.	F History
G Geography	G Geography
H Social Sciences	H Social Sciences
J Political Science	I Sociology
K Law	J Civics
L Education	K Legislation
M Music	L Sciences and Arts
N Fine Arts	M Natural History
P Language and Literature. Literary history	N Botany
Q Science	O Zoology
R Medicine	R Useful Arts
S Agriculture, Plant and Animal industry	S Constructive Arts
T Technology	T Fabricative Arts
U Military Science	U Art of War
V Naval Science	V Athletic and Recreative Arts
Z Bibliography and Library Science	W Fine Arts
	X Language
	Y Literature
	Z Book Arts

TERMINOLOGY

Before examining the first order arrays of the five schemes of classification in the light of the canons appropriate to arrays, with the help of the Canon of Enumeration we must make clear what is comprised in such of the classes as have unusual or ambiguous names.

1. In the Decimal Classification

(1) 0 Generalia includes 010 Bibliography and 020 Library Economy.

(2) 3 Sociology comprises 310 Statistics, 320 Political Science, 330 Political Economy, 340 Law, 350 Ad-

ministration, 360 Associations, 370 Education, 380 Commerce and 390 Customs.

(3) 5 Pure Science comprises 510 Mathematics, 520 Astronomy, 530 Physics, 540 Chemistry, 550 Geology, 560 Palaeontology, 570 Biology, 580 Botany, 590 Zoology.

(4) 6 Useful Arts comprises all the applications of Sciences.

(5) 9 History comprises 910 Geography, 920 Biography and 930-990 History.

2. In the Colon Classification

(1) Generalia includes 1 Bibliography and 2 Library Science.

(2) F Technology comprises only Chemical Technology.

(3) G Natural Science (General) includes Biology.

(4) M Useful Arts includes Recreative Arts and all applications of Sciences except Engineering, Technology, Agriculture and Medicine.

(5) U Geography includes U28 Meteorology.

(6) Y Social Sciences (General) includes Y1 Sociology.

3. In the Subject Classification

(1) A Generalia comprises A0 Generalia, A1 Education, A3 Logic, A4 Mathematics, A6 Graphic and Plastic Arts and A9 General Science.

(2) B, C, D, Physical Science includes among other things Engineering, Music, Astronomy, Meteorology, Geology, Chemistry and some Useful Arts.

(3) G, H Ethnology and Medicine includes Recreative Arts.

(4) I Economic Biology includes most of the Useful Arts.

(5) L Social and Political Science includes Economics.

(6) M Language and Literature includes Bibliography, Book Production and Library Economy.

(7) X Biography includes Heraldry.

4. In the Congress Classification

(1) B Philosophy includes BL Religion.

(2) G Geography includes GN Anthropology and GV Sports and Amusements.

(3) H Social Sciences comprises HA Statistics, HB-HJ and HX Economics and HM-HY Sociology.

(4) J Political Science includes JF-JQ Constitutional History and JX International Law.

(5) Q Science includes QM Human Anatomy, QP Physiology and QR Bacteriology.

(6) T Technology includes all applied Sciences.

5. In the Expansive Classification

(1) B Philosophy includes BR Religion.

(2) M Natural History includes Geology and Biology.

(3) V Athletic and Recreative Arts includes Vv Music.

Now the following table gives the percentage of the classes of the first array that are self-explanatory and do not require any special elucidation in the five schemes:—

Decimal Classification	Colon Classification	Subject Classification	Congress Classification	Expansive-classification
40%	70%	36%	71%	87%

Hence from the point of view of the Terminology of the First Order Array the five schemes may be arranged in the following order of satisfactoriness:—

1. Expansive Classification.
2. { Congress Classification.
 { Colon Classification.
3. Decimal Classification.
4. Subject Classification.

EXHAUSTIVENESS

All the schemes *formally* satisfy the canon of exhaustiveness with equal efficiency so far as the First Order Array is concerned by the provision of classes, which appear, from their names or otherwise, to be residual classes.

Examples:—

(1) In the Decimal Classification, the classes 0 Generalia, 3 Sociology, 5 Pure Science and 6 Useful Arts are residual.

(2) In the Colon Classification, the classes Generalia, A Science (General), G Natural Science (General), M Useful Arts, Y Social Sciences (General) are residual.

DECIMAL CLASSIFICATION

But the canon of exhaustiveness is not *actually* satisfied by the Decimal Classification.

This is due to the fact that its notation limits the number of classes in any array to 10. The second order arrays of all its residual classes have exhausted all the ten classes. Hence, any new subject that crops up cannot be accommodated in a natural way. It has to be squeezed in somewhere like an unwanted stranger.

SOCIOLOGY

Examples:—

(1) If we remember that the term Sociology is used in the scheme in the sense of Social Sciences, there is no place for the new subject "Sociology" (proper) that has taken shape in recent years. The nebulous subclass 360 Associations, which includes Insurance and the subclass 390 Customs may accommodate part of "Sociology", though even these classes are not placed contiguously. But what about other branches of "Sociology" like "Social Pathology"? Again, topics dealing with man in society, like Prehistoric Archaeology, Ethnology, and Anthropology, have to find shelter under 570 Biology, which is strictly the pure science

of living organisms, their ontogeny and philogeny, and has nothing to do with social life in groups.

FORESTRY

(2) The situation is even worse and almost borders on the ridiculous, in the case of the ancient subject of Forestry, which is given the ninth place under the class 634 Fruits and is closely followed by the class 635 Kitchen gardens in 630 Agriculture. But perhaps true to the tradition that forestmen are a rough, hardy, undaunted folk who would make themselves at home and live a full life in any environment whatever, the divisions thrown forth by 634·9 Forestry are amazingly many. And conscious, perhaps that the forces of law and order cannot penetrate far into forests, these Robin Hood divisions have kidnapped into their midst quite a rich caravan from Civil Engineering. Its members are covered by the numbers 634·9285 Mensuration to 634·9365 Domestic waterpower development! This range, which includes Surveying, Road and Bridge Construction, Electric Construction and Hydraulic Engineering, is secretly embedded between 634·9284 Forest Finance and 634·94 Forest Botany.

BIOCHEMISTRY

(3) When we examine the treatment given to the infant science Biochemistry, the whole thing becomes most pathetic. Biochemistry occurs in the index in the last line of page 1048 of the thirteenth edition in black face against the class number 574·19. The line just below it at the foot of the page announces in black face: "Topics in black face type are subdivided." Filled with hope, we turn to 574·19. But 575 closely follows 574 Physiologic and Structural Biology, Natural History, with only a two-line note in small type reading "Subdivided when wisht like 581 and 591; but class Phylogeny on 575, Variation on 575·2, Ecology on 575·3, Abiogenesis on 576·1, Cytology on 576·3". There is no 574·19 Biochemistry visible anywhere!

Undaunted however and ardently wishing to subdivide 574 like 591 we turn to 591 to see what 591·19 is like. But we find only the bald single line "591·19 Physiologic chemistry", traitorously forgetful of the promise about

subdivision. But if Zoology, the science of animals, fails us, let us see if at least the plants will not behave better. We look up 581.19. It is also labelled "Physiologic chemistry". But it has five subdivisions:—"192 General chemic composition, 193 Ferments and fermentation, Enzymes and catalysis, 194 Hormones. Vitamins, 196 Internal reaction, 197 Special products. Divided like 547 Organic chemistry"—a haphazard, make-believe, made-up affair!

Poor Biochemistry!—accustomed to extravagant fondling everywhere except in the Decimal Classification! Biochemistry can't get its rightful place in its paternal home 540 Chemistry, since Chemistry has already dispensed its ten places in a most erratic way, giving three (543, 544 and 545) to a single child—Analytical chemistry—and two others (548 and 549) to relations of doubtful affinity—Crystallography and Mineralogy, which more appropriately belong to the next door neighbour 550 Geology.

(4) In using the Procrustean decimal bed, all the available places have already been used up in 3 Sociology, 5 Pure Science and 6 Useful Arts and in their respective first arrays as well. It is a problem how any new Science or a new Application of Science, with an individuality of its own and coordinate with but not subordinate to the existing classes, is going to be accommodated. The merciless dismemberment of Sociology proper, the strange neighbours provided for Forestry and the step-motherly treatment given to Biochemistry are not encouraging auguries for the future.

COLON CLASSIFICATION

On the other hand most of the residual classes of the Colon Classification are meant to accommodate new subjects of a coordinate status that are likely to come into existence in future. Further, the Octaval feature of its notation, already explained, makes it possible to satisfy the Canon of Exhaustiveness not only *formally* but also *actually*.

CANON OF EXCLUSIVENESS

The Canon of Exclusiveness is generally satisfied by all the schemes. This is secured by the use of the Canon of Context. Occasionally, the Decimal, the Colon and the Congress Classifications add special notes to classes to clear up false appearances of overlapping.

HELPFUL ORDER

With regard to the Canon of Helpful Order, the First Order Arrays of all the schemes of classification cannot be said to come out equally well.

DECIMAL CLASSIFICATION

(1) Sayers has given a clever explanation of the order of the First Order Array of the Decimal Classification on developmental grounds in the following terms¹:—"The Dewey Classification must be regarded from the inside; and the characteristic of development is that of *mental perceptions*, if I may say so. Thus: let Generalia be chaos from which all things were drawn, and the prime thing drawn by man from that chaos—the characteristic which (as Richardson says) made him man—was reason, or Mind! We write down *mind* as our first class, *i.e.*, Philosophy. As soon as man can reason, as we see in the earliest questions of the child, he asks who made him, and deduces (and by revelation, if we accept it, is made certain of) a Divine Power over all things, which he worships. Hence we write down his second achievement as Religion. These things man has achieved in solitude, it may be presumed; but man multiplied, and formed the family, the tribe, and much later, the state. Hence this third achievement was what we write of as Sociology. For intercourse with other men his first requisite was language—merely a spoken one at first—hence what we name Philology. One can see how a knowledge of his environment followed as a necessity—Science; how he

¹ Sayers (W. C. Berwick): *A manual of classification*. Pp. 53-54.

adapted what he learned first to the sustaining of life—Useful Arts; and then to its beautifying—Fine Arts; and finally, how he made all his records through language—Literature and History.”

But there is no doubt much also in the remarks¹ of Bliss according to whom

(1) “No good reason can be found for” separating 4 Philology from 8 Literature.

(2) “Hardly less wry is the separation of Sociology in Class 3 from History in Class 9, whatever may be the point of view. . . . In view of modern studies it is wholly perverse.”

Bliss concludes with the rather severe stricture that these “Major separations are enough to disqualify any system as an organisation of knowledge, whatever the point of view may be. They are consistent with none of the comprehensive modern views.”

COLON CLASSIFICATION

(2) The helpfulness of the order of the classes in the First Order Array of the Colon Classification can be shown as follows:—

Out of the twenty-six classes represented by capital letters the first thirteen comprise the Sciences and their Applications, while the last thirteen comprise the Humanities.

Taking the Sciences, let us start with B. It is Mathematics, the purest of *pure* sciences, which is used as a tool in most of the other subjects.

Then follows C Physics, which uses Mathematics to elucidate the general (as distinguished from specific) properties of matter and energy. Next in order comes D Engineering which applies B Mathematics and C Physics so largely. Then comes E Chemistry which deals with the specific properties of substances (as distinguished from undifferentiated matter which is the province of C Physics). This class is followed by its application F Technology.

¹ Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. Pp. 203-204.

C—F constitute Physical Sciences and their applications.

Next, the element of life is introduced and we have Natural Sciences represented by the classes G—L.

Let us begin with H Geology which deals with the vestiges of old and extinct forms of life, and with the Earth, the scene of life. Coming to contemporary forms, we begin with the simpler vegetable life in I Botany and pass on to its applications in J Agriculture. Then comes the study of the higher animal life under K Zoology. Last in this series of Natural Sciences comes L Medicine which deals with the living body of man.

At the head of the classes H—L comes the comprehensive and residual class G Natural Science (General) which includes Biology, the science of life as such, (apart from the specific properties of plants, animals and the human body).

At the head of all the Sciences—pure, physical and natural—comes the comprehensive and residual class A Science (General) while the sequence is completed by M Useful Arts which comprises all the applications of Science not provided for already in the sequence, and Recreative Arts.

The order in the Humanities' half of the Array is not so natural as the order in the Science half. But still it cannot be said to flout the Canon of Helpful Order altogether.

For we begin with N Fine Arts, then pass on to the Fine Art *par excellence* O Literature, which leads us to P Philology, the science of language, the canvass, so to speak, of the art-form literature. In justification of Q Religion's position next to P Philology, we might quote the common saying of Indian devotees that the best use of man's power of speech is in praise of God. After the subsiding of the first fervour of religion, man begins to enquire about the reality or otherwise of God, himself, and other creations and so builds up R Philosophy. This involved use of the mind, the study of which is S Psychology. This is followed by its important application in the training of the mind of the young T Education.

The six classes N—S may be called Humanities Proper.

The six classes U—Z may be called Social Sciences which is the other half of the Humanities (General).

T may be classed with either half of the Humanities.

We might also make out a helpful order in the classes comprised in the Social Sciences. We begin with a study of the surface of the earth, the support of Human Society. This is U Geography. Then comes the concrete account of the life of humanity on Earth in the past and the present, which is V History. From the concrete data furnished by History, we distil the pure essence (unconditioned by space or time) of Political Science, which is represented by W. All Political Science, in the last analysis, is conditioned by man's economic needs and so the next subject is X Economics. The political organisation and the economic arrangement will become futile unless there is Law and Order. This is Z. The comprehensive residual class Social Sciences (General) has been put down as Y. It would have been wiser if Y represented Law and Z Social Sciences (General).

Now at the head of all these twenty-six classes—thirteen Sciences and thirteen Humanities—comes Generalia whose connotation is apparent and justifies its position as the first class of the Array. It is not represented by any symbol. But its parts are represented by Arabic numerals, a fact by which they gain priority over the other twenty-six classes of the First Array.

SUBJECT CLASSIFICATION

(3) In the case of the Subject Classification, Brown himself has indicated the developmental order in the lay-out. But in view of the out of the way terminology of its First Order Array, we do not get any significant result if we examine the apparent First Order Array. We have to go into the classes of the Second Order to realise how much the order of the classes goes counter to usage, convenience and filiation. The following extract¹ from Bliss,

¹ Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. Pp. 284-285.

in conjunction with previous remarks about what each class of the apparent First Array comprises, will make this clear. "Let us now proceed to examine the order of the special subjects. Psychology is separated on the one hand from Physiology and on the other hand from Education and Sociology. Aesthetics is remote from the Arts. Folk-lore, with Mythology and Religion (J5 and J4) is dissevered from Anthropology and Ethnology (G). Human anatomy and Physiology (G2) are separated from special anatomy and physiology (G6 to H4) by Pathology, Materia Medica, Pharmacy, Surgery, and Therapeutics (G3 to G5), and consequently these more general branches of medical science are separated from the special pathology of diseases and special practice by all the details of special anatomy and physiology. But worse is the separation of Chemistry in D7 from Physics in B by all of Engineering, Astronomy, and Geology, Meteorology and Metallurgy intervening in unconscionable confusion. Physiography and Meteorology come in between Astronomy and Geology, tho they should be subordinate to the latter. Hydrostatics, which belongs under Physics, is misplaced under Hydrography subordinate to Physiography; and the index refers Hydrodynamics to Hydrostatics. Crystallography and Mineralogy are separated from Chemistry by Metallurgy and Mining, which, to accord with Mr. Brown's scheme, should be subordinated to Chemical Technology and to Economic Geology respectively. General and theoretical Physics is separated from Mathematics with the Graphic and Plastic Arts and General Science intervening. In the Arts there is the same disregard for "conventions and groupings", convenience and consistency. Gardening (I220) is separated from Agriculture (I000) by Live Stock, Dairy Farming, Veterinary Medicine, and Milling and these are separated from Vegetable and Animal Products by Woodworking, Furniture, Textile Manufactures and the Clothing Trades, the former two of these subjects evidently being regarded as *applications* of Forestry, to which they are subordinated. Commerce and Trade (L8) are separated from Political Economy (L1) by all of Political Science and Law. In Law the subjects of Criminology and Criminal Law, Police and

Penology are interposed between Torts and Contracts. Paleography and Bibliography are brought together with Typography in M7 between American Languages (M6) and Practical Printing, Papermaking, and Bookbinding (M8). Paleography and Diplomatics and Archives are usually regarded as accessory to History. Into the details of the subdivisions it is needless to examine. Any competent classifier should see how bad this classification is. It not only disregards "conventions" and convenience but it ignores established scientific relations and conceptual or logical relations that are no less important."

CONGRESS CLASSIFICATION

(4) The Congress Classification has generally followed the Expansive Classification in the order of the classes of its First Order Array but has deviated from it in many ways, so that in the words of Putnam, the Librarian of the Congress responsible for the Scheme, "The system has not sought to follow strictly the scientific order of subjects. It has sought rather convenient sequence of the various groups, considering them as groups of books, not as groups of mere subjects." "But convenient sequence or collocation, of groups or classes or subjects depends on order consistent with the scientific and educational orders, and on logical subordination. Such order and collocation of subjects on shelves prove convenient to most readers who come in the subject-approach, whether for reference or research. The distinctions between group, class, and subject do not materially affect these principles. . . . The main practical objection is the lack of convenient sequence. . . . The fundamental sciences are not assigned main classes and are misplaced, and many other important subjects are misrelated."¹

As against this indictment, a reference may be made to Charles Martel's essay² entitled *The Library of*

¹ Bliss (Henry Evelyn): *Organisation of knowledge in libraries*. Pp. 246, 247, and 250.

² Putnam (Herbert). *Ded. : Essays offered by his Colleagues and friends on his thirtieth anniversary as librarian of Congress*. Pp. 327-332.

Congress classification in which are set forth "some considerations regarding the relation of book or library classification to the order of the sciences".

EXPANSIVE CLASSIFICATION

(5) With regard to the developmental order in the First Order Array of Expansive Classification, we may quote Sayers¹. "Allowing A General Works to stand for chaos, that which contains the materials of the universe, but without form and void; we first presume that man exists. When he becomes *conscious* of existence he may be said to have developed mind, which is covered by B (Philosophy); then the first question man asks himself is that which we all asked our parents at the beginning of things: "Where do I come from?" and man finds his answer in the existence of God which is covered by Br-C (Religion). Simultaneously or as an early development, man is conscious of and interested in his life as an individual (Biography); then his life as a member of a race (History); then, naturally, of the place in which he lives (Geography). Within that place his relations with his fellows came before everything (H-K Social Sciences). After that he turns his attention to the forces which govern existence (Science); then to the Arts that sustain life (R-U Useful Arts); then having discovered his origin and provided for his physical existence, he develops his higher life through the Fine Arts in all their forms, and he reaches the highest form of his mental life when he records his inner and outer life in Literature in all its forms."

NOT MUCH TO CHOOSE

The plausible justification found for the different order of the classes in the First Order Arrays (Lay-outs) of the Decimal Classification, the Colon Classification and the Expansive Classification, shows that, while the Canon of Helpful Order would object to extreme distortions like those of the First Order Array (Lay-out) of the Subject Classification, it is extremely tolerant and accepts any

¹ Sayers (W. C. Berwick). *A manual of classification*. Pp. 158-159.

reasonable order, of which many are possible. This means that, the Subject Classification apart, there is not much to choose between different schemes, in so far as the lay-out or the order of the main classes is concerned.

PRACTICAL ARRANGEMENT

Moreover, in the stack room of a library, several considerations weigh in the arrangement of subjects. One would very much like to have books and periodicals arranged in the order in which their subjects occur in the schedule of classification. But the logical or psychological order of the subjects found in the schedules of classification is seldom strictly parallel to the popular order. Nor is the popular order a permanent one. It does and must change with time.

Hence, the rigid arrangement by the schedule of classification only results in waste of the time and energy, not only of the reading public, but also of the reference staff. In an arrangement like this, a majority of readers may have to waste their time and energy in walking unnecessarily great distances to get at their books. The reference staff also are affected in the same way, as their movements are dependent on those of the readers. It is thus quite necessary to break the schedule order and judiciously repermute the subjects on the shelves. Literature, for example, as the subject attracting the greatest number of readers, may be located as near the entrance as possible, irrespective of its proper place in accordance with the schedule of classification. Other subjects may be arranged at distances from the entrance varying inversely with their popularity. Any one arrangement should not be considered as final merely on the ground of unwillingness to undertake additional labour. Its utility must be constantly tested by experience in the light of the statistics of issue. Any re-shuffling of subjects found to be necessary should be immediately carried out even at the cost of additional labour and time, as *the* convenience of the readers is *the* convenience of the library.

Altogether, then, the order of the main classes in the lay-out of a scheme of classification is not of much moment so long as it is reasonably tolerable.

7. COMPARATIVE STUDY

MATHEMATICS

We shall next study a few typical arrays of the second and higher orders of four current schemes of classification. As a copy of the Expansive Classification is not available in Madras, it has to be omitted in all further chapters.

COMPARISON OF ARRAYS OF THE SECOND ORDER

We shall first take up the comparative study of Arrays of the Second Order.

