Lib sc. 3; 1966; PAPER A.

Emergence of Library Science.

(Development of library science. I).

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Art and practice precede science. Library service is no exception to this. To understand the purpose of library service it is helpful to postulate that the personality of man consists of four sheaths,—vital (Physical), emotional, intellectual, and spiritual. Library service began with the satisfaction of intellectual wants alone and then extended to the satisfaction of emotional wants and then to vital wants. There was no library service when libraries were either unused collections or were small and used only by a few scholars. There was no library science when the scholar-librarian started reference service based largely on his flair. Flair proved insufficient and gave place to library techniques. There was very little chance for library science to be developed by the librarians of the nineteenth-century fiction-dominated libraries. Some *ad hoc* principles were evolved by Sayers in the early part of the present century. The present century has brought into operation the chain "Population pressure, economic want, development of technology, natural and social sciences, and intensification of library service". To satisfy the vital wants appreciable amount of team-relay-research is to be done. To conserve the research potential of the scientist, the production engineer and the manager, the documentalist is now recognised as a partner in their work. Since 1876, *ad hoc* library techniques of various kinds are being continuously improvised. The author observed the techniques during his visit to 120 libraries in the UK in 1924–25. He experimented these techniques along with his own techniques in the Madras University Library. He modified the techniques in the light of the reaction of the readers and gained new empirical experiences. In 1928, the Laws of Library Science were formulated. Gradually all the possible implications of the Laws were inferred. Canons and Principles were deduced from the Laws to develop certain subdisciplines of library science. The concept of the Spiral of Scientific Method was evolved. Library science got established by admitting of the Spiral of Scientific Method in its development.

1 Sequence of Emergence

Art and practice precede science. The art and practice of speaking began with the early man. It had to be practised through ages before the science of linguistics emerged. The art and practice of writing pieces of literature—poetry, drama, prose—began very early. But the science of prosody and rhetoric emerged only very much later. The practice of useful arts in an elemental form developed through several centuries before the physical sciences emerged. The art of healing was practised for long before biological sciences emerged. Economic and political life was lived for long before political science and the science of economics emerged. In fact, the emergence of the latter is quite recent. It has not yet established itself on an even keel. The emergence of the science of sociology is even more recent, though social practices have been in vogue for a long time The library sphere is no exception to this sequence. The practice of library service had been in existence ever since books were produced in manuscript form. There is a legend about the kind of library service received by Sankara, the great philosopher—of the 6th century of the Christian era, according to the most conservative estimate. He wished to write a commentary on the Thousand Names of the Goddess manifesting as Lalitha. He asked for a copy of the manuscript of the thousand names of Lalitha. But the librarian brought him the manuscript of the Thousand Names of God manifesting as Vishnu. The librarian was sent back to get the right manuscript. Every time he came back with different manuscripts of the Thousand Names of Lalitha, Sankara was puzzled and looked at him. The librarian said. "A new lady reference librarian is in the stack room. She tells me that you should now really write a commentary on the Thousand Names of Vishnu". Sankara knew that there was no lady reference librarian. The mystic in him made him *see* at once Goddess Lalitha herself giving him that direction. The art and practice of library service had been continuing through centuries. But library science emerged only in our own lifetime. We shall begin with examining the emergence and progress of library service itself.

11 Postulate about Personality

At bottom, library service is service to a person—the individual. To understand the purpose of library service, it will be helpful to postulate a schematic view of the personality of man. In this view the personality of man consists of four sheaths—*Kosas* in our language. These are vital (or physical), emotional, intellectual, and spiritual sheaths. The following is a schematic diagram of the same.

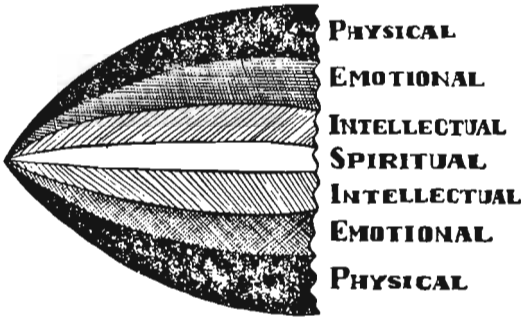

Fig 1. Sheaths of Personality

12 Human Wants

At bottom, library service is designed to satisfy human wants. The wants of the vital sheath are many and compelling. The wants of the emotional sheath come next in order. The wants of the intellectual sheath are fewer still and hardly compelling. The spiritual sheath is inert in most persons. In the few in whom it is activated, it feeds from its own inner resources; and its external wants are few.