Each scheme has many Arrays of the Second Order. The Decimal Classification has 10, the Colon Classification 47, the Subject Classification 16, and the Congress Classification 21. While, in most of the schemes, the number of Arrays of the Second Order is nearly equal to the number of Classes in the Lay-out, it is twice the number in the Colon Classification on account of its Colon Device. Space will not allow a critical study of all the 94 Arrays of the Second Order. We shall choose here for consideration one typical and corresponding Array from each of the four schemes.

We shall take up that Array of the Second Order which includes Mathematics as a class. As Mathematics occurs as a Class in the Array of the First Order in the Colon Classification, we have only three schemes to compare. Here are the Arrays of the Second Order in question:—

Classes of the Arrays of the Second Order in which
Mathematics occurs as a class.

Decimal Classification

Derived from

5 *Pure Science*

- 510 Mathematics
- 520 Astronomy
- 530 Physics
- 540 Chemistry

- 550 Geology
- 560 Palaeontology
- 570 Biology
- 580 Botany
- 590 Zoology

Subject Classification

Derived from

A Generalia

- A0 Generalia
- A1 Education
- A3 Logic
- A400-540 Mathematics
- A6 Graphic and plastic arts
- A9 General Science

Congress Classification

Derived from

Q Science

- QA101-935 Mathematics
- QB Astronomy
- QC Physics
- QD Chemistry
- QE Geology
- QH Natural History
- QK Botany
- QL Zoology
- QM Human Anatomy
- QP Physiology
- QR Bacteriology

CANON OF ENUMERATION

1. Applying the Canon of Enumeration, we find that the terms are used in the usual sense except in the following cases:—

- (1) In the Decimal Classification, as has been already pointed out, Biology, a pure science, is forced to hold within itself branches of social sciences like Anthropology and Ethnology.

- (2) In the Subject Classification, usage is violated by the inclusion of Weights and Measures and Book-keeping in Mathematics, as will be seen from its classes given in the next section.
- (3) In the Congress Classification, Human Anatomy, Physiology and Bacteriology, which are usually included in the Class Medicine, are placed with Science.

HOSPITALITY IN ARRAY

2. With regard to the Canon of Exhaustiveness and the Canon of Hospitality in Array, the Decimal Classification fails absolutely as all the ten available places have been used up. The Congress Classification has ample provision for new independent sciences that may in future arise. The Subject Classification calls for no remark, except that the gaps left in the notation may prove inadequate sooner or later.

CANON OF HELPFUL ORDER

3. The Canon of Helpful Order is well satisfied by the Decimal Classification and the Congress Classification. In fact the classes in the array follow the developmental order, which has been fully discussed in studying the First Array of the Colon Classification.

ARRAYS OF THE THIRD ORDER

While the number of Arrays of the Second Order found in the four schemes of classification taken together is 96, the number of Arrays of the Third Order runs to thousands. Hence, as before, we shall consider here only one typical and corresponding Array of the Third Order from each of the four schemes. We shall choose the Arrays which have Mathematics as their immediate universe.

It may be remarked here that although B Mathematics occurs formally as a class in the Array of the First Order

of the Colon Classification, it should in reality be looked upon as a class of the Second Order, in the light of previous discussion of the way in which the lay-out of the Colon Classification satisfies the Canon of Helpful Order. It was shown there that universal knowledge is in effect first divided into Sciences and Social Sciences and that Mathematics belongs to the first of these classes. For this reason, and for convenience of comparison, we shall treat Mathematics as a Class of the Second Order in all the four schemes, Colon Classification included.

Classes of the Array of the Third Order having
Mathematics as immediate universe

Decimal Classification

Derived from

510 Mathematics

- 511 Arithmetic
- 512 Algebra
- 513 Geometry
- 514 Trigonometry
- 515 Descriptive geometry
- 516 Analytical geometry
- 517 Calculus
- 519 Probabilities

Colon Classification

Derived from

B Mathematics

- B1 Arithmetic
- B2 Algebra
- B3 Analysis
- B4 Other methods of Analysis
- B5 Trigonometry
- B6 Geometry
- B7 Mechanics
- B8 Potentials
- B9 Astronomy

Subject Classification

Derived from

A400-540 Mathematics

A401-425	Arithmetic
A430-443	Algebra
A450-456	Weights and Measures
A460-461	Statistics
A470-489	Book-keeping
A500-515	Geometry
A520-525	Calculus
A530-532	Trigonometry
A540	Mensuration

Congress Classification

Derived from

QA101-935 Mathematics

QA101-145	Arithmetic
QA152-295	Algebra
QA300-431	Analysis
QA445-699	Geometry
QA802-930	Analytical mechanics
QA931-935	Elasticity

CANON OF ENUMERATION

1. Applying the Canon of Enumeration, we find that the connotation of the term 'Mathematics' varies from scheme to scheme. The Subject Classification, as usual, dispenses with convention, while the practice of the other schemes squares with convention to a tolerable degree.

(i) The apparent common factors are Arithmetic, Algebra, Analysis and Geometry. Trigonometry and Probability are also common, though not apparent, factors, as they are comprised in Geometry and Algebra (or Statistics) respectively.

(ii) One major variation consists in the Decimal Classification restricting the range of the term "Mathematics" to "Pure Mathematics", while the Colon Classifica-

tion and the Congress Classification use it in the wider sense to include "Applied Mathematics".

(iii) The two latter schemes, however, do not agree in the branches of Applied Mathematics which they include. The former omits Elasticity and assigns it to Physics. The latter omits Astronomy and makes it an independent class of the universe "Science".

(iv) The appearance of Potentials in the Colon Classification is not different from the practice of the Congress Classification, in which it is comprised under Analysis.

(v) Inclusion of Weights and Measures and Book-keeping in the array derived from Mathematics by the Subject Classification is utterly repugnant to accepted practice. This is only one of the many instances of flouting of convention out of extreme deference to its principle of "placing all topics in logical sequence . . . in a systematic order of scientific progression".

(vi) It may also be remarked that the whole subject of Statistics (as a mathematical method) is accommodated in the class Mathematics explicitly by the Subject Classification and implicitly (in Algebra) by the Colon Classification. But the subject is dismembered by the other two schemes and Probability alone is put under Mathematics. The other parts of Statistics are considered as a class of Social Sciences, along with the statistical data of the social variety. This is a practice of doubtful value which crept in at the initial stages before the real mathematical nature of statistical methods and the almost universal range of their application were realised and which has since been given up by the learned world.

(vii) The term "Calculus" has been rightly replaced by "Analysis" in the Colon Classification and the Congress Classification.

HOSPITALITY IN ARRAY

2. The Canon of Exhaustiveness and the Canon of Hospitality in Array are, as usual, disregarded by the Decimal Classification. They are

satisfied fully by the Colon Classification, and by the other two schemes to the extent allowed by the gaps in their notation.

DECIMAL CLASSIFICATION

(i) In the Decimal Classification, three of its ten places are given to one and the same subject—Geometry—and a separate place is given to a meagre subject like Probabilities which is thus put on a par with a very crowded subject like Calculus (Analysis).

COLON CLASSIFICATION

(ii) In the Colon Classification also, there is apparently no room for new classes, since all the nine divisions have been already used up in violation of its much boasted Octave Principle. But this is only apparent. Mathematics is essentially a tool or method. Its future developments can consist only of the development of new methods. The divisions 3 Analysis and 4 Other Methods of Analysis form the real core of Mathematics as method. Of these, 4 Other Methods of Analysis has been duly classified on the Octave Principle, as will be seen presently, thus ensuring Hospitality in Array to any desired extent.

SUBJECT CLASSIFICATION

(iii) The Subject Classification has thirty-nine vacant numbers in the Array, and can thus accommodate a possible maximum of thirty-nine new coordinate branches of Mathematics. But the numbers available will really be far less; for each new branch will need more than one number.

CONGRESS CLASSIFICATION

(iv) The Congress Classification has one hundred and fifteen vacant numbers. But since each new-comer will demand considerably more than one number, the Scheme still does not ensure Hospitality in Array to any desired extent as the Colon Classification does.

CANON OF EXCLUSIVENESS

3. To all appearance, the Canon of Exclusiveness is fully satisfied by all the four Schemes, if the

Canon of Context is remembered in interpreting their terms.

(i) In the Decimal Classification, 513 Geometry, 515 Descriptive Geometry and 516 Analytical Geometry should not be taken as independent classes.

(ii) Similarly in the Colon Classification, 3 Analysis and 4 Other Methods of Analysis should, as their names imply, be considered as a single class.

CANON OF HELPFUL ORDER

4. The Canon of Helpful Order is well satisfied by the Colon Classification and the Congress Classification but not so well by the other two schemes.

(i) Both in the Decimal Classification and the Subject Classification, the position of "Calculus" would be happier if it had priority over Geometry. Algebra and Calculus are pure methods and should be contiguous. Geometry has a large element of application in it and hence should not come between Algebra and Calculus.

(ii) In the Decimal Classification, Probabilities would be better situated between Algebra and Analysis. But it almost looks as if it had been thrust casually into the ninth place simply to fill up a vacant end-place.

(iii) The position of Trigonometry in the Decimal Classification between two branches of Geometry is quite anomalous and difficult to justify on any ground.

ARRAYS OF THE FOURTH ORDER

If Arrays of the Second Order are counted in tens, and those of the Third Order in thousands, Arrays of the Fourth Order have to be counted in tens of thousands. We shall therefore consider only one typical and corresponding Array of the Fourth Order from each Scheme.

Classes of the Array of the Fourth Order having Analysis
(Calculus) as their immediate universe

Decimal Classification

Derived from

517 Calculus

- 517·1 Infinitesimal
- 517·2 Differential
- 517·3 Integral
- 517·4 Of Variations
- 517·5 Of Functions
- 517·6 Of Finite Differences
- 517·7 Of Operations
- 517·8 Of Complex Variables
- 517·9 Problems

Colon Classification

Derived from

B3 Analysis and B4 Other Methods of Analysis

- B31 Foundation
- B32 Calculus
- B33 Differential equations
- B34 Continuous groups
- B35 Differential forms
- B36 Infinite Series
- B37-39 Functions
- B41 Calculus of Finite Differences
- B42 Calculus of Variations
- B43 Calculus of Functional Analysis
- B44 Graphical Calculus and Nomography
- B45 Quaternions
- B46 Vector Analysis
- B48 Operational Calculus

Subject Classification

Derived from

A520-525 Calculus

- A521 Differential
- A522 Integral
- A523 Quaternions

A524 Functions

A525 Finite Differences

Congress Classification

Derived from

QA300-431 Analysis

QA303-316 Calculus

QA331-351 Theory of Functions

QA371-381 Differential Equations

QA38 Continuous groups

QA401-431 Analytical methods connected with
physical problems**TERMINOLOGY**

1. The terminology of all the Schemes is fairly in accordance with usage.

It may be stated that, in general, the terminology of arrays of higher order will be accurate and definite. As the order of the Array increases, i.e., as we go down a chain, since we gain in intension and progressively eliminate extension, we have more and more opportunity to deal with specific entities with a more or less definite shape or denotation and there is thus a greater agreement in the names by which they are denoted.

HOSPITALITY IN ARRAY

2. With regard to the Canon of Exhaustiveness and the Canon of Hospitality in Array, the Colon Classification retains its infinite hospitality. The Congress Classification satisfies the canons to a very limited extent. The Decimal Classification and the Subject Classification have become rigid and petrified, with no places to offer.

DECIMAL CLASSIFICATION

(i) With its customary hasty prodigality, the Decimal Classification has squandered away all its ten places.

(a) It has given three places—(517·1 Infinitesimal, 517·2 Differential and 517·3 Integral) to Calculus proper, instead of one.

(b) As usual, not finding enough true claimants and anxious to have every place filled up, it has improvised a dummy class, dubbed it Problems and thrust it into the place 517·9—really a desperate method of filling up places.

(c) The result is that it cannot now find place for late comers of full stature, incapable of subordination to existing classes and claiming coordinate status. Some examples are Infinite Series, Integral Equations, Functions of Real Variables, Continuous Groups and hosts of new functions which are provided for in the Colon Classification and the Congress Classification.

COLON CLASSIFICATION

(ii) The Colon Classification has not only accommodated all these new comers already but has in reserve any number of places, as a result of its Octave Principle. The second Octave 49 and all the later Octaves are kept free and can cope with the situation, no matter what magnitude the number of new subjects eventually attains.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification, which had set apart only six inexpansive places for Analysis, all the six places have been occupied and even by putting the fullest possible load on its categorical tables, it cannot accommodate even one additional class of a coordinate status.

CONGRESS CLASSIFICATION

(iv) The more prudent Congress Classification has fifty-one free places. It can house a few newer classes, but a time will soon come when more places will be needed.

CANON OF EXCLUSIVENESS

3. The Canon of Exclusiveness is not properly satisfied by the Decimal Classification. But it is well satisfied in all the other schemes.

(i) The improvised class 517·9 Problems is the most prominent offender. How can this class be prevented from overlapping with the other classes? If there is a method, it should have been explicitly stated.

(ii) The class 517·8 Complex Variable is also a source of trouble. The class 517·3 Integral Calculus comprises 517·36 Abelian Functions. Have they not a natural place under 517·8 Complex Variable?

(iii) Although it is not quite relevant here, another extraordinary deviation from the Canon of Exclusiveness may be brought to light here as there may not be a more suitable occasion to deal with such cases. Under 517·2 Differential Calculus, we find the classes 517·24 Theory of Plane Curves and 517·26 Theory of Curved Surfaces. But under 513·2 Curves also, we find 513·26 Higher Plane Curves and under 513·5 Modern Geometry 513·59, Surfaces of Higher Order. Similar divisions are also repeated under 516 Analytical Geometry. But there is no explanatory note in any of the overlapping places as to how the situation is to be reconciled with the Canon of Exclusiveness. My fairly intimate knowledge of the subject shows me, as a matter of fact, that it is not easy to effect any reconciliation in the universe of books.

Such offences against the Canon of Exclusiveness are found in large numbers when we dive deep and compare Arrays of higher and higher orders of the Decimal Classification, though they are absent on the surface, *i.e.*, in the Arrays of the First, Second and Third Orders. It would be a good exercise for a student to make an exhaustive list of such deep-lying cases of overlapping (*i.e.*, offences against the Canon of Exclusiveness) in all the Arrays of all the orders in the Decimal Classification.

If we have books which deal, say with curved surfaces, exclusively by pure methods, by analytical methods and by differential methods, separating such books from one another and assigning the groups to different classes which are not contiguous—in fact far from one another—offends against the Canon of Relevant Sequence. It happens because the Decimal Classification divides first by the methods of study and then by the kind of spatial configuration. But experience shows that division first by spatial configuration and then by the method would be more helpful to readers, *i.e.*, would be a satisfactory relevant sequence.

In fact, that is exactly what is done by the Colon Classification. We have the following rules.¹

"Two characteristics are to be used for the subdivision of Geometry, *vis.*, Space or "S" characteristic and Method of "M" characteristic.

"The two characteristics forming the basis of classification of Geometry are to be taken in the order 'S', 'M'.

CANON OF HELPFUL ORDER

4. The Canon of Helpful Order is satisfied by all the Schemes except the Decimal Classification and the Subject Classification.

DECIMAL CLASSIFICATION

(i) The position of the Complex Variable in class 517·8 separated from 517·2 Integral Calculus by four other calculuses cannot be justified on any ground. It is a definite hindrance to users.

SUBJECT CLASSIFICATION

(ii) The thrusting in of A523 Quaternions between A522 Integral Calculus and A524 Functions is also a hindrance.

ARRAYS OF THE FIFTH ORDER

As usual, we shall consider only one typical and corresponding Array of the Fifth Order from each scheme.

Classes of the Arrays of the Fifth Order having
Functions as the common universe

Decimal Classification

There is no universe entitled Functions, but the following attenuated Array of functions is discernible as parts of another universe:

517·3 *Integral Calculus*

517·35 Laplace's Functions, Bessel's and allied
Functions

517·36 Elliptic and Hyperelliptic Functions, Abelian
Functions

¹Ranganathan (S. R.): *Colon classification*. Rules B 60 and B 601.

Colon Classification

Derived from

B37, B38, B39 Theory of Functions

- B37 Functions of Real Variables
- B38 Functions of Complex Variables
- B391 Elementary functions defined by a finite number of algebraic operations
- B392 Integrals of algebraic functions
- B393 Functions defined by contour integrals
- B394 Functions defined by differential and integral equations
- B396 Functions defined by Infinite Series and Products
- B397 Functions defined by groups
- B398 Functions of position defined in the manner of Riemann
- B3991 Functions qualitatively defined

Subject Classification

No attempt is made to classify functions in this scheme

Congress Classification

Derived from

*QA331-351 General Theory of Functions, and
QA406-QA411 Special Functions*

- QA332 Uniform Functions
- QA333 Multiform Functions. Riemann surfaces
- QA341 Algebraic Functions
- QA342 Logarithmic, circular and exponential Functions
- QA343 Elliptic Functions
- QA345 Abelian Functions
- QA351 Miscellaneous Special Functions
- QA406 Laplace's and Legendre's Functions
- QA408 Bessel's Functions
- QA409 Lamé's Functions
- QA411 Toroidal and other Functions

1. There are some obvious preliminary remarks:—

SUBJECT CLASSIFICATION

(i) The Subject Classification does not attempt to classify Theory of Functions on the basis of further characteristics.

So, Exit, Subject Classification! Evidently not destined to appreciate, enjoy and follow the rich and endless ramifications of the Theory of Functions!

DECIMAL CLASSIFICATION

(ii) The Decimal Classification has not recognised a separate class as Theory of Functions in the Array of the Fourth Order, already considered. It had a class 517·8 Complex Variable. But it is not subdivided. Nor is it clear what was intended to be comprised in it.

This is confirmed by two attendant factors:—

(a) This class 517·8 Complex Variable has the note "See also 512·82" and 512·82 reads "Theory of Equations. Complex Variable. See also 517·8".

(b) The few functions that the scheme mentions are shown in the Array of the Fifth Order having 517·3 Integral Calculus for its immediate universe. The enumeration of Functions is not exhaustive in itself. Nor does the scheme show any sign of its having recognised the existence of other Functions or the possibility of new Functions ever being brought to light for study. As a matter of fact, at the present stage of mathematical activity, new Functions are being very rapidly discovered. For example Quasi-analytic Functions were discovered only in 1917 and Almost Periodic Functions in 1923. Where are these Functions to be accommodated in the Decimal Classification? Yet we have separate treatises on them and articles on them are pouring in.

CONGRESS CLASSIFICATION

(iii) Even the Congress Classification, which has adopted the last resort of having a jejune

class under the heading QA351 Miscellaneous Special Functions, will only crowd them along with hosts of other Functions, having no means of bringing together on the shelf all the resources of the library on a particular Function.

COLON CLASSIFICATION

(iv) But the Colon Classification has just the right method of housing such newcomers. The two new Functions—Quasi-analytic and Almost Periodic—are at their genesis qualitatively defined and hence they are put into the class B3991 Functions Qualitatively Defined. They are then individualised by the chronological device as follows:—

B3991N17	Quasi-analytic Functions
B3991N23	Almost Periodic Functions

DECIMAL CLASSIFICATION

To return to Decimal Classification, surely it has begun to nod. At the depth of the Fifth Order it has lost all sense of direction. It has merely put in an appearance at the Fifth Order level, as if to fulfil a technical formality, but evidently unaware of the depths of that region. As it has put in its appearance, however formally, it may not be polite to say "Exit, Decimal Classification". But its performance recalls the tenderer we often meet with in opening tenders for a big job. Quite ignorant of the quantities and costs involved in the job, by blind guess work he quotes an absurdly low or an absurdly high figure. In the business world it is a recognised practice to ignore such tenderers without actually saying "Exit, dear ignoramus"! So we need not consider the Decimal Classification when we compare Arrays of the Fifth Order.

Thus we have virtually only two schemes to compare.

CONGRESS CLASSIFICATION

2. (i) The Congress Classification gives just one number QA331 to the Theory of Functions—

a subject which has at least two distinct branches, *viz.*, Real Variable and Complex Variable, each branch with its own distinctive features not only in method but also in the field of study. Thus the Congress Classification has no provision for individualising the different branches of the Theory. Nor has it any means of individualising the divisions of either branch. In fact, the Congress Classification comes to a sudden stop at the Fifth Order like a car whose petrol has run out.

COLON CLASSIFICATION

(ii) (a) But the Colon Classification continues undaunted. Its eyes are not blinded by the high pressure of the depths. It recognises the distinction between Theory of Functions of Real Variables and Theory of Functions of Complex Variables, and marks out B37 and B38 as their distinctive places.

COLON DEVICE

(b) Indeed, it is even prepared to dive deeper. With its Colon Device, it senses the existence of two different dimensions along which depth (order) can be still further increased. It says "I can dive deeper either along the dimension (characteristic) of the number of Variables used or along that of the problem studied".

(c) "Along each dimension", it announces, "I see further and further layers of Arrays lying one below the other. The order can be increased to any extent, one can go to any further depth".

SIXTH ORDER

(d) Let us, for example, examine the dimension corresponding to the Problem Characteristic. We have the following as the Array of the Sixth Order:—

- 1 Cauchy's theorem and complex integration
- 2 Analytic representation
- 3 Analytic continuation
- 4 Singularities
- 5 Distribution of values
- 6 Conformal representation and uniformisation
- 7 Maximum-minimum principles
- 8 Inequalities and mean values
- 9 Families of functions

SEVENTH ORDER

(e) Let us take class 2 Analytic Representation and set out the Array of the Seventh Order for which that class is the immediate universe.

- | | |
|-----|------------------------|
| 23 | As a Contour Integral |
| 26 | As an Infinite Series |
| 265 | As an Infinite Product |

EIGHTH ORDER

(f) Let us go one step further and set out the Array of the Eighth Order having "26 As an Infinite Series" as its immediate universe. We obtain the classes of this Array by the Chronological Device. We can thus have an infinity of classes in this Array of the Eighth Order, each new Series

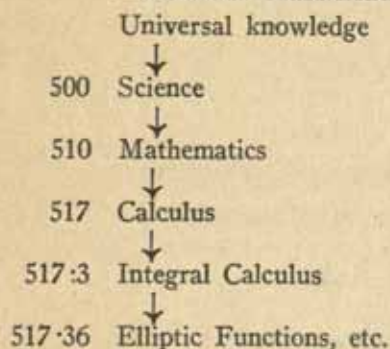
discovered bringing its own class number, so to speak. Here are two examples:—

- | | |
|-------|--------------------------------------|
| 26M22 | Representation as a Fourier Series |
| 26M39 | Representation as a Dirichlet Series |

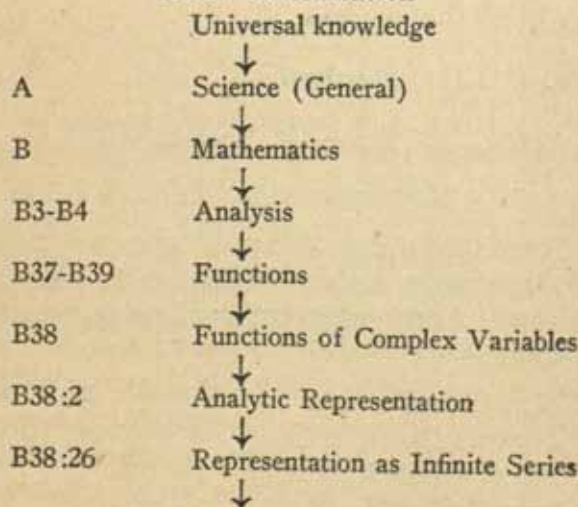
COMPARISON OF CHAINS

This has naturally brought us to comparison of chains. Let us, for definiteness, write out one corresponding chain in each of the schemes.

Decimal Classification



Colon Classification



B38:26M22	Representation as a Fourier Series
	↓
B382:26M22	Representation of a Function of two Variables as a Fourier Series

Subject Classification

	Universal knowledge
	↓
A	Generalia
	↓
A401-A546	Mathematics
	↓
A520-A525	Calculus
	↓
A524	Functions

Congress Classification

	Universal knowledge
	↓
Q	Science
	↓
QA	Mathematics
	↓
QA300-431	Analysis
	↓
QA331-351	Functions
	↓
QA331	Theory of Functions

HOSPITALITY IN CHAIN

These tables show the varying extent to which the four schemes satisfy the Canon of Hospitality in Chain. Arranged in order of merit, they stand as follows:—

- | | |
|----------------------------|-----------------------|
| 1. Colon Classification | Capable of 9 orders |
| 2. Congress Classification | Capable of 5 orders |
| 3. Subject Classification | } Capable of 4 orders |
| Decimal Classification | |

COMPARISON OF NOTATION

The following table giving the number of digits in the class numbers of successive orders in the different schemes will now help us to compare their *notation*.

NUMBER OF DIGITS IN CLASS NUMBERS OF DIFFERENT
ORDERS IN THE DIFFERENT SCHEMES

Order		Decimal Classi- fication	Colon Classi- fication	Subject Classi- fication	Congress Classi- fication
1	..	3	1	4	5
2	..	3	1	4	5
3	..	3	2	4	5
4	..	5	3	4	5
5	..	6	4		5
6	..		6		
7	..		7		
8	..		10		
9	..		11		

RELATIVITY

The table shows the extent to which the Canon of Relativity is satisfied by the notation of the different schemes.

The Colon Classification satisfies the Canon of Relativity admirably. The notation of the Decimal Classification is characterised by uniform length till the Third Order and then becomes relative. But the Subject Classification and the Congress Classification are characterised by notations of uniform length and entirely evade the Canon of Relativity.

LENGTH

Next, the notation is considerably shorter in the Colon Classification than in the other schemes up to and including

the Fifth Order. After the Fifth Order, all the other schemes drop out and there is no basis for comparison. Generally speaking, for any given order of classes, the Colon Classification has a shorter notation than the other schemes. The Congress Classification has the longest notation in the first three orders. It is so with that scheme in all subjects. Generally speaking, the Decimal Classification and the Congress Classification share the same rank with regard to notation in classes of the Fourth Order.

Remembering that the other schemes do not go beyond the Fifth Order, the Colon Classification notation should not be thought *long* because it reaches 6, 7, 10 and 11 digits in the higher orders. It is an elementary principle that the length of a decimal notation will increase with the order of the class represented. Hence it is meaningless to say that a certain notation is unduly long without reference to the order of the class represented.

What is really wanted is observance of the Canon of Relativity. Given that, it is open to a particular classifier not to pursue a chain of classes beyond the order where the length of notation reaches the *economic limit* which he has set for himself.

The table shows in general

(1) that for any given order of classes the notation of the Colon Classification is shorter than that of the other schemes;

(2) that for the first three orders the Congress Classification has the longest notation;

(3) that the chains of the Subject Classification are earliest arrested;

(4) that whatever be the *economic limit* fixed for length of notation, within those limits the Colon Classification reaches much farther down a chain (*i.e.*, individualises higher orders of classes) than the other schemes; and

(5) that the chains of the Colon Classification can be lengthened far beyond those of the other schemes.

CONCLUSION AND SUMMARY

The comparative features that have been brought out in the study of particular arrays of different orders in Mathematics are not peculiar to the particular arrays chosen. On the other hand they are common to almost all the arrays in Mathematics.

The following is a summary of the results in general terms:—

DECIMAL CLASSIFICATION

(1) The Decimal Classification adopts a terminology which is generally in consonance with usage although it is a little antiquated here and there. It occasionally fails when judged by the Canon of Helpful Order. While it satisfies the Canon of Exclusiveness in the first three orders, it evades it in the higher orders. It utterly fails to satisfy the Canon of Hospitality in Array. Nor does it generally satisfy the Canon of Hospitality in Chain beyond the Fifth order. Its notation is of uniform length in the first three orders and satisfies the Canon of Relativity from the Fourth order onwards. With regard to length of notation, it occupies the second place in the first three orders, it shares the third place with the Colon Classification in the Fourth and goes to the last place in the Fifth order.

COLON CLASSIFICATION

(2) The Colon Classification has a terminology which is consonant with modern usage. It

tolerably satisfies the Canon of Helpful Order. Its Colon Device saves it from the mistakes of the Decimal Classification with regard to the fulfilment of the Canon of Exclusiveness in classes of higher orders, and also contributes to the fulfilment of the Canon of Helpful Order. Its Octave Notation and its Chronological Device enable it to satisfy the Canon of Hospitality in Array to any extent whatever. With regard to the Canon of Hospitality in Chain, it is capable of going as far down as the Ninth Order, *i.e.*, five orders further ahead of the Subject Classification and four ahead of the Decimal and Congress Classifications. Its notation satisfies the Canon of Relativity admirably as it begins with a single digit for the class numbers of classes in the first and second order and progressively increases the number of digits to eleven when it reaches classes of the ninth order. Regarding the length of notation, it has the shortest notation in the first five orders of classes. Its notation exceeds five digits only from the sixth order onwards, *i.e.*, only in orders which are not reached by the other schemes of classification.

SUBJECT CLASSIFICATION

(3) The Subject Classification is the worst sinner against terminology. Its arrays generally follow the Canon of Helpful Order. It satisfies the Canon of Exclusiveness but it fails the Canons of Hospitality in Array, and Hospitality in Chain much more than any other scheme. In fact, it is not capable of going beyond the Fourth order. Its notation is of uniform length throughout, consisting always of four digits.

CONGRESS CLASSIFICATION

(4) The Congress Classification has satisfactory terminology except for the inclusion of jejune classes like Miscellaneous Functions. It satisfies the Canon of Helpful Order, and the Canon of Exclusiveness without failure. It has reasonable provision to satisfy the Canon of Hospitality in Array but any moment the gaps in the class numbers may be filled up and the Canon evaded. It shares the second place with the Decimal Classification when judged by the Canon of Hospitality in Chain, the first place having gone to the Colon Classification. Its notation is of uniform length throughout—five digits in all orders of classes.

8. COMPARATIVE STUDY

ECONOMICS

Having made a comparative study of Arrays and Chains in Mathematics as a subject representing the Sciences, we shall next deal similarly with Economics as a subject representing Social Sciences.

ARRAYS OF THE SECOND ORDER

We shall first take up the comparative study of Arrays of the Second Order. We shall take up that Array of the Second Order which includes Economics as a class. As Economics occurs as a class in the Array of the First Order in the Colon Classification, we have virtually only three schemes to compare. Here are the Arrays of the Second Order in question:—

Classes of Arrays of the Second Order in which
Economics occurs as a class

Decimal Classification

Derived from

- 300 *Sociology and Social Sciences General*
- 310 Statistics
- 320 Political Science
- 330 Economics
- 340 Law
- 350 Administration. Army
- 360 Associations. Institutions
- 370 Education
- 380 Commerce. Communication
- 390 Customs. Popular life

Subject Classification

Derived from

L Social and Political Sciences

- L000-092 Social Science
- L100-162 Economics

L170-185	Associations
L201-395	Political Science
L400-851	Law
L852-988	Commerce, Money and Finance

Congress Classification

Derived from

H Social Sciences

HA	Statistics
HB-HJ	Economics
HM-HX	Sociology

CANON OF ENUMERATION

1. Applying the Canon of Enumeration, we find that the connotation of the term "Social Sciences" varies from scheme to scheme.

In discussing the First Array of the Colon Classification from the point of view of the Canon of Helpful Order, it was indicated that the term "Social Sciences" has now come to cover all the subjects represented by the letters T-Z in the Colon Classification, *i.e.*, Education, Geography, History, Political Science, Economics, Sociology and Law. But none of the other schemes whose tables are given above interpret the term "Social Sciences" so fully.

(i) Here are some of the deviations in the Decimal Classification:—

(a) History and Geography do not find a place in "Social Sciences". In fact they are put in a separate class of the First Array with 900 for class number.

(b) As we have already pointed out while discussing classes of the Third Order in Mathematics, the Pure Science of Statistics as distinguished from Collection of Statistics from the field of Social Sciences is given a place under "Social Sciences".

(ii) (a) The Subject Classification also excludes History and Geography from Social Sciences.

(b) This Scheme further differs from the Decimal Classification in excluding Education also from the class "Social Sciences".

(iii) The Congress Classification has made the class "Social Sciences" extremely narrow.

(a) It has omitted not only History, Geography and Education from its purview, but has also dropped out Political Science and Law.

(b) In the matter of the Science of Statistics, it errs in the same way as the Decimal Classification.

HOSPITALITY IN ARRAY

2. The Canon of Exhaustiveness and the Canon of Hospitality in Array are not satisfied by the Decimal Classification, are satisfied by the Subject Classification to the extent that gaps in notation allow, while the Congress Classification has left more generous gaps than the Subject Classification.

(i) The Decimal Classification has already used up all its ten places rather freely and is inhospitable to possible future coordinate branches of Social Sciences. Exhaustion of the ten places could very well have been avoided and three places saved in the following way:—

(a) 300 Sociology, 360 Associations, Institutions and 390 Customs, Popular life might have been accommodated in a single class more appropriately.

(b) The same applies to 320 Political Science and 350 Administration.

(c) It is distinctly unhelpful to have distributed 330 Economics and 380 Commerce, Communications in two distinct classes.

(ii) The gaps left in the Subject Classification are too meagre, especially if we remember that they are to accommodate not only new coordinate classes that might arise in the same Array but also new subordinate classes that might arise in any of the Chains having their upper link in a class of the Array under consideration.

(iii) The gaps left in the Congress Classification are very liberal. But even here, since both coordinate and

subordinate classes have to compete for places in the same gaps, there is bound to be difficulty in due course.

CANON OF HELPFUL ORDER

3. The Canon of Helpful Order is ignored by the Decimal Classification and the Subject Classification, but well satisfied by the Congress Classification.

DECIMAL CLASSIFICATION

(i) A good deal of the trouble that the Decimal Classification has with this Canon could have been avoided if all the ten places had not been forcedly used in the manner already described. Even otherwise we find no developmental or relational order among the classes.

(a) The most irritating deviation from the Canon of Helpful Order is the separation of 380 Commerce from 330 Economics by four classes (340 Law, 350 Administration, 360 Associations and 370 Education), that have little affinity with either of them. It is difficult to see what considerations led to this unhelpful separation. Is it wrong to assume that the classes were arranged quite arbitrarily without any consideration whatever as to their mutual affinity?

(b) Another bad scattering is that of 300·1 Sociology, 360 Associations and 390 Customs more or less to the beginning, middle and end of the Array. This might have been due to the fact that when the Scheme was forged, the subject "Sociology" had not yet taken shape and disclosed its filiation.

(c) But no such explanation can be found for the separation of 320 Political Science and 350 Administration.

SUBJECT CLASSIFICATION

(ii) In the Subject Classification, in spite of its starting with the plan that "arrangement in a logical order, or at any rate, according to a progression for which reasons, weak or strong, can be advanced" and in spite of the fact

that the introduction to the scheme prepares us to expect "many departures from established convention which may at first appear a little drastic", it is extremely difficult to find any justification for the claim that "every class is arranged in a systematic order of scientific progression", at least so far as the arrangement of the classes in the Array of the Second Order under consideration is concerned.

(a) While we recognise drastic departure from established convention in separating L100-162 Economics from L852-988 Commerce, Money and Finance, what scientific progression is discernible in progressing from Economics to Finance through the classes Associations, Political Science and Law?

(b) Equally drastic is the departure from convention in separating L000-092 Social Science from L170-185 Associations, which includes L170 Friendly Societies and L185 Freemasonry by L100-162 Economics. Nor is any scientific progression conceivable in reaching Freemasonry from Social Science through Economics.

CONGRESS CLASSIFICATION

(iii) As the Array of the Second Order under consideration has only three classes in the Congress Classification, adherence to the Canon of Helpful Order could not have been a difficult affair.

ARRAYS OF THE THIRD ORDER

As in the case of Mathematics, we shall take up only one typical and corresponding Array of the Third Order from each of the four schemes. We shall choose those Arrays which have Economics as their immediate universe.

It may be remarked here that although X Economics occurs formally as a class in the Array of the First Order of the Colon Classification, it should in reality be looked upon as a Class of the Second Order, in the light of previous discussion of the way in which the lay-out of the Colon Classification satisfies the Canon of Helpful Order. It was shown there that universal knowledge is in effect first divided into Sciences and Social Sciences and that Economics belongs to the second of these classes. For

this reason, and for convenience of comparison, we shall treat Economics as a Class of the Second Order in all the four schemes, Colon Classification included.

A DIFFICULTY IN COMPARISON

But, before the Arrays are even put down for comparison, it must be observed that the Colon Classification uses four characteristics (Business, Economic, Geographical and Chronological) simultaneously for the classification of Economics. Moreover Economics can also be divided in the Colon Classification on the basis of Type of Organisation quite independently of the application of characteristics. In other words in the Colon Classification.

(1) Economics spreads Arrays of the First Order (relatively to Economics as the universe) along five dimensions;

(2) Chains of classes can grow in each of four of these dimensions simultaneously and independently of one another (No chain is possible from a class representing Type of Organisation); and

(3) A class in Economics can be formed by any combination of, from one to five classes of any order taken from these five dimensions, provided no two classes belong to the same dimension.

This feature, due to the Colon Device, increases the Hospitality in Chain to a great extent in the Colon Classification but renders the comparison with the other schemes rather difficult as their make-up allows them to send out their arrays and chains in one dimension only.

A WAY OUT OF THE DIFFICULTY

One device by which the difficulty can be got over and some kind of comparison effected is to transform the five dimensions of the Colon Classification into one dimension, so as to register with the other schemes. We shall do it in the following way. Each of the three arrays derived from Economics on the basis of Type of Organisation, Business characteristic and Economic characteristic (the arrays based on the Geographical characteristic and Chronological cha-

¹ Ranganathan (S.R.): *Colon classification*. 1933. Rule X0.

racteristic will not be given for considerations of space but will be taken as understood) will be given one below the other in one column when we write down the Arrays of the Third Order. When we pass on to Arrays of the Fourth and higher orders, we shall draw from any of these five Arrays of the Third Order according to need.

Classes of the Third Order having Economics as their immediate Universe

Decimal Classification

Derived from

300 *Economics*

- 331 Labour and labourers, Employers, Capital
- 332 Banks, Money, Credit, Interest
- 333 Land, Ownership, Rights and rent
- 334 Cooperation
- 335 Socialism and communism
- 336 Public finance, Taxation
- 337 Protection and free trade
- 338 Production, Economic organisation
- 339 Distribution and Consumption of wealth, Pauperism

Colon Classification

Derived from

X *Economics*

Based on

Type of Organisation

To be got by the

Chronological Device

(*Illustrative*)

- XM25 Cooperative
- XM55 Joint Stock Company
- XM85 Trust
- XN12 Public utility
- XN17 Communistic

Based on

Business Characteristic

- X4 Transport

- X6 Finance
- X7 Public Finance
- X8 Insurance

Other businesses

By the

Subject Device

(Illustrative)

- X9D Engineering Industry
- X9J Agricultural Economics
- X9JA Lumber Industry
- X9M13 Paper Industry
- X9M7 Textile Industry

Based on

Economic Characteristic

- X:1 Consumption
- X:2 Production
- X:3 Distribution
- X:4 Transport
- X:5 Commerce
- X:6 Financing
- X:7 Value, price
- X:8 Management
- X:9 Labour

Divisions based on the

Geographical Characteristic

and

Chronological Characteristic

are not given for considerations of space

Subject Classification

Derived from

L100-162 Economics

- L102 Production
- L103-105 Consumption
- L106-118 } Labour, work
- L150-161 }
- L120-147 Organisation
- L162 Cooperation

Congress Classification

Derived from

HB-HJ Economics

HB201-236	Value, Price
HB251-771	Distribution
HB801-845	Consumption
HB849-3840	Population
HC-HD2206	Natural products and Agricultural industry
HD2321-4730	Types of organisation (<i>Illustrative divisions</i>)
HD2709-2930	Trusts
HD2951-3570	Cooperation
HD3611-4730	Public utilities
HD4801-8940	Labour
HD9000-9999	Industries other than Agricultural (<i>Illustrative divisions</i>)
HD9750-9769	Lumber Industry
HD9820-9839	Paper Industry
HD9850-9975	Textile Industry
HE	Transport business
HF	Commerce
HG1-7933	Money, Banking, etc.
HG8011-9970	Insurance
HJ	Public Finance

Note. HB is called *Economic Theories*

HC-HD is called *Economic History*

CANON OF ENUMERATION

1. Applying the Canon of Enumeration, we find that the connotation of the term "Economics" varies from scheme to scheme. The Subject Classification, as usual, dispenses with conventions and the Decimal Classification does the same in this case to some extent. The Colon Classification and the Congress Classification agree most closely in their connotation.

DECIMAL CLASSIFICATION

(i) (a) The Decimal Classification's exclusion of Commerce from the class Economics has been already referred to in discussing Arrays of the Second Order. It is in this respect that the Decimal Classification supports the practice of the Subject Classification.

(b) The Decimal Classification's exclusion of Insurance from 330 Economics and insertion of it as a division of 360 Associations with the number 368 cannot be said to be in consonance with accepted contemporary practice.

(c) The inclusion of 335 Socialism and Communism as Types of Social Organisation and especially of 335.9 Socialist Communities in 330 Economics is a startling anomaly due to the fact that there is no adequate place for Sociology in the Scheme.

(d) Cooperation is the only special type of economic organisation that is given a place in the Decimal Classification. Other Types like Public Utility find no place in it.

COLON CLASSIFICATION

(ii) Almost all the classes occurring in the Array of the Congress Classification are found distributed in the three Arrays given under the Colon Classification. Further, though it is not apparent in the enumeration of the classes in the Array of the Third Order—the geographical and chronological classes of the Colon Classification (not written down in the above table for considerations of space) figure as Classes of the Third Order in the Congress Classification among the numbers of HC.

SUBJECT CLASSIFICATION

(iii) (a) The most objectionable feature of the Subject Classification's connotation of the term "Economics" is its exclusion from it of the entire subject of Finance (Money, Banking, etc.) which, moreover, is not placed near enough to Economics. In fact the two are separated by Politics and Law. No kind of justification for this can be found either on grounds of "logical order" or "scientific progression," if these are interpreted to serve the purpose of Library Classification whose final aim is to help readers.