13 Standard of Living

It is now common to relate human wants with standard of living. This term does not have a clear definition. But the

general trend is to measure it in terms of the number of commodities and services used to satisfy the human wants. Their number is used as the basis for a measure of the standard of life. It is greatest in the case of vital wants. Very often, it is measured in terms of the quantity and quality of the food, clothing, and shelter in use and of the number of automobiles, telephones, and other similar material amenities. The measure of standard of life in respect of emotional wants is based on the talkie service, the radio service, and similar services, and on the number of the physical commodities on which these services are dependent, and of late, on the number of librarians too. In respect of intellectual want, the basis for the measure of standard of life is often the number of schools, colleges, universities, research institutions, laboratories, and libraries. The term 'Standard of life' in this sense is not applicable to the spiritual sheath. Overlooking this fundamental difference many wrong statements are often made. Some of them are even abusive. The spiritually evolved Ramana Maharshi might be hastily put down as having a poor standard of life!

14 ANECDOTE I

A great admirer and disciple of the Maharshi hailing from the West met me about thirty years ago in the Madras University Library. I shall call him X, and denote myself as L.

X.— After living with the Maharshi for some years, I am getting disillusioned.

L.— So soon?

X.— After all, the belief that the rishis have few wants is not true. You have been telling me that our usual concept of standard of life is not applicable to spiritually awakened souls such as the Maharshi.

L.— I still hold that view.

X.— Probably you do not know that the Ashram of the Maharshi has put up hostels with furnished rooms. In the hostels there are radios. They have now a Manager with his staff. I think they will soon go in for a Staff Car.

L.— Is the Maharshi using them? Are they to satisfy *his* wants? Or, are they simply to provide the minimum of creature comforts to which his visitors are accustomed and without which they will be ill-at-ease — even in the immediate presence of Maharshi and in spite of his living example?

15 FIELD OF LIBRARY SERVICE

We shall then assume that the field of library service is confined to the satisfaction of intellectual, emotional, and vital wants. Library service began with the satisfaction of intellectual wants alone. It then got extended to the satisfaction of emotional wants. The supply of materials to satisfy emotional wants through library service depends on a prior satisfaction of intellectual wants. Lastly, library service got extended to the satisfaction of vital wants. The library does not itself supply the commodities and services needed to satisfy the vital wants. It merely helps the intellect in the production of the commodities and services needed. The above-mentioned direction of the extension of library service has been set by the chain, "population pressure, economic wants, development of technology, and library service". Till about two centuries ago, population pressure was comfortably low. Therefore, vital wants and technology did not play much part in the development of library service. There was no global social pressure for it. On the other hand, the pressure for library service was largely created only by the intellectual and emotional urges in man. These urges were compelling only in a comparatively few people. Thus the field of library service was very much restricted.

2 Library Service to Intellectuals

Till modern times, not even 10 percent of the people were literate. Not more than 10 percent of these—that is, not more than one centile of the population—were intellectuals. This formed the top one centile in the intellectual scale. Even of these few, perhaps most were not of a scholarly temperament. Indeed the persons of a nation drawing joy from scholarly intellectual pursuit were very few. Further, for about a century or two

after printing was invented, the number of books was very small. In this context, it was possible for each scholar to find out his book all by himself, from the library collection to which he was accustomed. Moreover, transport was not easy. Therefore, the scholar often used the same library collection. Again, scholars had been, as usual, poor and the number of library collections accessible to them was extremely small. There were no doubt library collections in royal palaces and in the house of rich courtiers. In most of these, the collections were often built as symbols of status. Indeed there are many anecdotes of poor scholars complaining of the rich courtiers hardly using their library collections and playing the "dog in the manger" against the intellectual thirst of scholars in poverty.

21 ANECDOTE 2

We have read about the story of a book market in Persia in the pre-printing days. Well-bound manuscripts were being auctioned. There was a keen bidding for one book. Ultimately there were only two bidders for it—a rich courtier in gaudy apparel and a poor scholar in rags.

Courtier.—My dear man, why do you go on raising the bid. Can we not come to an agreement?

Scholar.—This is a rare book. I had heard about it for long. But I could not get it till now.

Courtier.—Listen. Allow me to knock it down. Its binding is rich and lovely. It will fillingly fit and fittingly fill a gap in my library shelves. I want to fill up that gap before I receive the King in my palace.

Scholar.—But, then, I cannot get it for my use.

Courtier.—Do not be afraid of it. After the King's visit I shall give it away to you.

22 ANECDOTE 3

In India, having a beautiful and fully packed book-shelf in the drawing room has been regarded as a mark of nobility. Vatsyayana mentions it. It has been in vogue till recently. In

my home district, there were two very rich people. Their literacy in English would enable them to sign their names and no more. However, both had a few cupboards of well-polished rosewood, filled with attractive books in English with richly tooled leather bindings. One of these two rich people lived in my home town. One of the boys in that family was my classmate. Therefore, I had the privilege of going into my classmate's house and admire the beautiful library. One day the classmate told me, "These books were all bought by my father, as the Collector of the District visited our home last year." About the other rich man of the District, he said, "He is richer than my father. Even the Governor of our Presidency visited his house. He, therefore, built for the occasion even a larger library of books with their spines tooled with gold even more lavishly than ours!"