(b) The exclusion of Public Finance from Economics is equally objectionable. I wonder if any Professor of Economics in any University would agree to this divorce of Public Finance from Economics.

(c) In spite of the Decimal Classification, modern practice will not approve even the exclusion of Commerce from Economics.

(d) The remarks about Types of Economic Organisation made in the study of the Decimal Classification also apply to the Subject Classification.

CONGRESS CLASSIFICATION

(iv) (a) The Congress Classification deviates from current practice in including HB849-3840 Population in the class "Economics". Perhaps it would be more appropriate to put it under "Sociology".

(b) There are also other queer inclusions. For example the Law of Primogeniture finds itself caged in class numbers HD1236-1239 in the class Agriculture in this Third Order Array having Economics for its immediate universe.

HOSPITALITY IN ARRAY

2. The Canon of Exhaustiveness and the Canon of Hospitality in Array are not satisfied at all in the Decimal Classification and the Subject Classification. They are satisfied in the Congress Classification so far as the gaps in its notation permit, and they can be satisfied to any desired extent in the Colon Classification.

DECIMAL CLASSIFICATION

(i) As usual all the ten places have been forcedly used up by the Decimal Classification.

(a) This is due partly to the allocation of places, in the Array of the First Order of Economics for subjects which are really types of social organisation, as has been already remarked under the Canon of Enumeration.

(b) It is also due to the attempt to put in one Array classes which are derived from Economics on the basis of

different characteristics. This aspect of the Array will be dealt with in greater detail later on.

(c) It should also be noted that the Array of the Third Order discloses the fact that there is no provision in the Decimal Classification for the Economics of specific industries or businesses such as Agricultural Economics, Economics of Railways or of Oceanic Transport—unless it is intended that books that so specialise in industries should be placed in 330.19 and be further subdivided by the Number for the specific industries taken from 600. Even then, books dealing with particular aspects of a given industry such as wages, labour, financing, management and so on will not come out with the books dealing with the industry as a whole, as the scheme directs the placing of such specialised books under the aspect of specialisation like wages, labour and so on.

(d) The absence of any means of accommodating new Types of Economic Organisation and any existing type other than Cooperation also offends against the Canon of Hospitality in Array.

COLON CLASSIFICATION

(ii) As applied to the Colon Classification, the Canon of Hospitality in Array should be studied with reference to all the three Arrays of the Third Order severally and collectively.

(a) Take first the Array based on Type of Organisation. Its classes are individualised by the Chronological Device, with the result that Infinite Hospitality is ensured. In fact each Type of Organisation brings its own class number with it.

(b) The Array derived by the Business Characteristic is also characterised by Infinite Hospitality. This is secured in its case by the Subject Device, a device as powerful as the Chronological one in securing Infinite Hospitality in Array.

(c) To all appearance, however, the Colon Classification has forgotten its helpful Octave Principle and rendered the Array derived by the Economic Characteristic inhospitable, by exhausting the whole 1 to 9 range in the

fashion of the Decimal Classification. But this is only apparent. Actually, it has purposely left 98 free as will be seen when we discuss Arrays of the Fourth Order. 981, 982, etc., are to accommodate new divisions of the class "Labour" and 991, 992, etc., are to be used for further classes in the Array of the Third Order derived by the Economic Characteristic. This makeshift is occasionally resorted to whenever it is felt that it will add to convenience if nine classes are accommodated in the First Octave itself.

(d) Whenever concrete facts of history or contemporary occurrence and not pure theory are to be accommodated, the services of the Geographical and Chronological Characteristics are requisitioned—any concrete event can be individualised in terms of space and time—and the Geographical and the Chronological Schedules of the Colon Classification have infinite Hospitality in Array.

SUBJECT CLASSIFICATION

(iii) The Subject Classification has only seven unoccupied places in its Array of the Third Order, *vis.*, L119, L126-L129, L148 and 149. This means that its Hospitality in Array is negligibly small.

CONGRESS CLASSIFICATION

(iv) The Congress Classification, on the other hand, has several hundreds of vacant numbers, scattered throughout the Array. The only danger is that eventually it may happen that new coordinate classes will have to be accommodated somewhere where there happens to be a gap, even against the requirements of filiation.

CANON OF HELPFUL ORDER

3. The Decimal Classification and the Congress Classification appear to show little respect to the Canon of Helpful Order, while the other two schemes satisfy it to a fair extent.

DECIMAL CLASSIFICATION

(i) (a) The Array of the Third Order under consideration is a mess in the Decimal Classification. This accounts partly for the breaking of the Canon of Helpful

Order. All the classes of this Array are not derived from 330 Economics on the basis of the same characteristic. 334 Cooperation and 335 Socialism and Communism are based on the Type of Economic Organisation, making it appear that the latter's inclusion is to be justified at any cost. The classes 332 Banking, etc., and 336 Public Finance are derived on the basis of the Business studied, while the other five classes are based on another characteristic.

(b) Even otherwise there is hardly any kind of developmental or other relational element in the arrangement of the classes. On the other hand,

(1) on no ground can one justify the separation of 332 Banking, Currency from 336 Public Finance;

(2) nor is the separation of 331 Labour from 338 Production and Organisation by six varied classes helpful from any point of view;

(3) it would have been more helpful if 332 Land, Ownership, Right and Rent had been placed in juxtaposition with 339 Distribution, etc.

COLON CLASSIFICATION

(ii) The Colon Classification satisfies the Canon of Helpful Order in different degrees in its three different Arrays of the Third Order.

(a) In the Array based on the Type of Organisation, since the classes are formed by the Chronological Device there is no freedom to arrange them in any more Helpful Order, if the order that the Chronological Device fixes is not helpful. As a matter of fact, the order forced by it is likely to neglect the genetic and other relations of the classes.

A similar situation arose in Mathematics in the Array of the Fourth Order studied in the last chapter. There, Special Functions had to be individualised in the class B39. Instead of applying the Chronological Device directly, B39 was first divided on the basis of the genesis of the function, an Intermediate Array of the Fifth Order was formed, and each of the classes in this Array was divided by the Chronological Device. In the result, the Special Functions

of a similar genesis were grouped together and the groups themselves were arranged in a Helpful Order.

Such a device is not possible in the Array in Economics under consideration. Thus we have the different Types of Organisation in chronological order only, in preference to a possibly more Helpful Order.

(b) As a result of the use of the Subject Device to form most of the classes in the Array based on the Business Characteristic, the Colon Classification here satisfies the Canon of Helpful Order quite well. In the case of the first four classes of the Array formed independently of the Subject Device, one criticism may be made. It would perhaps have been happier if X8 Insurance had been placed in juxtaposition to X6 Finance (Banking, etc.) without the intervention of X7 Public Finance.

(c) Of the five Arrays of the Third Order of the Colon Classification, the Canon of Helpful Order is satisfied to the least extent in the Array derived on the basis of the Economic characteristic. This does not however mean that the arrangement in the Array is a mess as in the Decimal Classification.

A VINDICATION

In fact it may be vindicated as follows:—

(1) The Array begins with X:1 Consumption since all economic activities are ultimately traceable to it;

(2) Then comes X:2 Production which is concerned with the supply of the element implied in the first class;

(3) Then comes X:3 Distribution which discusses the various ways (helpful and injurious), in which the real benefits of Production may be shared by the various factors of Production such as Land, and Plant, Capital, Management, Labour and Middleman. These shares appear under the names of Rent, Interest, Profit, Wages and Commission.

(4) Apart from this subtle and elusive question of Distribution, Production next involves the transport of the concrete produce from the place of production to the consumer, which is put down as X:4 Transport.

(5) The whole chain of operations, excluding Transport, which effect the transfer of the produce from the Producer to the Consumer comes next under X:5 Commerce.

(6) It would have been happier if the next class were "Value, Price". But Value, Price is class X:7 and class X:6 is Financing. This is a fault.

(7) Then come in succession X:8 Management and X:9 Labour. These with X:6 Financing would have been better accommodated near X:2 Production of which they are correlates. But the other correlates that have been accommodated on either side of X:2 Production have at least an equal claim to be there. Because in a linear arrangement one cannot accommodate all in ideal places, these three divisions have been inevitably relegated to the end of the first Octave of the Array.

SUBJECT CLASSIFICATION

(iii) The Subject Classification satisfies the Canon of Helpful Order quite well except for the irrational dismemberment of Labour which assigns one part to L106-118 and the other to L150-161 with L120-147 Organisation in between. This is a grievous fault in a scheme which swears by the principle of "Constant Place".¹

CONGRESS CLASSIFICATION

(iv) The Congress Classification also makes a mess of the classes in the Array of the Third Order under consideration, though not to the same extent.

(a) HD21-2206 Agricultural Business and HD9000-9999 Other Industries are separated by the whole gamut of classes HD2321-4730 based on Type of Economic Organisation and the class HD4801-8940 Labour. No justification can be found for this. This is a fault that might easily have been avoided.

(b) The position of HD4801-8940 Labour is not satisfactory or helpful in any way. It seems to be a misfit here.

¹ Brown (James Duff) : *Subject classification*. 1914. Pp. 9-10.

(c) I suppose some justification can be found for putting the theoretical aspects in the order: Value, Prices, Distribution, Consumption.

(d) The classes at the end of the Array beginning with HF Commerce and ending with HJ Public Finance are in a most Helpful Order.

ARRAYS OF THE FOURTH ORDER

As we did in the case of Mathematics, we shall consider only one corresponding Array of the Fourth Order taken from each Scheme.

Classes of the Arrays of the Fourth Order having Labour as their immediate universe

Decimal Classification

Derived from

331 Labour

- 331.1 Relations of Capital to labour
- 331.2 Remuneration for work
- 331.3 Labour of children
- 331.4 Labour of women
- 331.5 Work under certain unfavourable conditions
- 331.6 Pauper labour
- 331.7 Different classes of workers. Skilled and unskilled
- 331.8 Labouring classes
- 331.9 Other questions

Colon Classification

Derived from

X:9 Labour

- X:91 Labour System
- X:92 Labour Market
- X:93 Skilled and unskilled labour
- X:94 Labour hygiene
- X:95 Service conditions
- X:96 Trade Unions
- X:97 Strikes

Subject Classification

Derived from

L106-132 & L150-161 Labour

L106-111 Skilled and unskilled labour. Training

L112-115

L117 } Service conditions

L119 Strikes

L150-158 Labour Systems

L159-161 Trade Unions

Congress Classification

Derived from

HD4801-8940 Labour

HD4801-4905 Labour Systems

HD4906-5250 Service conditions

HD5306-5659 Strikes

HD5701-6000 Labour Market

HD6053-6338 Classes of labour

HD6350-6740 Trade Union, etc.

HD6951-7791 Social conditions, etc.

HD7801-8031 State & Labour

HD8039 Labour by trade

HD8051-8940 Labour by country

TERMINOLOGY

1. The terminology of all the schemes is fairly in accordance with usage.

(a) As we observed about the terminology of the Arrays of the Fourth Order in the comparative study of the classification of Mathematics, the terminology of the Arrays of higher order will, in general, be accurate and definite. It may be repeated that as the order of the Array increases, i.e., as we go down a Chain, progressively gaining in intension and eliminating extension we shall have more and more opportunity to deal with specific entities having sharp boundary lines, so that there will be greater agreement in the names by which they are denoted.

(b) The terminology in the Decimal Classification has some ambiguity and vagueness in this high order, but it is removed by appropriate notes.

HOSPITALITY IN ARRAY

2. All the systems except the Subject Classification satisfy the Canon of Exhaustiveness and the Canon of Hospitality in Array.

(i) This Array is one of those in which the Decimal Classification provides for the accommodation of other known and unknown coordinate classes by reserving the division 9 for "Other". In fact, we have for the last class of the Array 331.9 Other Questions.

(ii) The Colon Classification adopts its usual Octave Principle in a slightly modified form. It begins the second octave at 98 instead of 99, as the latter is the point of departure of the second octave of the Array of the Third Order.

(iii) The Subject Classification has no free number in the range assigned to "Labour".

(iv) The Congress Classification has set apart a fairly large range for "Labour" as can be seen from the table and has also left a big set of gaps within that range. Thus, it meets the Canon of Hospitality in Array fairly well.

CANON OF EXCLUSIVENESS

3. The Canon of Exclusiveness is not properly satisfied by the Decimal Classification. But it is well satisfied by the other schemes.

(i) The fault is not at once visible. But the class 331.1 Relations of Capital to Labour has for a subclass 331.113 Classification of Work and Workers, which has for its subdivisions 331.1133 Age, 331.1134 Sex, 331.11355 Apprentice, 331.11359 Handicapped.

(a) Again, the class 331.5 Work under certain unfavourable conditions contains as subclass 331.555 Apprentice labour and 331.559 Handicapped.

(b) Then there is overlapping between 331.113 Classification of Work and Workers and 331.7 Different classes of Labourers. This overlapping is certainly only apparent, being due to ambiguity in terminology. For, the

latter class is explained by a note which confines its range to "Work and workers according to different occupations and objects of work", whereas the former class divides workers on another basis.

(c) Next, how is the overlapping between the corresponding subdivisions of these two classes and that between them and the classes 331·3 Labour of children and 331·4 Labour of women, to be removed? It does not appear easy. The schedule gives no clue. Even if individual libraries adopt some convention, the differentiation between them will be rather thin and forced.

(ii) In the Congress Classification, the Canon of Context should be used to infer that

(a) HD8039 Labour by Trade is the place for books that deal with several aspects of a specific trade in many countries;

(b) HD8051-8940 Labour by country is the place for books that deal with several aspects of several trades in a specific country; and

(c) the other classes are to be used for books that deal with specific aspects of labour either generally or as applied to specific industries or specific countries.

If this is done, violation of the Canon of Exclusion can be avoided.

CANON OF HELPFUL ORDER

4. The Canon of Helpful Order is observed fairly well but not to the same extent by all the schemes of classification.

(i) (a) In the Decimal Classification, it would have been much more helpful if 331·2 Remuneration for Work were in juxtaposition to 331·8 Labouring Classes, the first division of which is 331·81 Duration of Work, which includes 331·817 Holidays and other similar items. At the same time 331·2 Remuneration for Work should also be next to 331·1 Relation of Capital to Labour. This dilemma is really due to the diffuse way in which the classes of the Fourth Order have been formed, as we have shown in discussing the Canon of Exclusiveness,

(b) There is another place where the Canon of Helpful Order is violated. But it is hidden by the vagueness of the terms used in naming the classes and has to be dissected out from lower orders. The separation of 331·15 Labour Relations within the Plant and 331·89 Disagreements between Capital and Labour by about five pages of schedule cannot be said to show a Helpful Order.

COLON CLASSIFICATION

(ii) In the Colon Classification, the progression of classes is tolerable. It may be questioned, however, whether the arrangement would not have been more helpful if X:94 Housing, Social conditions, Labour, Hygiene and X:95 Service conditions had changed their places.

SUBJECT CLASSIFICATION

(iii) In the Subject Classification, L150-158 Labour System is jettisoned between L114 Strikes and L159-161 Trade Unions. It would have been happier if it had been placed first as in the Colon Classification.

CONGRESS CLASSIFICATION

(iv) The order of the classes in the Congress Classification is more haphazard than in the other schemes. It is not easy to find any helpful related order in their progression.

(a) HD4906-5250 Service Conditions and HD7801-8031 State and Labour would have been next to each other if Helpfulness of Order had been aimed at.

(b) The separation of HD4861-4905 Labour Systems and HD6053-6338 Classes of Labour has not resulted in Helpful Order.

(c) It would have given a more Helpful Order if HD5701-6000 Labour Market had been given precedence over HD4906-5250 Service Conditions.

MODULATION

5. The Canon of Modulation is usually satisfied by all the schemes in all orders. But the Congress Classification is one of the few instances where it is broken.

HD8039 Labour by Trade and HD8051-8940 Labour by Country are classes of greater extension and smaller intension than all the other classes in the Array. But they are given the last place in it. They should, as a matter of fact, be considered to belong to different orders. Considerations of exigency do sometimes lead to such different orders being put in one Array. But, when that has to be done, the classes of lower order should have priority in the Array over classes of higher order.

The classes in the Array of the Fifth Order do not correspond with one another in the different schemes of classification. Their comprehension varies from scheme to scheme. They are subdivided so differently in the four schemes that no useful purpose will be served by continuing the present method of comparison to Arrays of the Fifth and higher orders. Therefore we pass to a comparative study of Chains.

COMPARISON OF CHAINS

Here again, we cannot easily find chains whose links correspond in all the schemes. Hence, we shall compare primary chains whose last links correspond.

First we shall take a chain that lies in one dimension only, then a chain lying in two dimensions only and lastly one lying in four dimensions.

The Colon Classification is capable of having a Chain in five dimensions, but as no other scheme is capable of this, there is no basis for comparison and hence no such five dimensional chain is studied.

Chains lying in one dimension (Economic aspect)

Decimal Classification

Universal knowledge



300 Social Sciences



330 Economics



33

331 Labour
 ↓
 331·8 Labouring Classes
 ↓
 331·81 Duration of Work
 ↓
 331·814 Overtime

Colon Classification

Universal knowledge

↓
 Y Social Sciences
 ↓
 X Economics
 ↓
 X:9 Labour
 ↓
 X:95 Service Conditions
 ↓
 X:951 Hours
 ↓
 X:9511 Overtime

Subject Classification

Universal knowledge

↓
 L Social & Political Science
 ↓
 L100-162 Economics
 ↓
 L106-118 &
 L150-161 Labour
 ↓
 L112-114 Economic conditions
 ↓
 L112 Hours

Congress Classification

Universal knowledge



H	Sociology
HB-HJ	Economics
HD4801-8940	Labour
HD4906-5250	Service conditions
HD5106	Hours
HD5111	Overtime

The following table abstracts and displays the relevant features of the above four chains. It gives the number of digits in the class numbers of successive orders in the different schemes.

Order	Decimal Classification	Colon Classification	Subject Classification	Congress Classification
First Order ..	3	1	4	6
Second Order..	3	1	4	6
Third Order ..	3	3	4	6
Fourth Order..	5	4	4	6
Fifth Order ..	6	5	4	6
Sixth Order ..	7	6		6

It is obvious from the above that

(i) The notation of the Decimal Classification has the following features:—

(a) It is as usual of uniform length till the Fourth Order and thereafter satisfies the Canon of Relativity.

(b) It occupies the second place in regard to shortness of notation throughout the chain.

(ii) The notation of the Colon Classification has the following features:—

(a) As usual, it satisfies the Canon of Relativity from the beginning.

(b) With regard to shortness of notation, it occupies the first rank in the first three orders, shares the first rank with the Subject Classification in the Fourth Order, loses the first place to the Subject Classification in the Fifth Order and recovers the first place and shares it with the Congress Classification in the Sixth Order.

(c) For any given length of notation, it reaches a much higher order than the Decimal Classification, except when the notation is limited to three digits.

(iii) (a) The Subject Classification notation is, as usual, of uniform length having four-digit numbers in all orders.

(b) Its chain fails earlier than that of the other schemes.

(iv) The Congress Classification notation is also, as usual, of uniform length, having six-digit numbers in all orders.

CHAINS LYING IN TWO DIMENSIONS (ECONOMIC AND GEOGRAPHICAL)

The following chains have ramifications in two dimensions—those of Economic aspect and Geographical Divisions.

Decimal Classification

	Universal Knowledge
300	Social Sciences
330	Economics
331	Labour
331·892	Strikes
331·892954	Strikes in India

Colon Classification

	Universal Knowledge
Y	Social Sciences

X Economics
 X:9 Labour
 X:97 Strikes
 X:97:44 Strikes in India

Subject Classification

Universal Knowledge

L Social and Political Science
 L100-162 Economics
 L106-118 Labour
 L116 Strikes
 L116P600 Strikes in India

Congress Classification

Universal Knowledge

H Social Sciences
 HB-HJ Economics
 HD4801-8941 Labour
 HD5306-5659 Strikes
 HD5419 Strikes in India

Here is the table showing the length of notation in different orders:—

Order	Decimal Classi- fication	Colon Classi- fication	Subject Classi- fication	Congress Classi- fication
First Order ..	3	1	4	6
Second Order..	3	1	4	6
Third Order ..	3	3	4	6
Fourth Order ..	7	4	4	6
Fifth Order ..	10	7	7	6

(i) With regard to the Canon of Relativity all the remarks already made continue to hold good for all the schemes.

(ii) In regard to length of notation also all the usual remarks hold good except that the Congress Classification has gained the first place in the Fifth Order, by the very clever trick by which the

table of Geographical Divisions given in the Appendix is constructed and applied.

The Chains of the Decimal Classification and the Subject Classification fail at the Fifth Order. But the Colon Classification and the Congress Classification can reach two further orders, by their ability to enter two other dimensions—Industrial and Chronological.