23 Library Janitor

When libraries were either unused collections or were small and were used only by very few scholars, there could have been no need for a librarian in the modern sense. Only a janitor was necessary to keep the books clean and to safeguard them from pilferage. Indeed there was no 'Library Service'. In this context library science could not have had any chance to emerge.

24 Scholar Librarian

As time advanced more books were published. Further, while the scholars were mortals, the books were immortals. Therefore, very soon the number of books in a library became considerably large—too large for a scholar to find his book without the aid of a catalogue. No doubt the catalogue might be a mere list of the most primitive kind. But even this required more than a janitor to prepare it. A scholar was, therefore, put in charge of the library. Some scholar librarians familiarised themselves with all the books in the library and acquired the flair to spot out a book answering the needs of a scholarly reader, without the aid of any special techniques. This was the beginning of reference service. There are many anecdotes of such a

service being given by scholar librarians in the 18th and 19th centuries in a few libraries.

25 ANECDOTE 4

But in many other libraries even this incipient form of reference service was travestied. This brings to mind such a travesty even as late as 20 years ago in one of our libraries. I was invited by that library as a consultant to advise it on its reorganisation and staff requirements. One of the points stressed was that there should be a good reference staff to get the books fully and properly used. It was further stressed that the salary of the reference librarian should be high in order to attract men of ability and wide knowledge. The Chairman of the Managing Council appreciated this recommendation. Then came the question of recruiting a reference librarian. Then arose the following incident.

Librarian.—I recommend my attendant to be appointed as the reference librarian.

Chairman.—Have you understood for what purpose the consultant has recommended the appointment of a reference librarian?

Librarian.—Yes, Sir.

Chairman.—How can your attendant, who has not completed even his school course, do the kind of work which the consultant described?

Librarian.—Sir, suppose a reader asks for the 40th volume of the *Nature*. My attendant can pick it out immediately. (laughter). During lunch time, the Chairman told me, "Do you now understand why I insisted on your coming here instead of your writing to us on our requirements? When we meet after lunch, do not press for the salary scale of the librarian to be raised!"

26 FLAIR AND NOT SCIENCE

But the scholar librarians of the last century were able to give helpful service to readers by their sheer knowledge of the

books and as a result of their loving the work. Their success was based more on flair and a highly cultivated commonsense than library science. All honour to them. But as time advanced, and the number of books increased at a great rate and more readers sought service of the library, this dependence on mere familiarity with books, flair, and commonsense was proving increasingly insufficient. Melvil Dewey was one of the first to sense this even when he was a boy. So did Charles Ammi Cutter. So also did librarians such as James Duff Brown and Wyndham Hume. Dewey developed special techniques and also formed the American Library Association to make the librarians think of well-planned library service with the aid of suitable techniques. Similarly did the three British librarians. They formed the Anonymous Club to discuss their techniques and practices and bring them as it were to the threshold of science. They had to call it Anonymous Club, because if they had mentioned their objective, they were afraid that the list of members would have had to face ridicule.

3 Library Service for Leisure Time

By the middle of the Nineteenth Century, the Industrialisation of the countries in the West had given much leisure to the upper class. They had to use their leisure time. For, as it is well known, unoccupied leisure is a danger to the individual as well as the society. One harmless method of using leisure time without dependence on other persons was found to be the reading of recreative books. Such books are usually read only once. They are then thrown away. Once a person was accustomed to getting entertained by books, he soon develops an addiction to it. To meet the demands thus created, a large quantity of fiction was produced. The persons found it too costly to buy all of them and also too wasteful to buy the novels which had to be thrown away in a short while. The Public Libraries used this opportunity to develop a collection of recreative and travel books and biographies, for leisure time use. The service from this collection did not, however, call for any improvement in the technique of service. Further, in the earlier years the staff of such libraries was largely recruited from teen-agers before they could enter a

university. Therefore, there was very little chance for a library science to be developed by the librarians of such libraries. However, a few of them were men of exceptional ability. They developed and refined several library techniques in an *ad hoc* way. W C Berwick Sayers was one of the prominent among them. Work of these people also brought the *ad hoc* library techniques to the threshold of science.