We have the following table for comparison:—

Chains lying in four dimensions

(Economic, Industrial, Geographical and Chronological)

Subject	Colon Classification	Congress Classification
Strike in India	X:97:44	HD5419
Strike in Chemical Industries in India	X9F:97:44	HD5419·C48
Strike of 1936 in Chemical Industries in India	X9F:97:44:N36	HD5419·C48 1936

The following table gives the number of digits in the class numbers of different orders in the two schemes of classification:—

Order	Colon Classification	Congress Classification
Fifth Order ..	7	6
Sixth Order ..	9	10
Seventh Order ..	13	14

We see that

(a) The Congress Classification begins to respect the Canon of Relativity from the Sixth Order onwards;

(b) The Colon Classification regains the first rank over the Congress Classification with regard to shortness of notation;

(c) The Colon Classification and the Congress Classification are able to reach one order higher with a notation which is respectively less than or equal to that of the Decimal Classification in the next lower order.

CONCLUSION AND SUMMARY

(1) So far as pure theory of Economics of a general nature is concerned, the Colon Classification is able to represent it by a number of one digit, whereas the Decimal Classification requires three digits, the Subject Classification four and the Congress Classification six digits.

(2) In regard to special aspects of pure theory, the Decimal Classification and the Colon Classification require only three digits to begin with. On account of the elastic nature of their notation, these schemes use numbers of increasing length for subdivision of special aspects of economic theory.

(3) When we turn to the general aspect of economic theory as applied to specific industries or businesses, such as Agricultural Economics, Economics of Textile Industry, etc.

(a) the Decimal Classification has no means of accommodating them;

(b) the Colon Classification however has a special array of classes for accommodating general theories of individual industries. As this array is built by the aid of the Subject Device, it has infinite capacity. It can individualise any industry or business whatever and arrange them in a related order.

(c) The Subject Classification does not attempt this problem at all, though some industries can as it happens be individualised with the aid of the categorical table.

(d) The Congress Classification has special places for different industries. But since they are arranged alphabetically, related industries do not come together. To put carpenters in C2 and wood carvers so far away as W7 is certainly bad.

(4) Regarding particular aspects of specific industries such as Labour, Financing, Marketing and so on, all the schemes have methods for individualising them, with this one difference:—

(a) In the Colon Classification the Array of Industries and the Array of Economic Aspect are given independently and by the Colon Device any necessary combination of any division of the first array with any division or subdivision of any order of the second array can be formed as and when required. This with the Subject Device in the construction of the First Array makes the schedule in Economics extremely compact and easy of reference in the Colon Classification.

(b) In the other schemes, however, in every subdivision of Economics, division by Industries has to be specifically provided for, and its unavoidable repetition considerably lengthens the schedule. Moreover, if division by industry is necessary in divisions in which no provision has been made for it by the scheme the Classification has either to be brought to a dead stop or different libraries must improvise means according to their lights.

(5) When it comes to concrete economic phenomena in particular geographical areas or in particular periods or points of time, the schemes are not equally efficient.

(a) In the Decimal Classification, if an Economic Division is subdivided on the industrial basis, it cannot be subdivided geographically. Further, there is no provision to differentiate books dealing with economic occurrences in different periods in a particular country. In other words, there is no provision for dividing economic happenings on the basis of time. After all, time is an essential characteristic for dividing Economic History or Concrete Economic Occurrences.

(b) In the Colon Classification however the geographical and chronological characteristics are available for division of any class or subclass of any order in Economics. Every concrete economic event is thoroughly individualised in the Colon Classification by its Colon Device.

(c) The Subject Classification fails in this respect in the same way as the Decimal Classification.

(d) The Congress Classification provides for division on the basis of both spatial and temporal factors only in certain classes such as Strikes, Public Finance, Transport, and so on. But there are several subclasses which admit only of geographical division.

(6) Lastly, there is a difference in the treatment given to Types of Economic Organisation.

(a) In the Decimal Classification, Cooperation is the only type which is recognised and that too is treated cursorily.

(b) The Colon Classification, however, has a special array for such divisions constructed by the Chronological Device. This Array can admit of an infinity of classes. Moreover divisions based on every other characteristic, *viz.*, Business, Economic, Geographical, and Chronological, can be applied to any Type of Organisation—an arrangement which is both thorough and elaborate.

(c) The Subject Classification has only one number for Cooperation in Type of Organisation. It does not divide this single type even as much as the Decimal Classification does. Nor has it any place for other Types of Organisation.

(d) The Congress Classification recognises not only Cooperation but also Public Utility as a Type of Organisation. But here again, no hospitality is provided. If new Types of Organisation come into existence, they cannot be accommodated in a filiationary manner. The only places we can find must be in gaps in numbers, and they may not be natural places. There is no means of housing such new Types of Organisation in appropriate filiationary order in relation to the divisions based on the different characteristics,—Business, Economic, Geographical and Chronological.

(7) We have also seen that although the Colon Classification has the necessary apparatus for dealing with all kinds of characteristics—in other words, has chains of classes, whose links lie in one or more

of five dimensions—the length of the class number is generally shorter than that of any other scheme when we compare class numbers taken from orders of equal intension.

9. SOME HINTS, SUMMARY AND CONCLUSION

In the last page of the first chapter, the implications of the process of classifying the entities of a universe were set forth. Applying these ideas to the universe of books in a library, classifying a book is assigning it to the appropriate class in the chosen scheme of classification and the assigning to it of the appropriate class number.

CLASSIFYING BOOKS

As Book Classification essentially depends on Knowledge Classification, we have seen that often we will get books corresponding to which there is no suitable class in the existing schedule. In such cases, we should create the necessary class in the proper filiationary place in accordance with the apparatus specified by the Scheme for the purpose. Examples have been given in chapter 4. If the new class demanded transcends such apparatus, a reference to the official editor of the scheme will become necessary.

As we have seen in chapter 4, a new class may have to be obtained either by introducing an extra class in an existing Array or by lengthening an existing Chain of classes. If the decimal notation is used, the latter process will involve lengthening of class number. Here comes the question of "economic length" of class numbers advocated by Bliss. Any library that has fixed such economic limit may have to give up increasing the intension of classes beyond a certain limit and assign many books to classes of smaller intension and greater extension than they warrant. To that extent, the need for creating new classes will be lessened. However, for cross reference purposes and for arranging bibliographies in the most helpful filiationary order, it is not desirable to fix any such economic limit but to create additional classes that answer exactly the intension of the idea or topic to be classified. Personally, I would

not vote for the economic limit even for books—particularly for pamphlets. My experience is that unless the pamphlets are minutely classified, both the Laws "Every reader his or her book" and "Every book its reader" get violated.

In all cases, the new classes created and the new decisions arrived at must be recorded.

To be consistent in classifying books, as soon as a book is classified a reference should be made to the catalogue and if necessary to the books of the same class already in the library, to compare the book newly classified with the old books that have received the same class number. Any correction indicated by such a comparison should be made, whether it is in the call number of the new book or of an old book.

The details of such routine involved in the classification of books in a library has been fully described in my book on library administration.¹

STAGES IN CLASSIFYING A BOOK SEQUENCE-MARKING

We have seen, in the first part, that there are four stages in the classification of a book. Of these, the fourth or the final stage is concerned with its assignment to the appropriate sequence of arrangement, according to the prescribed rules followed by the library. The assignment will have its counterpart in the amplification of the Call Number of the book by the corresponding sequence symbol. This stage may be called *Sequence marking*.

The number of sequences, their specification and their symbols will vary from library to library. Each library should frame its own rules on the subject. For an illustration, reference may be made to the practice of the Madras University Library, described in the author's book on library administration.² Leaving the books of the main sequence without any additional symbols, the underlining of the call numbers to indicate pamphlets, the overlining to

¹ Ranganathan (S. R.): *Library administration*. 1935. Chaps. 5, 8.

² *Ibid.* Rule 81, commentary.

indicate over-sized books, the underlining and overlining to indicate special collections, and the starring to indicate secondary sequence may be specially mentioned here as worth adoption in all libraries. In a school library, sequences may have to be formed on the basis of standards. This question and the associated set of sequence symbols are discussed in the author's forthcoming book entitled *School and college libraries*. It may be stated here that Roman numerals are recommended to be written above the Call Numbers to indicate standards.

The sequence-symbols are liable to be changed more often than the Class Number. Hence, under no circumstances should they be written in ink.

It may be stated that as the name Fourth Stage Classification implies, the marking of the sequence-symbols should be taken last, after the Call Number is fully worked out. This stage does not call for any further remarks.

BOOK-NUMBERING

The third or the penultimate stage in the classification of a book is to be taken up after its Class Number is fully worked out. It is concerned with the individualisation of the book—the assignment of its Book Number—so that it can be distinguished from the other books that share with it the same Ultimate Class. This stage may be called *Book-Numbering*. Here again, each library is to follow its own rules of practice. Whether the Cutter Numbers or the Biscoe Numbers are used or whether the more elaborate system specified in the *Colon classification* is used, the work is simple and calls for no special remarks or hints.

COMMON SUBDIVISION NUMBERING

The second stage in the classification of a book is that of amplifying, by an appropriate Common Subdivision Number, the Class Number reached at the end of the first stage. While every book will require to be given a Book Number, it is not every book that will admit of a Common Subdivision Number. But this fact does not save the classifier the need for paying attention to this stage and spending some time over it, even if it be to decide that the book does not admit of a Common Subdivision Number.

While any system of Book-Numbering and any system of Sequence-symbols can be used with any Scheme of Classification, the system of Common Subdivisions is something intrinsic to a Scheme of Classification. In other words, when a library chooses a particular Scheme of Classification for adoption, it implies that it has also chosen the Scheme of Common Subdivisions to be used, whereas it has still freedom to choose any system whatever of Book Numbers and of Sequence-symbols.

PITFALLS

The second stage of classification is also simple though not so simple as those of the third and the fourth stage. Beginners will have to beware of certain pitfalls.

(i) One chief source of trouble is the occurrence of the term Reports on the titles of books. This term may denote many things:—

(a) It may denote a regular periodical report, such as annual report, half-yearly report and so on issued by Government Departments, Learned Bodies and many other corporate bodies. They are the Reports proper and they have to be assigned the Common Subdivision digit for Reports.

(b) But the Report of a committee or commission should receive the Common Subdivision digit for Committees or Commissions and not that for Reports.

(c) Again, the Report of the Proceedings of a Conference or Congress should receive the Common Subdivision digit for Conference or Congress and not that for Reports.

(d) Similarly, the Report of a Survey should be given only the Common Subdivision digit for Surveys and not that for Reports.

(e) To mention another possibility of mistake, a statistical report should be given only the Common Subdivision digit for Statistics and not that for Reports.

(ii) In the Colon Classification, where the Common Subdivision digits are further amplified by the Chronological and/or Geographical Device, to secure greater intension and individualisation, some pitfalls are likely to occur.

(a) In most cases, the epoch for constructing the Chronological Number is that of the commencement, but in a few cases like history and survey the epoch is the latest decade covered. This lack of uniformity, which is due to the nature of the case, often leads beginners into mistakes.

(b) Again, the geographical area to be used for the construction of the Geographical Number is the country of origin of the publication in the case of Societies and Periodicals, but it is the country forming the subject of study in Yearbooks, Commissions, Acts, Reports, Statistics, Surveys and History.

(iii) Similar remarks apply also in the case of the Subject Classification and the Congress Classification, wherever geographical areas figure in the terms specified for Common Subdivisions.

BIAS-NUMBERING

Lastly we come to the first stage in the classification of a book. This stage begins with the choice of the first digit of the Class Number of the book and concerns itself with the progressive addition of further digits, until the time comes for the assignment of the Common Subdivision Number. Two substages can be recognised in the first stage—one that falls entirely into the sphere of Knowledge Classification and another that belongs to the sphere of Book Classification. The second substage consists of amplifying the Class Number reached at the end of the first substage,

(i) by the Relation Sign in the case of the Decimal Classification; and

(ii) by the Bias Number Device or the Classic Device in the case of the Colon Classification.

There is no second substage in the other schemes, except that the Categorical Tables of the Subject Classification represent a hybrid of the second substage and the second stage.

The second substage is not difficult except to the extent that the use of discretion which it demands may not become steady and helpful until some experience is gained. It must, however, be stated that the maximum possible

intension should be reached at the first substage, before entering the second substage.

THE FIRST SUBSTAGE

It is the first substage that usually gives much difficulty to beginners and often demands arduous work even from veterans. It is again the first substage that often involves the creation of new classes and the fixing of their filiation position in the chosen Scheme of Classification, in accordance with the apparatus furnished by the Scheme for this purpose. It is in this first substage that many pitfalls occur in almost all the Schemes of Classification, to the extent to which the Schemes themselves or their users fail or overlook any of the twenty-one Canons of Classification, developed in the General Theory and the Special Theory applicable to the Universe of Knowledge. The Decimal and the Congress Classification seek to minimise such pitfalls by the addition of notes under several classes in their schedules themselves. The Colon Classification seeks to achieve the same purpose by prescribing certain rules in the first part, and the Subject Classification by a carefully worded introduction. In spite of such provisions, there is need for each library to build up its own code as experience advances—a code of “principles by which consistency may be maintained by the classifier in assigning books to their appropriate places in a system of classification”.¹ A common factor of several such codes built up in American libraries is Merrill’s *Code for classifiers* published by the American Library Association in 1928.

PITFALLS

We shall now state some common pitfalls that should be avoided whatever be the Scheme of Classification adopted:—

CONFLICT WITH COMMON SUBDIVISIONS

(i) The first pitfall is due to the occurrence of certain terms both in the schedule of Common Subdivisions and in the schedules of Knowledge Classes. Care must be taken to see that no mistakes creep in on account of this.

¹ Merrill (William Stetson): *Code for classifiers*. 1928. P. vii.

(a) For example, in almost all the schemes, the term History occurs in both places. The Canon of Context and the Canon of Enumeration should be prominently borne in mind in deciding whether a book, which has the term History featured in its title, should go into the Main Class History, or whether it should go into some other Main Class and have its Class Number amplified by the Common Subdivision digit for History.

To give a concrete example, History of Indian Constitution should go into the Main Class History; but History of Indian Philosophy should go into the Main Class Philosophy.

(b) In certain schemes, the term Bibliography also occurs in both places as the term History and a similar precaution must be taken.

(c) Again, in the Decimal Classification and the Colon Classification several of the Common Subdivisions like Encyclopædias, Societies, Periodicals, Congresses, Yearbooks, and Biography, occur both in the schedule of Common Subdivisions and among the divisions of the Main Class, Generalia. Here also, a book—say an Encyclopædia, a Periodical, a Yearbook or a Biography—should be put in the Generalia Class only if the subject matter covered by the book answers the definition of Generalia. If, on the contrary, the subject matter is a definite one which belongs to a specific Class of Knowledge, it should be put into that class and the aid of the Common Subdivisions invoked to bring out the fact that it is an Encyclopædia or a Periodical, etc.

To give concrete examples,

(a) (1) The *Encyclopaedia Britannica* should be put in the Generalia Class, Encyclopædias; but

(2) the *Encyclopaedia of social sciences* should go into the Main Class Social Sciences and get its Class Number amplified by the Common Subdivision digit for Encyclopædias;

(3) the *Browning cyclopaedia* should go into the specific class for Browning—the English Poet—within the Main Class, Literature, and get its Class Number ampli-

fied by the Common Subdivision digit for Encyclopaedias;

(4) the *Banking encyclopaedia* should go into the specific class for Banking within the Main Class Economics, and get its Class Number amplified by the Common Subdivision digit for Encyclopædias; and so on.

(b) (1) Similarly, the *Indian antiquary* should be put in the Generalia Class, Periodicals, as it deals with all kinds of subjects; but

(2) the *Indian journal of obstetrics* should go into the specific class for Obstetrics within the Main Class Medicine, and get its Class Number amplified by the Common Subdivision digit for Periodicals.

CONFLICT WITH BIAS NUMBER DEVICE

(ii) The second pitfall is the temptation to invoke the aid of Relation Sign or the Bias Number Device prematurely, without bringing the Class Number to the greatest possible intension before their aid is sought or forgetful of the functions of Common Subdivisions.

To give concrete examples,

(a) We should not seek to construct the number for the Physiology of Vertebrates by using the number for Vertebrates as the basic number and the number for Physiology (general) as the related bias number or the number to come after the relation sign, if the scheme provides a special place for Physiology of Vertebrates within the Main Class Zoology.

(b) Nor should we seek to represent the History of Chemistry by coupling the Class Number of Chemistry and that of History by the Relation Sign or the Bias symbol. It should be represented by amplifying the Class Number of Chemistry by the digit for the Common Subdivision, History.

THE FIRST DIGIT

(iii) A third pitfall relates to the fixing of the first digit of the Class Number, i.e., to the deciding of the Main Class to which the book should be assigned. The pitfall may be due to different causes:—

DECEPTIVE TITLE

(a) A common mistake of the beginners is to put too much faith on the title and not confirm its indication by a reference to the contents, preface or the whole book if necessary, before acting upon it.

There are for example three books entitled *Grass*. The one by K. Rangachari is a botanical book on grass, of the vegetable kingdom. There is another which is a poem; while the one by Merian C. Cooper belongs to human geography as it deals with the migration of tribes in Persia.

OBLIQUE INTENTION

(b) Another cause for such a pitfall is the difficulty in deciding the main intention or purpose of the book.

(1) To take a concrete example, consider the solid, thought-provoking book Royden (Maude), *etc.*: *Seven pillars of fire*. It is a symposium of the following seven essays:—

The way of religion by Maude Royden;
 The human fact by L. P. Jacks;
 Erewhon come true by A. E. Richardson;
 The riddle of money by the Marquis of Tavistock;
 The art within the bellicose civilisation by C. R. W. Nevinson;
 The coming reformation by Bernard Acworth; and
 Utopia while you wait by E. Denison Ross.

No wonder if a beginner is puzzled by the range of these essays and is tempted to consign it to the class *Generalia*. But, if the whole book is studied and its background properly probed, one should say that the main aim of the book is to make an etiological analysis of the present day ills and maladjustments of society and hence its proper place is in the class, *Social Pathology*. The foreword in the book confirms this view.

(2) To take another example, a book in metaphysics may be apparently engaged in attacking Monism. But its real intention may be to establish Dualism. A book like that should be classed in Dualism and not in Monism.

(3) Similarly, Chesterton's *Browning* should be classed with Browning and not with Chesterton.

(4) So also, a literal Tamil translation of Kalidasa's *Sakuntala* should be classed in Sanskrit Literature and not in Tamil Literature and Maude's English translation of Tolstoy's works should be classed in Russian Literature and not in English Literature.

One rule that is found to be of help to beginners in many cases is this:—"Reduce the title to *one* word, blotting out all the words but the *most significant* one. Then, there is every chance for the Main Subject of the work to be that which is suggested by that *one* word." In the following examples, the *one* word to be retained is shown in italics:—

Examples:—

- (1) Grammar of *politics*.
- (2) Science of *society*.
- (3) *History* as a science.
- (4) Adventures in *philosophy*.
- (5) *Number* books for infants: a graduated series of exercises in addition and subtraction.
- (6) *Money* and a changing civilisation.

FURTHER DIGITS

(iv) A fourth pitfall may be met with even after the first digit or the Main Class of a book is correctly fixed. This pitfall may be due to the same type of causes as the third pitfall:—

DECEPTIVE TITLE

(a) Putting too much faith on the title and not confirming its indication by a reference to the contents, the preface or the whole book, if necessary, before acting upon it.

*Example:—*A book by A. S. J. Baster has the title *The international banks*. This title would tempt one to put it in the class, Bank of International Settlement. But the preface and the text show that the book is confined only to "the London banks operating mainly in foreign countries" and that a more appropriate class for the book is that of Commercial Banks.

OBLIQUE INTENTION

(b) Difficulty in deciding the main intention or purpose of the book.

*Example:—*A book by Harry Hamilton Laughlin has the title *Duration of the several mitotic stages in the dividing root-tip cells of the common onion*. In this title, the term *onion* occurs. This might lead a beginner to look upon this book as a book on Onions. But a careful perusal of the book will show that the purpose of the book is not to study onions, but to study the dynamics of mitosis. As some plant has to be taken for experiment, the onion has been taken. In other words, onion is taken only as a representative plant. In fact we read in page 25 of the book under the heading *Material for Experiments*,

"The temperature-range having been decided upon, it is next necessary to select suitable material. The onion, having proven to be so well adapted to the sort of study in hand, was chosen for the completer investigations. Not only has it long been known to show mitotic rhythm; but it presents a homogeneity of samples not so easily obtained in other types of organisms . . . Moreover, one sample may be taken without disturbing the activity of the others, at least during the few hours of sampling. They are not difficult to prepare cytologically . . . Finally the cells are large and the rate of mitotic activity permits convenient (10-minute) sampling intervals."

Hence, this book has to be given the Class Number for mitosis in the cytology of plants and not the one for onions.

OTHER PITFALLS

(v) Many other pitfalls may arise if the Canons of Enumeration and Context are not carefully observed. This has been already illustrated in Chapter 3, where the canons were enunciated and discussed.

(vi) Books of Partial Comprehension form another source of trouble. If the emphasis is visibly on one of the subclasses comprehended, the book can be classed in that subclass. Otherwise, it should be treated as suggested in

Chapter 5, where the Canon of Partial Comprehension is enunciated and discussed.

PITFALLS IN SYNTHETIC CLASSIFICATION

(vii) Lastly, there are some pitfalls peculiar to a synthetic type Classification. They can be avoided if one follows carefully the rules prescribed for the combination and permutation of the classes taken from the different characteristics specified for the Main Subject into which the book goes.

The Class Number should be built, digit by digit, in accordance with the rules. The digits that belong to the first characteristic should be first added to the first digit or the first set of digits, representing the Main Class or a Canonical Division of the same. Then the digit for the indication of change of characteristic should be added. Thereafter, the digits belonging to the second characteristic should be added; then again the digit for the indication of change of characteristic and so on. When we reach the end of the specified characteristics, we have reached the end of the first substage. We must reach the maximum possible intension demanded by this book before we leave this substage.

Then, we must examine if the book is written from any special point of view and if so we must add the relation sign or the bias digit and then add the bias number (the class number representing the special point of view). This completes the second substage of the first stage of classification.

Then, we enter the second stage, when we put the appropriate common subdivision digit, if any, and amplify it in accordance with the rules prescribed for the purpose.

Next, we construct the book-number in accordance with the rules prescribed for it. This completes the third stage of classification.

Lastly, we put the sequence-symbol, if any, in accordance with the rules on the subject and in consultation with the Reference Section and the Shelf Section in all cases of doubt.

SUMMARY AND CONCLUSION

In the first part we discussed successively the General Theory of Classification, the Special Theory of Knowledge Classification and the Special Theory of Book Classification as a means of building up the Theory of Library Classification.

As a preliminary to the General Theory, we devoted the first chapter to an analysis and clarification of the fundamentals of the subject and in so doing isolated certain new concepts and defined the terminology required to make further discussion economical. That chapter concluded by defining a Scheme of Classification as

a filiatory arrangement of the classes formed in the process of complete assortment of any universe under consideration.

Then we considered the following five categories implied in a scheme of classification:—

1. Associated scheme of characteristics
2. Arrays of classes
3. Chains of classes
4. Terminology
5. Notation

In chapters 2 and 3, we developed eighteen canons which the five categories must satisfy in order to make the scheme of classification efficient and the work of classifying consistent.

In chapter 4, we explored the special features of the Universe of Knowledge and developed three additional canons which a Scheme of Knowledge Classification must satisfy.

In chapter 5, we explored the special features that distinguish the Universe of Books from the Universe of Knowledge and enunciated seven additional canons to be satisfied by a Scheme of Book Classification, if it is to be an efficient basis for Library Classification.

We showed the superior suitability of a synthetic type of classification when the Universe is infinite as it is in Library Classification.

The comparison of the Decimal Classification, the Colon Classification, the Subject Classification, the Congress Classification and the Expansive Classification, incidentally made in the first part in elucidating the canons of classification was completed in the second part by a systematic comparison.

Chapter 6 was devoted to comparison of the Arrays of the First Order (Lay-outs) of the schemes.

Chapter 7 made a close comparison of these schemes with regard to certain typical Arrays and Chains in the case of Mathematics (chosen as representative of the Sciences).

Chapter 8 made a similar close study of the classification of Economics (chosen as representative of the Social Sciences).

The present chapter has given some general practical hints that may be of help in classifying books.

The twenty-eight Canons of Library Classification next page so as to show their respective fields of application:—

		Special Theory of Book Classification and Library Classification	
		Special Theory of Knowledge Classification	
		General Theory of Classification	
1	Canon of Differentiation	Characteristics	
2	Canon of Concomitance		
3	Canon of Relevance		
4	Canon of Ascertainability		
5	Canon of Permanence		
6	Canon of Relevant Sequence		
7	Canon of Consistency		
8	Canon of Exhaustiveness	Arrays	
9	Canon of Exclusiveness		
10	Canon of Helpful Order		
11	Canon of Consistent Order		
12	Canon of Intension	Chains	
13	Canon of Modulation		
14	Canon of Currency	Terminology	
15	Canon of Enumeration		
16	Canon of Context		
17	Canon of Reticence		
18	Canon of Relativity	Notation	
19	Canon of Hospitality in Array		
20	Canon of Hospitality in Chain		
21	Canon of Mnemonics		
22	Canon of Partial Comprehension		
23	Canon of Local Variation		
24	Canon of Viewpoint		
25	Canon of Classics		
26	Canon of Common Subdivisions		
27	Canon of Distinctiveness		
28	Canon of Individualisation		

INDEX

- a.t.* = applied to
i.r.t. = in relation to
q.i.r.t. = quoted in relation to
r.i.r.t. = referred in relation to

- Absolute values of digits, 75.
 Accidents *i.r.t.* canon of context, 72.
 Adjustable classification *i.r.t.* importance of notation, 98.
Adjustable classification, Publication of, 191.
 Agricultural economics, Provision in Decimal Classification for, 247.
 All India Library Conference, Second: *Proceedings*, *r.i.r.t.* canon of mnemonics, 130.
 Alphabetic device *i.r.t.* canon of hospitality in—
 Array, 104. Chain, 118-119.
 Alphabetic index, Function of, 28.
 Ambiguity in terminology, 62-63.
 American Electrotherapeutic Association *i.r.t.* canon of permanence, 34.
 American Library Association, Foundation, 185.
 — *i.r.t.* canon of currency, 65.
 — Catalog Section. *comp.: Cataloguers' & classifiers' yearbook*, 6, *q.i.r.t.*—
 Canon of currency, 66. Neglect of mnemonics, 124-125.
 Amplified class, Defined, 19.
 Analysis, 216.
 Analytical approach to general theory, 8-92.
 Anterior divisions in Colon Classification, 76.
 Anterior divisions *see* Common subdivisions.
 Anterior positions for common subdivision classes, 173-174.
 Anthropology *i.r.t.* canon of currency, 67.
 Applied mathematics, Connotation of, Compared, 216.
 Arable or Indian notation, Recommended, 185.
 Arithmetic *i.r.t.* canon of enumeration, 69.
 Arrangement, Filiatory—
 Contrasted with complete assortment, 20. Defined, 20. Illustrated, 6, 20-24.
Array—
 A concept involved in a scheme of classification, 26. Defined, 13. Illustrated, 5.
 —, Canons for, Defined and illustrated, 40-58.
 —, Closed, Defined and illustrated, 105-106.
 —, Collateral, Defined, 14.
 — in five dimensions in economics in Colon Classification, 241.

Array of—Contd.

Eighth order in mathematics in Colon Classification, 228-229.
 Fifth order in mathematics, compared, 223-227. First order, compared, 197-210. Fourth order in economics, compared, 252-256. Fourth order in mathematics, compared, 218-223.
 Second order containing mathematics, compared, 211-213.
 Second order in social sciences, compared, 236-240. Seventh order in mathematics in Colon Classification, 228. Sixth order in mathematics in Colon Classification, 228. Third order in economics, compared, 240-252. Third order in mathematics, compared, 213-218.

—, Open—

Defined and illustrated, 105-106. *v.i.r.t.* canon of exhaustiveness, 40.

Artificial composite book, 148.

Ascertainability, canon of, *see* Canon of ascertainability.

Associated complete assortment—

Defined, 17. Illustrated, 17-18.

Associated scheme of assortment, Defined, 17.

Association of Special Libraries: *Report and proceedings of the third conference*, *q.i.r.t.* length of notation, 88.

Assortment—

Defined, 12.

—, Associated scheme of, Defined, 17. Characteristic, Defined, 12.

—, Complete—

and associated scheme of classification, 25. Contrasted with filiiary arrangement, 20. Defined, 13, 16. Illustrated, 4.

Scheme of, Defined, 17.

Astronomy, 216.

Attribute—

Defined, 8. Illustrated, 8-9.

Author mark, 177.

Author number, 178.

Auto-bias device—

Defined and illustrated, 114-116. When first conceived, 194.

Banks, Types of, *i.r.t.* canon of mnemonics, 133.

Bhaktisutras *i.r.t.* canon of mnemonics, 133.

Bias number device *i.r.t.* canon of—

Consistent order, 51. Mnemonics, 128. Viewpoint, 155.

Bias-numbering, 272-273.

Bibliographic classification *i.r.t.* minuteness of classification, 268.

Biochemistry in Decimal Classification, 201.

Biography *i.r.t.* pitfalls in first stage classification, 274-275.

Biscoe numbers, 179.

Bliss (Henry Evelyn) *v.i.r.t.* economic length in notation, 268.

a.t. = applied to.

i.r.t. = in relation to.

- Bliss, *Organisation of knowledge in libraries q.i.r.t.* canon of—
 Helpful order in lay-out of—
 Congress Classification, 208. Decimal Classification, 204.
 Subject Classification, 207-208.
 Individualisation, 177. Mnemonics, 120-121.
 — *q.i.r.t.* subject-index illusion, 135.
 — *r.i.r.t.* canon of purity, 78.
 — *System of bibliographic classification, q.i.r.t.*—Anterior position to common subdivisions, 173-174. Canon of local variation, 150.
 Bodley *r.i.r.t.* canon of reticence, 68.
 Book-classification, Special theory of, 142-181.
 Book-keeping, 216.
 Book-number—
 i.r.t. canon of individualisation, 176. *i.r.t.* third stage classification, 176. Of the Colon Scheme, 179-180.
 Book-numbering, 270.
 Books, Universe of, Peculiarities of, 142-143.
 Borden (Wm. Alanson) *i.r.t.* canon of local variation, 153.
 Box—
 Related, defined, 22. Stranger, defined, 22.
 Bragg's work on crystals *i.r.t.* canon of mnemonics, 131.
 British Library Association, founded, 185.
 Brown (James Duff), Biography of, 190-191.
 — *Subject classification, q.i.r.t.*—
 Biscoe numbers, 179. Canon of consistent order, 46. Canon of hospitality in array, 104. Canon of individualisation, 176-177.
 —, *r.i.r.t.* canon of helpful order applied to array of third order in economics, 251.
 — and Sayers (W. C. Berwick): *Manual of library economy, r.i.r.t.* biography of Brown, 190.
 Calculus, 216.
 Canon of—
 Ascertainability—
 Defined, 33. Illustrated, 33.
 Classics—
 Defined, 157-158. Illustrated, 158-160.
 Common subdivisions—
 Defined, 163. Illustrated, 164-175.
 Concomitance, Defined, 31.
 Consistency—
 Defined, 39. Illustrated, 39.
 Consistent order—
 Defined, 46. Illustrated, 46-58.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

Canon of—Contd.

Context—

a.t. array of third order in mathematics, 218. Defined, 71. Illustrated, 72. *i.r.t.* pitfalls in first stage classification, 278.

Currency—

a.t. lay-outs, 197-199. Defined, 64. Illustrated, 64-67.

Differentiation, Defined, 31.

Distinctiveness, Defined, 163.

Enumeration—

a.t. array of—

Second order in sciences, 212-213. Second order in social sciences, 237-238. Third order in economics, 244-246. Third order in mathematics, 215-216.

a.t. lay-outs, 197-199. Defined, 69. Illustrated, 69-71. *i.r.t.* pitfalls in first stage classification, 278.

Exclusiveness—

a.t. array of—

Fourth order in economics, 254-255. Fourth order in mathematics, 221-223. Third order in mathematics, 217-218.

a.t. lay-outs, 203. Defined, 41. Illustrated, 41.

Exhaustiveness—

a.t. array of—

Fourth order in economics, 254. Fourth order in mathematics, 220-221. Second order in sciences, 213. Third order in economics, 246-248. Third order in mathematics, 216-217.

a.t. lay-outs, 200-202. Defined, 40. Illustrated, 40.

Helpful order—

a.t. array of—

Fourth order in economics, 255-256. Fourth order in mathematics, 223. Second order in sciences, 213. Second order in social sciences, 239-240. Third order in economics, 248-252. Third order in mathematics, 218.

a.t. lay-outs, 203-210. Defined, 42. Illustrated, 42-45.

Hospitality in array—

a.t. array of—

Fourth order in economics, 254. Fourth order in mathematics, 220-221. Second order in sciences, 213. Second order in social sciences, 238-239. Third order in economics, 246-248. Third order in mathematics, 216-217.

Defined, 99. Illustrated, 99-105.

Hospitality in chain—

a.t. chain in two dimensions in economics, 262. *a.t.* mathematics, 230-231. Defined, 106. Illustrated, 106-119.

Individualisation—

Defined, 176. Illustrated, 176-180.

a.t. = applied to.

i.r.t. = in relation to.

Canon of—Contd.**Intension—**

Defined, 59. Illustrated, 60.

Local variation—

Defined, 149. Illustrated, 150-153.

Mnemonics—

Defined, 120. Illustrated, 121-141.

Modulation—*a.t.* array of fourth order in economics, 256. Defined and illustrated, 61.**Partial comprehension—**Defined, 143-144. Illustrated, 144-148. *i.r.t.* pitfalls in first stage classification, 278.**Permanence—**

Defined, 34. Illustrated, 34-36.

Purity, 78.**Relativity—*****a.t.* chain in—**Four dimensions in economics, 262-263. One dimension in economics, 259-260. Two dimensions in economics, 260-262. *a.t.* mathematics, 231-233. Defined, 90. Illustrated, 90-92.**Relevance—**

Defined, 31. Illustrated, 31-32.

Relevant sequence—*a.t.* array of fourth order in mathematics in Decimal Classification, 222. Defined, 37. Illustrated, 37-38.**Reticence—**

Defined, 68. Illustrated, 68.

Viewpoint—

Defined, 153-154. Illustrated, 154-157.

Canonical order, Illustrated, 44-45.

Canons for—

Arrays, Defined and illustrated, 40-58. Chains, Defined and illustrated, 59-61. Characteristics, Defined and illustrated, 31-39. Notation, 73-92. Terminology, 63-72. Universe of books, 142-181. Universe of knowledge, 93-141.

Canons of library classification, Tabulated, 282.

Card catalogue *i.r.t.* canon of currency, 67.Catalogue, *i.r.t.* canon of—

Currency, 66-67. Partial comprehension, 146-148.

Cataloguers' & classifiers' yearbook, 6, *q.i.r.t.*—

Canon of currency, 66. Neglect of mnemonics, 124-125.

Categorical table, *i.r.t.* canon of—

Consistent order, 46. Hospitality in chain, 117.

Chain—

Defined and illustrated, 15.

—, Canons for, Defined and illustrated, 59-61.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

Chain—Contd.

—, Complete—

Defined, 15. Illustrated, 7, 15.

— in economics, Compared, 257-263.

— in mathematics, Compared, 229-233.

—, Incomplete, In the universe of knowledge, 96.

—, Loose, Defined and illustrated, 15.

— of classes—

A concept involved in a scheme of classification, 26. Illustrated,

7. In the universe of knowledge, 95-96.

—, Primary—

Defined, 15. Illustrated, 7, 15.

Characteristic—

A concept involved in a scheme of classification, 26. Defined, and illustrated, 9.

—, Assortment, Defined, 12.

—, Canons for, Defined and illustrated, 31-39.

—, Concomitant, Effect on division, 10.

—, Division, Defined and illustrated, 10.

—, Independent, Effect on division, 10.

Characteristics, Train of, Illustrated, 106-110.

Charles Ammi Cutter referred to, 188.

Chimerical notion about length of notation, 83.

Chronological Device i.r.t. canon of—Consistent order, 49. Helpful order *a.t.* array of third order in economics, 249. Hospitality in array, 102-103. Local variation, 152. Mnemonics, 128.— *i.r.t.* pitfalls in second stage classification, 271-272.**Class—**

Creation of new, 268. Defined, 13. Illustrated, 4.

—, Collateral, Defined, 14.

—, Index Entry *i.r.t.* canon of currency, 67.

—, Multiple—

Defined, 13. Illustrated, 5.

—, Number, Defined, 28.

—, Subordinate, Defined, 14.

—, Unitary—

Defined, 13. Illustrated, 3.

Classes—

Array of: A concept involved in a scheme of classification, 26.

—, Chain of—

A concept involved in a scheme of classification, 26. Illustrated, 7.

Classic Device *i.r.t.* canon of classics, 161-163.Classics, Canon of, *see* Canon of classics.Classification Decimale *i.r.t.* notation, 77.*a.t.* = applied to.*i.r.t.* = in relation to.

Classification—

- of economics, Compared, 236-267.
- of mathematics, Compared, 211-235.
- , Scheme of—
 - And associated complete assortment, 25. Defined, 26.
 - Fundamental categories of, 30. Illustrated, 7. Implications of, 26. Necessary aids in, 28.
- , Synthetic *see* Synthetic classification.
- , Theory (General), 1-181.

Classified catalogue code—

- q.i.r.t.* canon of currency, 67.
- r.i.r.t.* canon of partial comprehension, 147. Canon of permanence, 34. Classification of artificial composite books, 148-149.

Classifying,—Defined, 29. Described, 268-279.

Closed array, Defined and illustrated, 105-106.

Code for classifiers r.i.r.t. to first stage classification, 273.

Collateral array, Defined, 14.

Collateral class, Defined, 14.

Colon—

- Invented as an ordinal number, 192. Value of, 192.

Colon Classification—

Arrays in five dimensions in economics, 241. Genesis, 192.

i.r.t. anterior divisions, 76.

i.r.t. anterior position for common subdivisions, 174.

— *i.r.t.* canon of—

Classics, 158-163. Consistency, 39. Consistent order, 47-52.

Currency *a.t.* lay-out, 198-199.

Enumeration *a.t.*—

Array of third order in economics, 245. Lay-out, 198-199.

Exclusiveness *a.t.* array of—

Fourth order in economics, 254. Third order in mathematics, 218.

Exhaustiveness, 40.

Helpful order, 42-45.

— *a.t.* array of—

Fourth order in economics, 256. Fourth order in mathematics, 223. Third order in economics, 249. Third order in mathematics, 218.

— *a.t.* lay-out, 204-206.

Hospitality in array, 100-104.

— *a.t.* array of—

Fourth order in economics, 254. Fourth order in mathematics, 221. Third order in economics, 247-248. Third order in mathematics, 217.

Hospitality in chain, 108-116.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

Colon Classification—Contd.

i.r.t. canon of—contd.

Hospitality a.t.—

Chain in two dimensions in economics, 262. Economics, 257-263. Mathematics, 229-230.

Individualisation, 179-180. Local variation, 150-152. Mnemonics, 123-141. Relativity, 90-92.

Relevant sequence, 37-38. a.t. mathematics, 223.

Viewpoint, 154-157.

— i.r.t. chain in four dimensions in economics, 262-263. Creation of new class numbers, 141. Importance of notation, 98. Mathematical functions, 226-229. Non-scheduled mnemonics, 129-133. Notation, 75-76. Parallel order, 55-57. Terminology in lay-out, 198-199. Theory of functions, 227-229.

—, Lay-out, 196.

— vs. Decimal Classification i.r.t. canon of common subdivisions, 170.

Colon Classification—

— q.i.r.t. anterior position for common subdivisions, 174.

— q.i.r.t. canon of—

Classics, 161-163. Common subdivisions, 166-167. Consistent order, 48, 50. Local variation, 151. Relevant sequence, 223. Viewpoint, 155.

— r.i.r.t. canon of—

Consistency, 39. Consistent order, 49, 51. Enumeration, 71. Hospitality in chain, 110. Relevant sequence, 38. Individualisation, 176.

— r.i.r.t. comparison of array of third order in economics, 241.

Colon curve, 86.

Colon device i.r.t. canon of—

Consistent order, 49-50. Hospitality in chain, 108-110 and 112-114. Mnemonics, 127.

Colon scheme book numbers, 179-180.

Colon vs. Decimal Classification, a statistical study of their notation, q.i.r.t. length of notation, 83-89.

Commerce in Decimal Classification and Subject Classification, 245.

Committee on Decimal Classification, 65.

Common subdivision numbering, 270-272.

Common subdivisions, Canon of, see Canon of common subdivisions.

— i.r.t. canon of consistent order, 46-48. Schedules of, 164-165.

Communism in Decimal Classification, 245.

Complete assortment—

And associated scheme of classification, 25. Contrasted with filiator arrangement, 20. Defined, 13, 16. Illustrated, 4.

—, Associated—

Defined, 17. Illustrated, 17-18.

a.t. = applied to.

i.r.t. = in relation to.

Complete chain—

Defined, 15. Illustrated, 7, 15.

Complete division, Defined and illustrated, 11.

Complete pseudo-chain, Defined, 19.

Completely amplified class, Defined, 19.

Completely amplified original universe, Defined, 19.

Composite terms, Derived, 137-139.

Concomitance, Canon of, *see* Canon of concomitance.

Concomitant characteristic, Effect on division of, 10.

Congress cards, Decimal Classification numbers on, 65.

Congress Classification—

Genesis, 189-190. *i.r.t.* anterior position for common subdivisions, 174-175.

— *i.r.t.* canon of—

Consistent order, 52-55. Currency, 64. Currency *a.t.* lay-out, 199.

Enumeration *a.t.* array of—

Second order in sciences, 213. Second order in social sciences, 238. Third order in economics, 246.

— *a.t.* lay-out, 199.

Exclusiveness *a.t.* array of fourth order in economics, 255.

Helpful order, 42-44.