4 Intensification of Library Service

41 Population Pressure

During the present century, the population pressure has reached the saturation point. This has happened in most of the countries. But Canada, U S A, Australia and some of the countries in South America perhaps continue to be the exceptions. In the other places—particularly in India—the population pressure has even crossed the point where the vital human wants—such as food, shelter, clothing, and transport—could not be met fully with the natural and near-natural commodities produced in the traditional way. Agriculture has to be intensified with the aid of technology. So it is with fisheries. Even then the natural and the near-natural commodities will not be sufficient, to satisfy the vital human wants. Raw materials, which are not directly consumable, have to be transformed into consumable commodities. This transformation needs the use of technology of ever-increasing complexity. Further, due to the mischief of nature, the raw materials are concentrated only in certain spots on earth. Therefore, either the raw materials themselves or the intermediate commodities or the ultimate commodities ready for human use have to be transported through long distances. This requires the freight transport—be it land, ocean, or air—, to be increased enormously both in number, size, and speed. This again needs the use of technology of ever-increasing complexity. Large-scale production and commerce have also become a necessity. This has made Management itself transcend the capacity of the shrewd man with extraordinary flair. A Science of Management has become necessary. The overall political, economic, sociological, and legal consequences of large-scale production and

commerce also require considerable continuous re-thinking and research. The younger generation has to be prepared to do the necessary research and to put the results of research to social use. Further, education has to reach down to the lowest quartile in the intellectual scales. These needs transcend the capacity of the traditional methods of education, especially the method of examination-centred mass-lecture method. Need has thus arisen for considerable re-thinking and research in education. All these has brought into operation the chain:

> "Population pressure, economic wants, development of technology, natural and social sciences, and intensification of library service."

Library service has therefore to be intensified in order to meet the demands of technology and the natural and social sciences made necessary by the vital wants of humanity generated by increasing population pressure.

42 Team Research

The amount of overall research to be done to meet the vital wants of the teeming millions of humanity adequately is enormous. There has to be division of labour here. This division has to be based on the distinction between fundamental research and developmental research. Usually it is only a man of genius endowed with great intuition that can produce new seminal ideas. A few persons nearest to him in the intellectual scale will have to do the first stages of follow-up work in bringing the seminal ideas near to their application for social well-being. They will have to work out and uncover the implications of the seminal ideas capable of serving social needs. The term 'Fundamental Research' will be used to denote the research done up to this point. The successive later stages of research should be taken over by groups of men drawn from the farther positions in intellectual scale—positions of increasing removes from that of those engaged in fundamental research. In fact, we want a hierarchy of research workers to exploit the results of the fundamental research purposefully. The work of this hierarchy may be denoted by the term 'Developmental Research'. Those engaged in fundamental research

and in developmental research should work as a team. This is the most economical organisation for research. In this organisation, each person contributes to research in the measure of his own capacity. There is a pretty folk-story illustrating such team-work. A bridge had to be built across the sea dividing the mainland of India from the Island of Ceylon, to enable Rama's army to go across to Ceylon. This had to be done quickly. In this work a whole team consisting of the top-engineers down to the common soldiers worked together. The folk-story is that even squirrels took part in this team-work by dropping pebbles in the interstices between boulders. Rama appreciated this effort of the squirrels and gently rubbed on their back in token of his appreciation of their team spirit.

43 Relay Research

Team research alone is not sufficient. Several teams will be working on the same or similar projects in different parts of a country and in the world at large. The best result can be got only by each team carrying forward the work already done by another team. This is Relay Research.

44 Dissipation of Research Potential

Organised research by several teams working in relay will precipitate new ideas at a high rate. There is the danger of some of the nascent micro-thought created at one point in this team-relay-research being lost sight of at some other point. This would lead to the repetition of the same piece of work unknowingly or unintended. Cases are known of one and the same management having estimated the loss due to this repetition to run to hundreds and thousands of dollars. Some have even found such a repetition even within the team working under the same management and under the same roof. This amounts to dissipation of the all-too-small research potential available.

45 Conservation of Research Potential

It is necessary to prevent such a dissipation of research potential, if we can. In the earlier years of the present half-

century, a few members of the research team itself was put in charge of the task of preventing loss due to unwanted repetition. It is only in recent years that it has been realised that it is equally wasteful to turn persons capable of research in a particular field on to the task of scanning the micro documents embodying nascent micro-thought and lying scattered among hundreds of periodicals. Moreover, a person with competence for research in a particular technological or scientific area cannot be expected to develop efficient methods of literature-search.

46 Documentation, a New Task for the Library Profession

It has now been found out that there should be a further division of labour in the overall attempt of humanity to find out efficient vital wants of the teeming millions. This division of labour has brought in the library profession as a supporting agency for the conduct of research. To emphasise this new role of the library profession, this task of feeding the research workers with nascent micro-thought, is denoted by the new term 'Documentation'; when engaged in documentation, the librarian is denoted by the new term 'Documentalist'. It is now recognised that the research workers in the positive fields of technology and sciences and the documentalists should be deemed as partners in research. It is only such a division of labour and such a co-operation that can conserve the research potential and get the best out of it for the benefit of humanity.

5 Ad hoc Improvisation of Technique

Since 1875 *ad hoc* techniques of various kinds are being continuously improvised. They are all based upon experience arising out of the difficulties actually met while rendering library service. I had the opportunity, in 1924, to observe many of the successive techniques developed *ad hoc*, in some library or other in the United Kingdom. This was observed in a visit to about 120 libraries. What was observed enriched empirical experience of diverse kinds. It was also possible to observe the further changes coming in the field of library service. This led to the feeling that the capacity of this series of *ad hoc* improvisations would soon be transcended. This feeling, released as it were,

the trigger. The new feeling developed that the time had come to place the design of techniques on a scientific basis. It was further felt that such a scientific basis could enable new techniques being inferred as compelling deductions from the fundamental laws of library science—if only such laws could be formulated. With the aid of the fundamental laws, it was even felt that, as and when the boundary conditions laid by social needs changed, the new techniques necessary could be inferred readily. Even models of new techniques could be established so as to meet the demands of different kinds of changes in the social needs. These feelings were evidently pushed down to the deeper levels of science. There they were simmering for three years.

6 Genesis of Library Science

61 Empirical Stage

The rich experience, gathered while observing during 1924–25 the libraries in the West at different stages of development, was somewhat unique. Librarians in the West were all tied down to the libraries in which they were employed. They could not get an opportunity to visit different libraries in the country and make a comparative study of their varying practices. But for a visitor from India, it was naturally possible to visit all the important libraries of a country within a few months with undivided attention and compare their varying library practices. This was a great advantage. The experience gained got soaked in the mind. During the next three years, the conscious mind was fully engaged in organising the Madras University Library from scratch. It was also engaged in experimenting with the library techniques picked up in the West and a few new techniques improvised in the course of the organisation of the university library. The students and the teachers of the university began to use the library in increasing numbers. They got interested in the new developments in the library. They were extremely participative. In the first place, this enabled the demonstration of the value of modern library techniques. Further, their participativeness permitted their being used as guinea-pigs, as it were, test the old and the new techniques, and modify them in the light

of the reaction of the readers. This gave new empirical experiences which could be added to the experiences gained abroad. All these empirical experiences went down into the trans-conscious level, as the conscious level itself was fully occupied with the re-organisation work and the experiments.

62 Haul up from the Trans-Conscious

In 1928, another unique opportunity came. The University of Madras and the South India Teachers' Union provided this opportunity. About a thousand teachers were to meet in their Annual Conference in December 1928 in the Meenakshi College, Chidambaram—now Annamalai University, Annamalainagar, Chidambaram. It was arranged that the ideas of modern library service should be broadcast at the Conference. For this purpose the University of Madras asked me—then University Librarian in Madras—to deliver a course of Vacation Lectures at the Conference. This hauled up to the conscious level all the empirical experiences simmering at the trans-conscious level. It led to the naming of the subject of the lectures as "Laws of Library Science". This naming was done in July 1928. This is a case of christening being before birth. What is it that was going to be born? This was then unknown. Therefore, the next few months were spent on cogitation.

63 First Formulation of the Laws

First came out a doublet. What are now known as Law 2 and Law 3 came out as a single Law. Then came the Fourth and the Fifth Laws. The First Law would not come out. There were only two weeks for the lectures to begin. The concentration and pain were enormous. About the end of the first week of December, the Professor for Mathematics—Edward B Ross, to whom I owe many things in my life—made his usual evening visit to the University Library. He walked into the Librarian's room.

Ross.—You seem to be very worried.

Ranganathan.—Not worry—but contemplation!

Ross.—You are too young to retire into contemplation! (He laughed).

Ranganathan.—In June last, I agreed to the University and the South India Teachers' Union to deliver a course of lectures this month on the Laws of Library Science. I had been trying to distil them out. I have succeeded in the formulation of some of the Laws. But they all look like corollaries. The Basic Law is still evading.

Then Ross and myself discussed the Laws that had come out. After a few minutes Ross started home. As usual I accompanied him to the porch. Ross got on his motor cycle. He was about to start the engine. Suddenly the familiar glow came in his eyes. The familiar twitching of the lips appeared. He said, "Books are for use". Is that not what you mean?" and rode away.

64 Four Laws of Library Science

Thus Professor Ross helped in completing the First Formulation of the Laws of Library Science. These were then formulated as

1 Books are for use;

2 Every reader his or her book and every book its reader;

3 Save the time of the reader; and

4 Library is a growing organism.

Lantern slides were made of these laws. Several other slides were also made depicting the functioning of libraries. At Chidambaram, the Four Laws were expounded and their implications were drawn out one after another and illustrated with the slides. In the course of exposition, two reactions developed in me. In the Colon Classification already designed and brought into use in the Madras University Library, the digit '4' was mnemonic for 'Disease'. Therefore, there was a sentimental objection to have 'Four Laws'. Either one of them should be dropped or a fifth should be added. Five Laws were preferred as the digit '5' was mnemonic for 'Energy'. The next problem was "How to get it done?" Then came the intellectual reaction.