— *a.t.* array of—

Fourth order in economics, 256. Fourth order in mathematics, 223. Second order in sciences, 213. Second order in social sciences, 240. Third order in economics, 251-252. Third order in mathematics, 218.

— *a.t.* lay-out, 208-209.

Hospitality in array, 105.

— *a.t.* array of—

Fourth order in economics, 254. Fourth order in mathematics, 221. Second order in sciences, 213. Second order in social sciences, 238-239. Third order in economics, 248. Third order in mathematics, 217.

Hospitality in chain, 118-119.

— *a.t.*—

Chain in two dimensions in economics, 262. Economics, 257-263. Mathematics, 229-230.

Mnemonics, 134. Modulation in array of fourth order in economics, 256. Relativity, 90-92. Viewpoint, 157.

— *i.r.t.*—

Chain in four dimensions in economics, 262-263. Mathematical functions, 225-227. Notation, 76-77. Parallel order, 58.

Terminology in lay-out, 199. Theory of functions, 226-227.

— Lay-out, 197.

Consistency, Canon of, *see* Canon of consistency.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

- Consistent order, Canon of, *see* Canon of consistent order.
 Constituent terms, Fundamental, 137-139.
 Context, Canon of, *see* Canon of context.
 Continuous groups, 221.
 Correlation coefficient of Colon Classification and Decimal Classification, 88.
 Correlation table, 84.
 Creation of new class, 268.
 Cross reference entry and canon of partial comprehension, 147-148.
 Crystals *i.r.t.* canon of mnemonics, 131-132.
 Currency, Canon of, *see* Canon of currency.
 Cutter (Charles Ammi)—
 Biography, 188-189. *i.r.t.* Congress Classification, 190. *i.r.t.* Decimal Classification, 188.
 Cutter (William Parker)—
 i.r.t. Congress Classification, 190.
 — Charles Ammi Cutter, Referred to, 188.
 Cutter numbers, 178.
 Cyclopaedias *i.r.t.* pitfalls in first stage classification, 274-275.
 Dawe (Grosvenor). *Comp.: Melvil Dewey, seer, inspirer, doer.*—
 q.i.r.t. canon of local variation, 153. *r.i.r.t.* Dewey's biography, 184.
 Deceptive title *i.r.t.* pitfalls in first stage classification, 276-277.
Decimal Classification—
 Committee on, 65. Genesis, 186-187. *i.r.t.* anterior position for common subdivisions, 174. *i.r.t.* array of fifth order in mathematics, 223-226.
 — *i.r.t.* canon of—
 Consistency, 39. Consistent order, 47. Currency, 64-66.
 Currency *a.t.* lay-out, 197-199.
 Enumeration *a.t.* array of—
 Second order in sciences, 212. Second order in social sciences, 237. Third order in economics, 245.
 — *a.t.* lay-out, 197-199.
 Exclusiveness *a.t.* array of—
 Fourth or higher order, 222. Fourth order in economics, 254-255. Third order in mathematics, 218.
 Exhaustiveness, 40.
 — *a.t.* array of second order in sciences, 213.
 Helpful order, 42-45.
 — *a.t.* array of—
 Fourth order in economics, 255-256. Fourth order in mathematics, 223. Second order in sciences, 213. Second order in social sciences, 239. Third order in economics, 248-249. Third order in mathematics, 218.

a.t. = applied to.

i.r.t. = in relation to.

Decimal Classification—Contd.— *i.r.t.* canon of—*contd.*Helpful order *a.t.* lay-out, 203-204.

Hospitality in array, 99-100.

— *a.t.* array of—

Fourth order in economics, 254. Fourth order in mathematics, 220-221. Second order in sciences, 213. Second order in social sciences, 238. Third order in economics, 246-247. Third order in mathematics, 217.

Hospitality in chain, 106-108.

— *a.t.*—

Chain in two dimensions in economics, 262. Economics, 257-263. Mathematics, 229-230.

Local variation, 152-153. Relativity, 90-92. Relevant sequence, 38. Relevant sequence *a.t.* mathematics, 222.

Viewpoint, 154, 157.

— *i.r.t.*—

Commerce, 245. Importance of notation, 98. Insurance, 245. Mathematical functions, 235. Notation, 75. Parallel order, 58. Scheduled mnemonics, 121-126. Socialism and communism, 245. Sociology, 239. Terminology in array of fourth order in economics, 253. Terminology in lay-out, 197-199.

— Lay-out, 196. Mutilation of, 192. Proposed, 185.

— numbers on Congress cards, 65.

vs. Colon Classification *i.r.t.* canon of common subdivisions, 170.*Decimal classification*, Editions of, 187.*Decimal classification and relative index q.i.r.t.*—

Author numbers, 178. Canon of hospitality in array, 99. Canon of viewpoint, 154. Minute classification, 111-112.

Decimal curve, 86.

Decimal notation, 74-75. *i.r.t.* canon of hospitality in chain, 116.

Derived composite terms, 137-138.

Developmental order, Illustrated, 42-43.

Dewey (Melvil), Biography, 184-187.

— *i.r.t.*—

Colon Classification, 192-193. Congress Classification, 190.

— Putnam's estimate of, 185-186.

— *q.i.r.t.*—

Canon of local variation, 153. Colon Classification, 194.

— *r.i.r.t.* Canon of currency, 64.—: *Decimal classification and relative index, q.i.r.t.*—

Author numbers, 178. Canon of hospitality in array, 99. Canon of viewpoint, 154. Minute classification, 111-112.

Diagrammatic approach to general theory, 2-7.

Dictionaries *i.r.t.* pitfalls in first stage classification, 274-275.Differentiation, Canon of, *see* Canon of differentiation.

Digit, 73.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

- Distinctiveness, Canon of, *see* Canon of distinctiveness.
- Division characteristic, Defined, 10.
- Division, Complete, Defined and illustrated, 11.
- Division, Defined and illustrated, 10.
- Dunoyer's work on molecular rays *i.r.t.* canon of mnemonics, 132.
- Eaton (John) *i.r.t.* Decimal Classification, 187.
- Economic length in notation, 268-269.
- Economic limit in length of class number in mathematics, 232.
- Economics—
 Comparative study of, 236-267. Of specific industries, Provision in Decimal Classification for, 247.
- Eighth order array in mathematics in colon classification, 228-229.
- Elasticity, 216.
- Embodied knowledge, 142.
- Empty box, And pseudo-entity, 25.
- Encyclopaedias *i.r.t.* pitfalls in first stage classification, 274-275.
- Entity—
 Defined and illustrated, 8. Related, Defined, 22. Stranger, Defined, 22.
- Enumeration, Canon of, *see* Canon of enumeration.
- Essays offered to Herbert Putnam by his colleagues and friends on his thirtieth anniversary as librarian of Congress i.r.t.* canon of helpful order *a.t.* lay-out of Congress Classification, 208.
- Evasion in terminology and synthetic classification, 135-139.
- Exclusiveness, Canon of, *see* Canon of exclusiveness.
 — in common subdivisions, 171.
- Exhaustiveness, Canon of, *see* Canon of exhaustiveness.
 — in common sub-divisions, 168.
- Expansive Classification**, Genesis of, 188-189.
 — *i.r.t.* canon of—
 Consistent order, 46. Currency *a.t.* lay-out, 199. Enumeration *a.t.* lay-out, 199. Helpful order *a.t.* lay-out, 209.
 — *i.r.t.* importance of notation, 98. Notation, 77. Terminology in lay-out, 199.
 —, Lay-out, 197.
- Extension and intension, Defined and illustrated, 59-60.
- Family of *Siddhas* as an illustration of complete assortment, 20.
- Favoured country *i.r.t.* canon of local variation, 151.
- Favoured language *i.r.t.* canon of local variation, 151.
- Fifth order array in mathematics, Compared, 223-226.
- Filiatory arrangement—
 Contrasted with complete assortment, 20. Defined, 20. Illustrated, 6, 20-24.

First link—

Defined, 15. Illustrated, 7, 15.

First order arrays, Compared, 197-210.

First stage classification, Hints for, 272-279.

First substage in first stage classification, Hints for, 273-279.

Five laws of library science r.i.r.t.—

Genesis of Colon Classification, 192. Library classification, 93.

Forestry in Decimal Classification, 201.

Form and style in poetry q.i.r.t. canon of permanence, 35-36.

Form division of poetry, *i.r.t.* canon of permanence, 35-36.

Form-headings *see* Common subdivisions.

Foundation *i.r.t.* canon of context, 72.

Four dimension chain in economics, Compared, 262-263.

Fourth order array in—

Economics, Compared, 252-256. Mathematics, Compared, 218-223.

Fourth stage classification—

Hints for, 269-270. Need for, 173.

Fraser (Ronald G.J.): *Molecular rays, q.i.r.t.* and *r.i.r.t.* canon of mnemonics, 132.

Frequency curves, 86.

Functions of real variables, 227.

Function-space *i.r.t.* canon of mnemonics, 130-131.

Fundamental constituent terms, 137-139.

General theory—

Analytically approached, 8-93. Diagrammatically approached, 2-7.

Generalia *i.r.t.* pitfalls in first stage classification, 274-275.

Geographical device *i.r.t.* canon of—

Consistent order, 48. Hospitality in array, 103-104. Local variation, 152. Mnemonics, 128.

— *i.r.t.* pitfalls in second stage classification, 272. *i.r.t.* scheduled mnemonics, 121-122.

Geometry—

In Decimal Classification, 217. *i.r.t.* canon of enumeration, 69.

Group—

Defined, 11. Multiple, Defined, 11. Unitary, Defined, 11.

Handbuch der experimental physik r.i.r.t. canon of mnemonics, 132.

Helpful order, Canon of, *see* Canon of helpful order.

— in common subdivisions, 168.

Hilbert space *i.r.t.* canon of mnemonics, 130.

History *i.r.t.* pitfalls in first stage classification, 274.

Hospitality in array, Canon of, *see* Canon of hospitality in array.

Hospitality in chain, Canon of, *see* Canon of hospitality in chain.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

- Hospitality in common subdivisions, 168.
 Humbugs, 68.
- Immediate universe, Defined, 14.
 Incomplete chain in universe of knowledge, 96.
 Independent characteristic, Effect on division of, 10.
 Indian Botanical Society *r.i.r.t.* canon of permanence, 34.
 Indian notation recommended, 185.
 Individualisation, Canon of, *see* Canon of individualisation.
 — in common subdivisions, 168-169.
 'Individualise', Defined, 16.
 Infinite series, 221.
 Institut International de Bibliographie *i.r.t.* canon of currency, 65.
 Insurance in Decimal Classification, 245.
 Integral equations, 221.
 Integral notation, 74. *i.r.t.* canon of hospitality in chain, 116.
 Intension and extension, Defined and illustrated, 59-60.
 Intension, Canon of, *see* Canon of intension.
 Intention of author, Oblique, *i.r.t.* pitfalls in first stage classification, 276, 278.
 Internal repair of catalogue, 67.
 International Institute of Bibliography *i.r.t.* notation, 77.
 Introduction to library classification *q.i.r.t.*—
 Author marks, 177. Canon of intension, 59-60. Cutter numbers, 178. Importance of notation, 97. Merrill numbers, 178.
 — *r.i.r.t.* canon of purity, 78.
- Johnsonian definition of oats, 68.
Journal of Indian botany r.i.r.t. canon of permanence, 34.
- Ker (W.P.): *Form and style in poetry q.i.r.t.* canon of permanence, 35.
 Kinship, Lineal, In chain, 22.
 Knowledge classification—
 Importance of notation in, 97-98. Special theory of, 93-141.
 Knowledge, Defined, 93.
 Knowledge, Future, Inaccessible or Potential, 94.
 Knowledge, Universe of—
 As a completely amplified universe, 25. Defined, 95. Peculiarities of, 95-96.
- Lake Placid Club Education Foundation *i.r.t.* canon of currency, 64.
 Last link—
 Defined, 15. Illustrated, 7, 15. In the universe of knowledge, 96.
 Law of Parsimony *i.r.t.* synthetic classification, 137-138.
 Laws of Library Science *i.r.t.* minute classification, 269.

a.t. = applied to.

i.r.t. = in relation to.

Lay-out—

Compared, 197-210. Tabulation of, 196-197. Unimportance of order in, 209-210.

Learned societies and periodicals *i.r.t.* canon of permanence, 34-35.

Left-handed notation, 74.

Length of notation, 79-92.

— Compared in mathematics, 231-233. Discussed, -92. *i.r.t.* chain in four dimensions in economics, 262-263. *i.r.t.* chain in two dimensions in economics, 261-262.

Library administration *r.i.r.t.*—

Creation of new classes, 269. Fourth stage classification, 173, 269. Principle of parallel movement, 180.

Library Association record *q.i.r.t.*—

Canon of common subdivisions, 170. Canon of local variation, 152. Creation of class numbers, 141.

Library Bureau founded, 185.

Library classification—

Basis for, 93. *i.r.t.* knowledge classification, 93.

Library journal—

Founded, 185. *q.i.r.t.* genesis of Decimal Classification, 186.

Library of Congress: *Classification. Class D. Universal and old world history r.i.r.t.* canon of partial comprehension, 146.

Library of Congress classification—

q.i.r.t. Canon of hospitality in array, 105. *r.i.r.t.* canon of helpful order *a.t.* lay-out of Congress Classification, 208.

Library School of Madras *i.r.t.* Colon Classification, 194.

Library world—

Founded, 190. *q.i.r.t.* canon of common subdivisions, 165-166.

Like, Defined and illustrated, 9.

Lineal kinship, in chain, 22.

Linear notation, 74.

Linear transformations in Hilbert Space and their application to analysis q.i.r.t. canon of mnemonics, 130-131.

Link, First—

Defined, 15. Illustrated, 7, 15.

—, Last—

Defined, 15. Illustrated, 7, 15. In the universe of knowledge, 96.

Local list *i.r.t.* canon of consistent order, 46.

Local variation, Canon of, *see* Canon of local variation.

Long—

Notation, 79-92. Class numbers, Justified, 156. *vs.* short notation, 79-92.

Loose chain—

Defined, 15. Illustrated, 7, 15.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

- Madras University Library—
i.r.t. Colon Classification, 193. *r.i.r.t.* canon of permanence, 35.
- Manual of classification q.i.r.t.* canon of—
 Helpful order in lay-out of—
 Decimal Classification, 203. Expansive Classification, 209.
 Mnemonics, 120.
 — *q.i.r.t.* importance of notation, 98.
 — *r.i.r.t.* canon of purity, 78.
- Manual of library economy—*
 Publication, 191. *r.i.r.t.* biography of Brown, 190.
- Martel (Charles) *i.r.t.* Congress Classification, 189-190.
 —: *Library of Congress classification r.i.r.t.* canon of helpful order
 in lay-out of Congress classification, 208.
- Mathematics, Comparative study of, 211-235.
- Means of Colon Classification and Decimal Classification, Compared,
 87.
- Medians of Colon Classification and Decimal Classification, Com-
 pared, 85.
- Medicine, Systems of, *i.r.t.* canon of local variation, 152.
- Medical library *r.i.r.t.* canon of permanence, 34.
- Melvil Dewey: *seer, inspirer, doer, q.i.r.t.* canon of local variation,
 153. *r.i.r.t.* Dewey's biography, 184.
- Merrill (William Stetson): *Code for classifiers r.i.r.t.* first stage
 classification, 273.
- Merrill numbers, 178.
- Metric Bureau, 185.
- Minor authors *i.r.t.* canon of reticence, 68.
- Minute classification, Dewey's defence of, 111-112.
 —, Need of, In—
 Bibliographic classification, 268. Knowledge classification, 93.
 Library classification, 268-269. Pamphlet classification, 269.
- Mixed notation, 73.
- Mnemonics, Canon of, *see* Canon of mnemonics.
 — In common subdivisions, 168.
 —, Non-scheduled—Defined, 121. Result of neglect of, 124-126.
 —, Scheduled—
 Defined, 121. Illustrated, 121-128.
- Modern librarian q.i.r.t.—*
 Artificial composite books, 149. Length of notation, 83-89.
- Modes of Colon Classification and Decimal Classification, Compared,
 85.
- Modulation, Canon of, *see* Canon of Modulation.
- Molecular rays *i.r.t.* canon of mnemonics, 132.
- Molecular rays q.i.r.t.* and *r.i.r.t.* canon of mnemonics, 132.
- Morphology *i.r.t.* canon of context, 72.
- Mother country *i.r.t.* canon of local variation, 151.

Multiple class—

Defined, 13. Illustrated, 5.

Multiple group, Defined, 11.

Narada: *Bhaktisutras* i.r.t. canon of mnemonics, 133.Natarajan (K.): *Vagaries in Indian book production*, Quoted, 149.

Neglect of mnemonics, Result of, 124-126.

New class, Creation of, 268.

New English dictionary r.i.r.t. terminology, 63.*New placings in Colon Classification*, Some, q.i.r.t. canon of mnemonics, 130-134.

Non-scheduled mnemonics—

Defined, 121. Illustrated, 129-133.

Notation—

Canons for, 73-92. Defined, 28. Importance in knowledge classification, 97-98. Length of, 79-92.

Nunc Dimittis, 65.

Oats, Johnsonian definition of, 68.

Oblique intention of author i.r.t. pitfalls in first stage classification, 276, 278.

Octave notation r.i.r.t. canon of exhaustiveness, 40.

Octave principle a.t. array of—

Fourth order in mathematics, 221. Third order in economics, 247-248. Third order in mathematics, 217.

— Defined and illustrated, 100-101. i.r.t. canon of hospitality in array a.t. array of fourth order in economics, 254.

One dimension chain in economics, Compared, 257-260.

Open array—

Defined and illustrated, 105-106. i.r.t. canon of exhaustiveness, 40.

Order—

Defined, 14. Illustrated, 5, 6, 13.

Organisation of knowledge in libraries q.i.r.t. canon of—

Helpful order in lay-out of—

Congress Classification, 208. Decimal Classification, 204.

Subject Classification, 207-208.

Individualisation, 177. Mnemonics, 120-121.

— q.i.r.t. subject index illusion, 135.

— r.i.r.t. canon of purity, 78.

Original universe, Illustrated, 3.

—, Completely amplified, Defined, 19.

"Other" device—

Defined, 99. Illustrated, 99-100.

q.i.r.t. = quoted in relation to. r.i.r.t. = referred in relation to.

- "Other" principle, Extended, 100-101.
- Pamphlets *i.r.t.* minute classification, 269.
- Parallel order of similar classes, Illustrated, 55-58.
- Parsimony, Law of, and synthetic classification, 137-138.
- Partial comprehension, Canon of, *see* Canon of partial comprehension.
- Periodicals *i.r.t.* pitfalls in first stage classification, 274-275.
- Periodicals and Learned Societies *i.r.t.* canon of permanence, 34-35.
- Periodogram analysis and canon of mnemonics, 131.
- Permanence, Canon of, *see* Canon of permanence.
- in common subdivisions, 171.
- Philology *i.r.t.* canon of currency, 67.
- Philosophical systems *i.r.t.* canon of local variation, 151-152.
- Philosophy *i.r.t.* canon of—
- Currency, 67. Enumeration, 71.
- Physical review i.r.t.* canon of permanence, 35.
- Physical Society *i.r.t.* canon of permanence, 35.
- Pitfalls in—
- First substage classification, 273-279. Second stage classification, 271-272.
- Plane notation, 74.
- Poetry, Form division of, *i.r.t.* canon of permanence, 35-36.
- Politics *i.r.t.* canon of enumeration, 71.
- Potentials, 216.
- Pressy (J.C.) *q.i.r.t.* canon of currency, 66.
- Principle of parallel movement, 180.
- Primary chain—
- Defined, 15. Illustrated, 7, 15.
- Probabilities in Decimal Classification, 217.
- Problems in calculus in Decimal Classification, 221.
- Proceedings of the Second All India Library Conference r.i.r.t.* canon of mnemonics, 130.
- Pseudo-chain, Defined, 19.
- , Complete, Defined, 19.
- Pseudo-class, Defined, 19.
- , Rank of, Defined, 19.
- Pseudo-entity—
- And empty box, 25. Defined, 19. In the universe of knowledge, 95.
- Public libraries in the United States r.i.r.t.* genesis of Decimal Classification, 187.
- Pure mathematics, Connotation of, Compared, 215.
- Pure notation, 73-74.
- Purity, Canon of, *see* canon of purity.
- Putnam (Herbert) *i.r.t.* Congress Classification, 189-190.

a.t. = applied to.

i.r.t. = in relation to.

Putnam, *Ded.*: *Essays offered by his colleagues and friends on his thirtieth anniversary as librarian of Congress, r.i.r.t. canon of helpful order in lay-out of Congress Classification, 208.*

Putnam's estimate of Dewey, 185-186.

Quantitative order, Illustrated, 42.

Quartos of Shakespeare *i.r.t.* canon of reticence, 68.

Quaternions in Subject Classification, 223.

Quinn (John Henry) *i.r.t.* Adjustable Classification, 191.

Radiation *i.r.t.* canon of enumeration, 70.

Radium, *Le, r.i.r.t.* canon of mnemonics, 132.

Raman's work on ultra-sound *i.r.t.* canon of mnemonics, 133.