The Second Law disobeyed the Principle of Unity. This solved the problem. The Second Law was broken into two distinct laws. This was the genesis of the Five Laws.

65 Five Laws of Library Science

Such was the genesis of the Five Laws of Library Science. They are

1 Books are for use;

2 Every reader his book;

3 Every book its reader;

4 Save the time of the reader; and

5 Library is a growing organism.

651 COROLLARY TO FOURTH LAW

In the course of pulling out the implications of the Fourth Law, a corollary from it figured frequently. It is, "Save the time of the Staff".

652 BREAKING UP THE FIFTH LAW

The Fifth Law was always giving trouble. It was because the full implications of the term 'Growing Organism' were not realised. The exposition at Chidambaram brought out the implications of 'Growth' only in the sense of 'Child-Growth'—that is, growth involving steady increase in overall-size. But the term has also another sense. It is 'Adult-Growth'—that is, growth by replacement of constituents without increase in overall-size. This double import of the 'Fifth Law' leads to the recognition of two types of libraries—Conserving or Storage Library, and Service Library.

653 PUBLICATION

The Five Laws formed the basis of teaching library science in the Library School established by the Madras Library Association in 1929 and taken over by the University of Madras in 1931. The students were all mature persons. They appreciated the

a priori development of the library practices from the Five Laws. This was experienced in each of the three years. This experience led to the publication of the *Five laws of library science* in 1931.

7 Recognition of Library Science

71 Doubt Expressed by Scientists

The formulation of the Five Laws and the demonstration in the class room of the advantages of basing the teaching of the subject on these Fundamental Laws confirmed that the use of the term 'Library Science' was not altogether unwarranted. In fact, the Five Laws had pushed into the Spiral of Scientific Method, what was originally called the art of librarianship and brought out a Library Science. The design of the Spiral of Scientific Method was provoked by the votaries of the Natural Sciences resenting the usurpation of the term 'Science' by the library profession. This charge led to an examination of what the term 'Science' connotes. This Spiral of Scientific Method has now given an objective definition of the term 'Science'. This definition indicates that the snake was not in the garden of librarians but in the garden of the votaries of the Natural Sciences. The next few sections describe the Spiral of Scientific Method and how Library Science got established as a result of the Art of Librarianship being pushed into the Spiral.

72 Spiral of Scientific Method

Scientific method is characterised by a never-ending spiral movement. It is schematically represented in fig. 2. The cycle implied in the spiral will be followed in the clock-wise direction. For convenience of reference, the four cardinal points of the cycle are denoted by the terms Nadir, Ascendent, Zenith, and Descendent. The nadir marks the accumulation of facts, obtained by observation, experimentation and other forms of experience. The ascendent marks the accumulation of indicted or empirical laws got out of the facts accumulated at the nadir, by inductive logic including normal equations and other aids from statistical calculus. The zenith marks the fundamental laws formulated with the aid of intuition of

some degree or other, so as to comprehend all the inducted or empirical laws accumulated at the ascendent as compelling implications. The descendent marks the accumulation of the deduced laws got from the fundamental laws at the zenith, with the aid of deductive logic including general semantics and all kinds of mathematical calculuses.

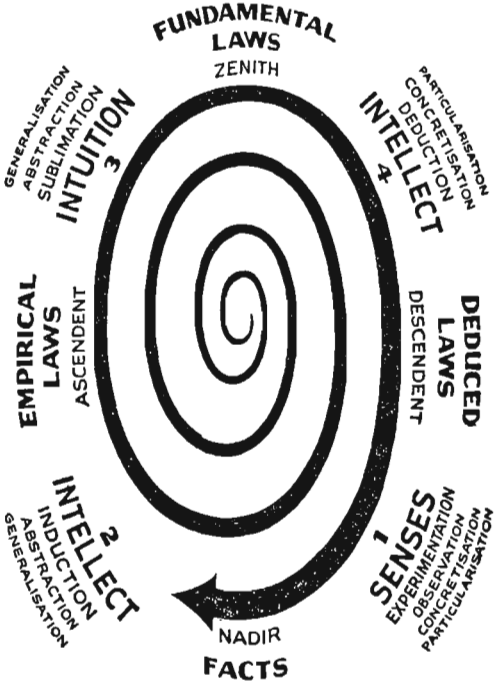

Fig 2. Spiral of Scientific Method

720 THE FOUR QUADRANTS

The four cardinal points give rise to four quadrants in the cycle implied in the spiral. For convenience of reference, the quadrants will be numbered 1 to 4 respectively, as follows: Quadrant 1 is the one between descendent and nadir; Quadrant 2 is the one between nadir and ascendent; Quadrant 3 is the one between ascendent and zenith; and Quadrant 4 is the one between zenith and descendent. The following statement is taken to be intelligible in the light of what has been said already:—

721 QUADRANT 1

Quadrant 1 corresponds to the stage in the development of a domain of the universe of knowledge, conforming to scientific method, in which:

1 Primary senses are used either in their native state or with the aid of instruments of various degrees of powerfulness;

2 Observations are made of knowees, either with or without experimental interference and conditioning;

3 There is progression towards particularisation, and regression from generalisation;

4 There is progression towards concreteness, and regression from abstractness; and

5 Facts are found and recorded.

722 QUADRANT 2

Quadrant 2 corresponds to the stage in which:

1 Intellect is used either by itself or aided by machinery constructed to speed up the work of the intellect and to give relief to it in some measure;

2 Reasoning is made with the aid of inductive logic including normal equations and other statistical methods and other calculuses to boil down the numerous facts accumulated at the nadir to a small number of inducted or empirical laws—example, Kepler's Law of Equal Area, in the motion of planets, boiled

down from the facts recorded by Tycho Brahe—more easy to hold in memory than the multitude of the facts themselves;

3 There is regression from particularisation, and progression towards generalisation;

4 There is regression from concreteness, and progression towards abstractness; and

5 Inducted or empirical laws are formulated and recorded.

723 QUADRANT 3

Quadrant 3 corresponds to the stage in which:

1 Intuition of some intensity or other is used unmediated by the primary senses or the intellect;

2 The inducted or empirical laws stand boiled down to a very small number of fundamental laws—example, Newton's Laws of Motion, to which many empirical laws such as the Kepler's Laws are reduced at one stroke—more easy to hold in memory than the more numerous empirical or inducted laws;

3 There is regression from particularisation and progression towards ultimate generalisation;

4 There is regression from concreteness and progression towards ultimate abstractness; and

5 The fundamental laws are seized and recorded.

724 QUADRANT 4

Quadrant 4 corresponds to the stage in which:

1 Intellect is used either by itself or aided by machinery constructed to speed up the work of the intellect and give relief to it in some measure;

2 Reasoning is made with the aid of deductive logic including general semantics, and mathematical and other calculuses to work out all the compelling implications of the fundamental laws;

3 There is progression towards particularisation, and regression from generalisation;

4 There is progression towards concreteness, and regression from abstractness; and

5 The deduced laws are derived and recorded;

6 The derived deduced laws include one and all of the inducted empirical laws; and

7 The number of deduced laws exceeds that of the empirical laws, if the fundamental laws have been seized with intuition of adequate intensity.

725 ENTRANCE INTO THE NEXT CYCLE

The Spiral of Scientific Method begins the next cycle thereafter, by re-entering quadrant 1. Two things happen at the stage of development corresponding to quadrant 1 in the new cycle;

1 Observations and experiments are made to verify empirically the validity of the new deduced laws; and

2 Further observations and experiments are made continuously and this leads to accumulation of new empirical facts.

73 HELPFULNESS OF THE FUNDAMENTAL LAWS

So long as the deduced laws are empirically verified to be true and the new empirical facts are found to be in conformity with the implications of the fundamental laws, there is no further movement in the spiral, and the fundamental laws hold sway and continue to be deemed helpful. But, this seldom holds good for long. Disturbance arises sooner or later in almost all the domains in the universe of knowledge, as they get cultivated and developed.

74 ARDUOUS EFFORT

As and when empirical facts and experience appear to contradict the fundamental laws, arduous effort is made to ensure absence of any kind of fallacy in the process of deduction, any kind of defect in the logic or the calculus used in the process, and any kind of fault in the experiment or observation or in the instruments used. When warranted, more powerful instruments

of observation, more exacting experiments, and sharper calculuses for deduction, are devised. Witness, for example, the invention of mass-spectroscopy which dissolved an apparent contradiction to Dalton's fundamental law about the atom, the devising of observations of stars during total solar eclipse which dissolved an apparent contradiction to Einstein's fundamental law of relativity, and the unceasing progress in the development of general semantics, and the mathematical calculuses to make deductions penetrating and free from fallacies. Every effort should also be made to reinterpret the terms in the formulation of the fundamental laws with the aid of exegetics, so as to get out of them their fullest possible import, lying hidden until the necessary empirical experience draws attention to it.

75 Declaration of Crisis

Now and again, contradiction between the empirical facts of experience and the currently used fundamental laws persists, in spite of all the possible precautions to ensure absence of faults and fallacies in the building of the facts of experience and the inference of the implications of the fundamental laws, and in spite of every possible and proper use of exegetics. Then we have to recognise the existence of a new class of facts and declare the incidence of a crisis in the application of the scientific method.