Ranganathan (S. R.): *Classified catalogue code—*

r.i.r.t. canon of—

Currency, 67. Partial comprehension, 147. Permanence, 34.

r.i.r.t. classification of artificial composite books, 148-149.

—: *Colon classification—*

q.i.r.t. anterior positions for common subdivisions, 174.

q.i.r.t. canon of—

Classics, 161-163. Common subdivisions, 166-167. Consistent order, 48, 50. Local variation, 151. Relevant sequence in mathematics, 223. Viewpoint, 155.

r.i.r.t. canon of—

Consistency, 39. Consistent order, 49, 51. Enumeration, 71. Hospitality in chain, 110. Individualisation, 176. Relevant sequence, 38.

r.i.r.t. comparison of arrays of third order in economics. 241.

—: *Five laws of library science r.i.r.t.* Genesis of Colon Classification, 192. Library classification, 93.

—: *Library administration r.i.r.t.—*

Creation of new classes, 269. Fourth stage classification, 173, 269. Principle of parallel movement, 180.

—: *Some new placings in colon classification q.i.r.t.* canon of mnemonics, 130-134.

Rank, Defined, 16.

— of pseudo-class, Defined, 19.

"Ranked," Illustrated, 4.

Rays, Molecular, *i.r.t.* canon of mnemonics, 132.

Readers and Writers company, Founded, 185.

Related box, Defined, 22.

Related entity, Defined, 22.

Relation sign and canon of viewpoint, 154.

Relational order, Illustrated, 43-44.

Relativity, Canon of, *see* Canon of relativity.

Relevance, Canon of, *see* Canon of relevance.

q.i.r.t. = quoted in relation to. *r.i.r.t.* = referred in relation to.

- Relevant sequence, Canon of, *see* Canon of relevant sequence.
- Reports *i.r.t.* pitfalls in second stage classification, 271.
- Reticence, Canon of, *see* Canon of reticence.
- in common subdivisions, 172-173.
- Right-handed notation, 74.
- Roman notation attacked by Melvil Dewey, 184.
- Rules for a dictionary catalogue, mentioned, 188.
- Saving in terminology in synthetic classification, 135-139.
- Sayers (W. C. Berwick)—
- And the phrase "canons of classification", 30. *i.r.t.* Colon Classification, 193. Reviser of *Manual of library economy*, 191.
- and Brown (James Duff): *Manual of library economy* *r.i.r.t.* biography of Brown, 190.
- : *Introduction to library classification q.i.r.t.*—
- Author marks, 177. Canon of intension, 59-60. Cutter numbers, 178. Importance of notation, 97-98. Merrill numbers, 178.
- *r.i.r.t.* canon of purity, 78.
- : *Manual of classification q.i.r.t.* canon of—
- Helpful order in lay-out of—
- Decimal Classification, 203. Expansive Classification, 209. Mnemonics, 120.
- *r.i.r.t.* canon of purity, 78.
- : *Systems of classification with particular reference to those used in special libraries q.i.r.t.* length of notation, 88.
- Scheduled mnemonics—
- Defined, 121. Illustrated, 121-128.
- Schedules of common subdivisions, 164-165.
- Scheme, Associated, Defined, 17.
- Scheme of assortment, Defined, 17.
- Scheme of classification—
- And associated complete assortment, 25. Defined, 26. For a universe of knowledge and its special requirements, 97. Fundamental categories of, 30. Illustrated, 7. Implications of, 26. Necessary aids in, 28.
- Schwingungs und Wellenlehre Ultraschallwellen* *r.i.r.t.* canon of mnemonics, 132.
- Second All India Library Conference: *Proceedings* *r.i.r.t.* canon of mnemonics, 130.
- Second order array in—
- Mathematics, compared, 211-213. Social sciences, compared, 236-240.
- Second stage classification—
- Hints for, 270-272. Need for, 106.

- Second substage in first stage classification, Hints for, 272-273.
 Sequence-marking, 269.
 Seventh order array in mathematics in Colon Classification, 228.
 Sixth order array in mathematics in Colon Classification, 228.
 Shakespeare *i.r.t.* canon of reticence, 68.
 Short *vs.* long notation, 79-82.
 Shortness of notation *see* Length of notation.
 Siddhas, Family of, As an illustration of filiatory arrangement, 20.
 Similar classes, Parallel order of, Illustrated, 55-58.
 Sivaraman (K. M.): *Colon vs. Decimal classification, a statistical study of their notation* quoted, 83-89.
 Socialism in Decimal Classification, 245.
 Societies *i.r.t.* pitfalls in first stage classification, 274-275.
 Sociology in Decimal Classification, 200-201, 239.
 Sociology *i.r.t.* canon of currency, 67.
 Solid notation, 74.
 Some new placings in Colon classification *q.i.r.t.* canon of mnemonics, 130-134.
 South Indian teacher *q.i.r.t.* length of notation, 83-89.
 Spatial order, Illustrated, 43-44.
 Species, 73.
 Spelling Reform Association, 185.
 Spofford (Ainsworth Rand) *i.r.t.* Congress Classification, 190.
 —, Librarian of the Congress, 189.
 Stages of classification, 269-279.
 Standard deviations of Colon Classification and Decimal Classification, Compared, 87.
 Statistics, 216, 237.
 Stewart (James Douglas) *i.r.t.* Subject classification, 191.
 Stone *i.r.t.* canon of context, 72.
 Stone (Marshal Harvey): *Linear transformations in Hilbert Space and their applications to analysis q.i.r.t. and r.i.r.t. canon of mnemonics*, 130-131.
 Stranger box, Defined, 22.
 Stranger entity, Defined, 22.
 Subject Classification—
 Fifth order array absent in mathematics, 224. Genesis, 191.
 i.r.t. anterior position for common subdivisions, 174.
 i.r.t. canon of—
 Consistent order, 46. Currency in lay-out, 198-199.
 Enumeration *a.t.* array of—
 Second order in sciences, 213. Second order in social sciences, 237. Third order in economics, 245-246.
 — *a.t.* lay-out, 198-199.
 Exclusiveness *a.t.* array of fourth order in economics, 254.
-
- q.i.r.t.* = quoted in relation to. *r.i.r.t.* = referred in relation to.

Subject Classification—Contd.*i.r.t.* canon of—*contd.*Helpful order *a.t.* array of—

Fourth order in economics, 256. Fourth order in mathematics, 223. Second order in social sciences, 239-242. Third order in economics, 251. Third order in mathematics, 218.

—*a.t.* lay-out, 206-208.

Hospitality in array, 104-105.

—*a.t.* array of—

Fourth order in economics, 254. Fourth order in mathematics, 221. Second order in sciences, 213. Second order in social sciences, 238. Third order in economics, 248. Third order in mathematics, 217.

Hospitality in chain, 117.

—*a.t.* chain in two dimensions in economics, 262.

Mnemonics, 134. Relativity, 90-92. Viewpoint, 156.

—*i.r.t.* notation, 76. Terminology in lay-out, 198-199.

—Lay-out, 196.

Subject classification q.i.r.t.—

Biscoe numbers, 179. Canon of hospitality in array, 104. Canon of individualisation, 176-177.

r.i.r.t. canon of helpful order *a.t.* array of third order economics, 251.**Subject Device *i.r.t.* canon of—**Consistent order, 50-51. Helpful order *a.t.* array of third order in economics, 250. Hospitality in array, 101-102. Mnemonics, 128.*i.r.t.* scheduled mnemonics, 122.

Subject-index illusion, 134-135.

Subordinate class, Defined, 14.

Synthetic classification *i.r.t.*—

Canon of local variation, 152. Evasion in terminology, 139. Law of parsimony, 137-138. Pitfalls in first taxonomic classification, 279.

System of bibliographic classification q.i.r.t.—

Anterior position to common subdivisions, 173-174. Canon of local variation, 150.

Systems of classification with particular reference to those used in Special libraries q.i.r.t. length of notation, 88.*Systems of medicine i.r.t.* canon of variation, 152.**Terminology—**

Defined, 28. In array of fourth order in economics, 253. In array of fourth order in mathematics, 220. In synthetic classification, 135-139. Of lay-out compared, 197-199.

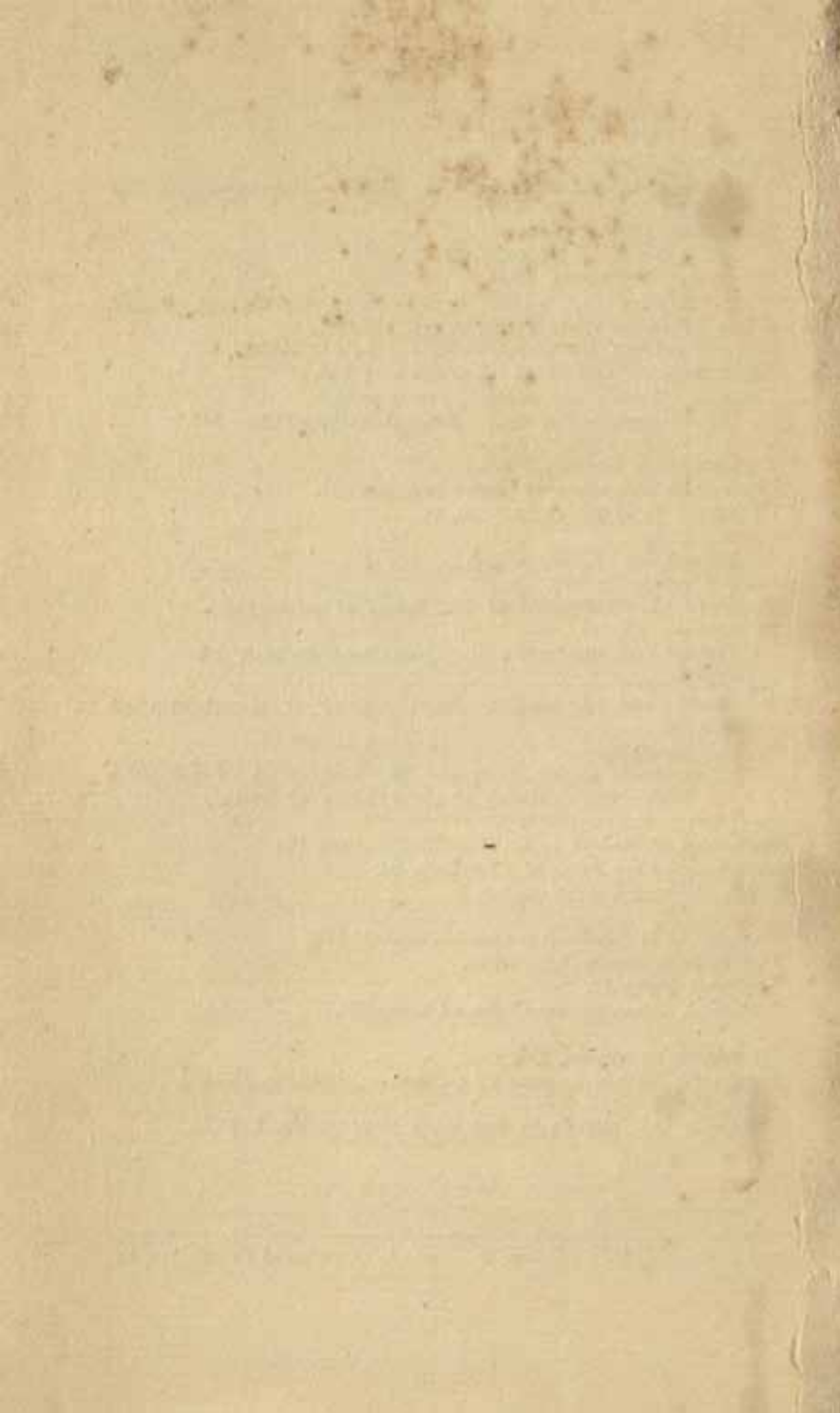
—, Canons for, 63-72.

Terms—

Derived composite, 137-139. Fundamental constituent, 137-139.

a.t. = applied to.*i.r.t.* = in relation to.

- Testing laboratory, 66.
 Theory, General, 2-29.
 Third order array in—
 economics, compared, 240-252. Mathematics, compared, 213.
 Three stage classification—
 Hints for, 270. Need for, 173.
 Time order, Illustrated, 43-44.
 Title, Deceptive, *i.r.t.* pitfalls in first stage classification, 276-277.
 Traits of characteristics, Illustrated, 106-110.
 Two dimension chain in economics, Compared, 260-262.
 Types of banks and canon of mnemonics, 133.
 Types of economic organisation, Provision in—
 Colon classification, 247. Decimal Classification, 247.
 Ultimate class, Defined, 176.
 Ultra-sound and canon of mnemonics, 132-133.
 Uniformity in length of notation, 90.
 Unitary class—
 Defined, 13. Illustrated, 3.
 Unitary group, Defined, 11.
 United States, Government of, *i.r.t.* canon of currency, 64.
 Universe—
 Defined and illustrated, 10. Immediate, Defined, 14.
 — of books—
 Peculiarities of, 142-143. Special theory of classification of,
 142-181.
 — of knowledge—
 A completely amplified universe, 25. Defined, 95. Peculiarities
 of, 95-96. Special theory of classification of, 93-141.
 —, Original, Illustrated, 3.
 University of Madras *i.r.t.* Colon Classification, 194.
 University of the State of New York, 64.
 Usake, Defined and illustrated, 9.
 Vagaries in Indian book production quoted, 149.
 Vagueness in terminology, 62-63.
 Values of digits, 75.
 Viewpoint, Canon of, *see* Canon of viewpoint.
 Weights and measures, 216.
 Wright (W.F.) *q.i.r.t.* canon of common subdivisions, 165-166.
 Yearbooks *i.r.t.* pitfalls in first stage classification, 274-275.



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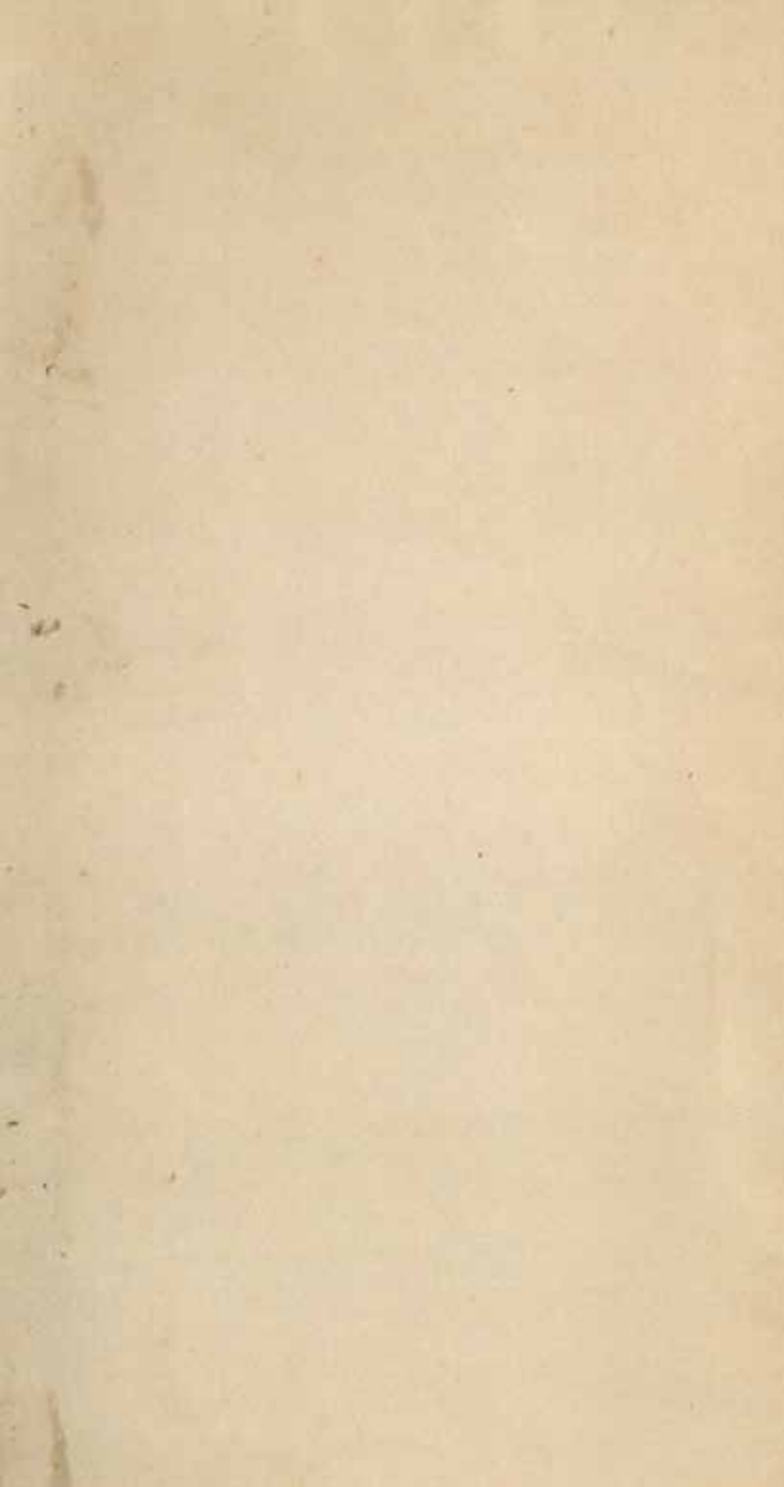
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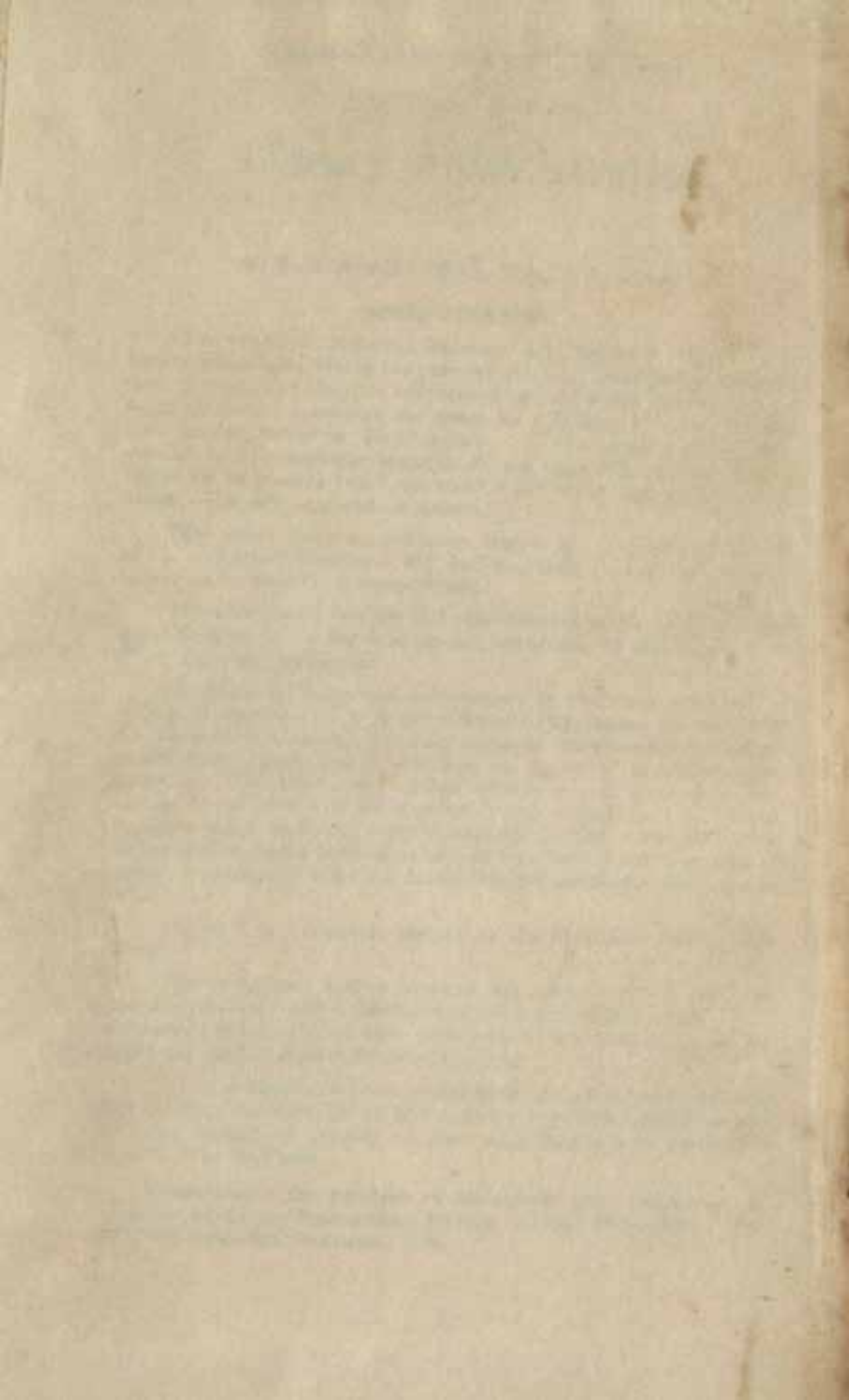
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