76 Resolution of Crisis

Then, the new class of empirical facts are accumulated at the nadir; and a new cycle gets into full swing and carries the Spiral of Scientific Method further. Work in quadrant 2 leads to a new set of empirical laws. Work in quadrant 3 leads to the seizing of a new set of fundamental laws. Work in quadrant 4 leads to a new set of deduced laws. Work in quadrant 1 is again started as before. This cycle is liable to be repeated without end in many a domain.

77 Definition of Science

Any domain in the universe of knowledge, irrespective of the subject and the method of study, which admits of the above-described spiral of scientific method in its development, is a science.

In the natural sciences, including the physical and the biological sciences, the fundamental laws are called hypotheses. They furnish a descriptive formulation of the empirical facts of experience. In the social sciences, such as education, political science, economics, sociology, law, and library science—which is also one of them—the fundamental laws are called normative principles. They furnish an interpretative explanation of the empirical fact of experience and of the techniques found necessary in experience. The terms 'true' and 'false' apply only to facts and the empirical and deduced laws. They do not apply to hypotheses and normative principles—that is, to fundamental laws. These can only be described as helpful or unhelpful, according to as they fit in or not with the facts of empirical experience. Newton's laws did not fit in with certain new empirical facts found during the present century; and in this context, they ceased to be helpful hypotheses and gave place to Einstein's laws of relativity. These two sets of laws belong to two different cycles in the spiral of scientific method. As it often happens, particularly if the laws are seized by a sufficiently intensive intuition, the Newtonian hypothesis is contained in the Einsteinian hypothesis. For, the former is got out of the latter by taking the speed of light to be greater than any conceivable finite speed. Similarly, the old second law of library science—*viz*, books are for the Chosen Few—did not fit in with the library practices coming into vogue in community after community during the last century as a result of the onslaught of democracy. In this context, it ceased to be a helpful normative principle and gave place to the new second law—*viz*, Books are for All. These two laws belong to two different cycles in the Spiral of Scientific Method. It can also be seen that the former version of the second law is contained as a particular case in the later version. Again, the old normative principle of political science—*viz*, 'The king can do no wrong' —did not fit in with the political practices coming into vogue in community after community during the last two centuries as a result of the onslaught of republic-idea. In this context, it ceased to be a helpful normative principle and gave place to the new normative principle—The Judiciary can do no wrong. As all the functions of the judiciary were vested in the king in the

earlier days, the earlier normative principle was contained in the latter.

8 Nature of Fundamental Laws

The term 'Fundamental Laws' is the generic one used to comprehend the 'Hypothesis' of the Natural Sciences and the 'Normative Principles' of the Social Sciences. The Hypotheses form a descriptive formulation. The Normative Principles are thus different from Hypothesis in its role. However, both admit of deduced laws different from the empirical laws from which they were intuited.

81 General Laws

In their application, occasionally conflict may arise between the indications of the different Normative Principles. Again the inference from them will have to be subjected to the boundary conditions set by the social factors from time to time. In the case of the Fundamental Laws of Library Science the boundary conditions concern the

1 Public finance available for library service;

2 Extent of literacy;

3 Extent of industrialisation;

4 Scale of dominance of the vocations of the community served; and

5 Social pattern.

In the resolution of the conflict we usually invoke the aid of some of the following General Laws:

1 Laws of Interpretation;

2 Law of Impartiality;

3 Law of Symmetry;

4 Law of Parsimony; and

5 Principle of Local Variation.

82 Normative Principles for Sub-Disciplines

Just as we invoke the aid of General Laws as explained in Sec 67, it has been found helpful to formulate special and distinctive Normative Principles to develop certain sub-disciplines of library science. We call these distinctive normative principles 'Canons'. The Canons of any sub-discipline are at bottom implications of the Five Laws themselves and are consistent with them. Further, in developing a sub-discipline along the lines indicated by its canons, we generally require some other aids. These aids are called 'Principles'. The terms—Laws, Canons, and Principles—are introduced for convenience in order to distinguish their relative status. The canons and the principles applicable to the different sub-disciplines of library science will be illustrated in subsequent publications in this series. They will also trace the march of these subdivisions till today. Possible march of these sub-disciplines in future will also be discussed.

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Gear Production Engineering: Depth Classification.

Abdul Rahman and Afroze Fathima, *Hindustan Machine Tools Ltd, Bangalore* 31, and T Ranganathan, *National Aeronautical Laboratory, Bangalore* 6.

(Classification problems. 15). (Design series. 10).

Explains the importance of gear as a machine element. Gives a brief history and definition. Provides a tentative scheme for the classification of the subjects going with the (BC) 'D9*m* Gear Production Engineering.' The schedules given are confined to the first characteristics for [1P]. Gives a list of 42 examples classified according to the above scheme.