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PHYSICAL BIBLIOGRAPHY FOR LIBRARIANS



PHYSICAL BIBLIOGRAPHY FOR LIBRARIANS

58298

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RANGANATHAN'S FIVE LAWS OF LIBRARY SCIENCE

1 *Books are for use*

2 *Every reader his/her book*

3 *Every book its reader*

4 *Save the time of the reader*

5 *A library is a growing organism*

CHAPTER AA

BIBLIOGRAPHY

1 Communication

11 Necessity for Communication

Communication is of the very essence of human existence. Man cannot live long in isolation. Men have to lean on one another to get their food, clothing, and shelter for keeping their body in happiness (= *sukha*). They have to associate themselves with one another to escape boredom and get emotional satisfaction. They have to think together and do their thinking in unison in order to sharpen their intellect and to get mental joy (= *pramoda*). The man that apprehends things-in-themselves, directly and unmediated by senses and intellect, sees the universe as a whole and each part of it also as a whole in its infinite spatial and temporal context and revels in spontaneous self-born delight (= *ananda*), radiates his delight and wisdom over others, and the others have to lean on him for their own delight to get stimulated. Thus, to get happiness, joy, and delight men have to communicate with one another. Communication is necessary for their satisfactory and efficient living in all the five planes — physical, vital, emotional, intellectual, and spiritual. Men in the highest reaches of the spiritual plane communicate by radiation, direct thought-transfer perhaps, quite unmediated by aid of any sort — gestures, symbols, sounds, words, writings, printing, or books.

12 Medium for Communication

Men in the normal levels of mental existence communicate with the aid of gestures, symbols, sounds, words, and written and printed books. The first four media of communication limit the range of time and space that can be covered. In time, it is momentary; and in space, it is limited by visibility

or audibility in spite of the modern electronic devices. Books make communication transcend the limitations of time and space. These may be said to transform the idea, to be communicated, into physical entities called Books, and thus make it fit for transport across space and through time.

13 Book as a Medium

In this physical form, an idea is carried from any point to any other point on earth and it is also preserved for any length of time. A man in Bangalore thereby communicates with a man in Washington. I communicate even my fleeting ideas by writing to a colleague in Washington; and he reciprocates by writing. I communicate my more lasting ideas to him and to my other colleagues in India and in other countries through books; and they reciprocate. The ideas of the great Sankara of the first millennium after Christ are communicated to us through books, even at the end of the second millennium; and we pick them up. The ideas of the thinkers of today are similarly embodied in books; and they are thus rendered fit for communication to the endless generations to come; and they will pick it up.

14 Authorial Art

Linguistics, authorial art, and fine arts are concerned with the transformation of thought prior to the physical act of writing and printing. They deal with the subtle embodiment of thought.

15 Physical Medium

The art of writing, printing, and publishing deals with the gross embodiment of ideas — the physical medium for communication.

2 Book as a Trinity

"Book" is a composite concept. When the term 'Book' is uttered, it may bring to mind one or more of several ideas. The ideas suggested by the term may vary from person to

person and even, in the case of one and the same person, from context to context.

21 Soul or Idea

When we say that the *Gita* is a seminal book (= *prabhu-sammita* as explained in my *Library book selection*), the term 'book' means only the ideas communicated by it. Again when we say, "That exhibition of books on Arithmetic from Vedic age to our own days shows the long way Arithmetic has passed," the term 'book' denotes its soul (= idea-content) and nothing more.

22 Subtle Body or Expression

On the other hand, when we say that George Gamow's *Inside the atom* is a lucid book (= *kanta-sammita*), with helpful illustrations, the term 'book' refers to the style, the clarity, and the simplicity of the language, and the aptness, expressiveness, and revealing nature of the pictorial aids and diagrams, — in short, the subtle medium through which the idea is communicated. Again when we say, "That Bible Exhibition is one of the most interesting exhibitions of books we have had. What a variety of books! It looks as if there is no language of the world which goes unrepresented," the term 'book' refers only to the subtle body (= linguistic medium).

23 Gross Body or Physique

When we say that every book produced by Nonesuch Press is beautiful, the term 'book' refers to the excellence of the binding, the typography, the reproduction of illustrations, the quality of the paper, and the overall appeal to the eye — in short, the physique in which the subtle intangible medium is impressed and the idea is embodied. Again, when we say, "The books in the exhibition held by the Bibliothèque Royale at Brussels in 1930 showed the beauty of the tooling and of the binder's workmanship in the sixteenth

century," the term 'book' refers only to the gross body (= physical medium) — its look and particularly its exterior.

3 Bibliography a Homonym

A book may, then, be taken to be a trinity of soul (= *atma*), subtle body (= *sukshma sarira*), and gross body (= *sthula sarira*). In association with each of these members of the trinity, the term 'Bibliography' gets a different meaning. Even when associated with any one of these members, the meaning of the term changes with the purpose. Indeed the term 'Bibliography' is a severely homonymous term. We have to distinguish the various meanings by prefixing to the term 'Bibliography' a qualifier — that is, a qualifying epithet setting forth its kind.

CHAPTER AB

DOCUMENT BIBLIOGRAPHY

1 Definition

When 'Bibliography' is dominantly associated with the soul of books, we call it 'Document Bibliography'. It may mean a list of embodied macro and/or micro ideas — that is, of books and/or of articles in periodicals — on a specialised subject or on any number or on even all the subjects; it may be restricted also in other ways as shown in the succeeding sections. When it is prepared so as to meet the requirements of advanced specialists, it is called 'Documentation List'. The term 'Document Bibliography' may also mean the art of preparing such a list. To denote this, we shall use the term 'Documentation Work'. Documentation work has been expounded in Part 4 of my *Reference service and bibliography* 1940 (Madras Library Association, publication series, 9).

2 Subject Bibliography

A Subject Bibliography is a document bibliography confined to a specified subject-field only, instead of covering the entire universe of subjects. William Jaggard's *Shakespeare bibliography* (1919) of 756 pages, Montgomery Schuyler's *Bibliography of Sanskrit drama* (1906) of 120 pages, and R N Dandekar's *Vedic bibliography* (1946) of 398 pages are all Subject Bibliographies. The annual volumes of *Library literature* constitute a subject bibliography coming out annually as a serial.

21 Linguistic Bibliography

There are also document bibliographies listing reading materials in a specific language. For example, T Aufrecht's *Catalogus catalogorum* is a bibliography of Sanskrit manuscripts. Its revised edition in preparation at the University of Madras aims to list also the printed editions of the manuscripts. These are Linguistic Bibliographies. The catalogue of

the British Museum Library includes many volumes of linguistic bibliographies devoted to Sanskrit, Hindi, Marathi, Gujarati, Arabic, Persian, Urdu, Tamil, Malayalam, Kanarese, and Telugu.

22 EXPOSITIONAL BIBLIOGRAPHY

There are also document bibliographies of writings in the form of essays. Wilson's *Essay and general literature index* (1934-....) is an example. Another example is my *Bibliography of reference books and bibliographies* (Madras Library Association, publication series, 10), 1941. It lists hundreds of reference books. It also lists subject bibliographies. T Besterman's *World bibliography of bibliographies* (1939-40) in two volumes aims to make a full list of subject bibliographies. Here are examples of document bibliographies of writings in other forms of exposition:

A H Cole's *Finding list of Royal Commission reports in British Dominions* (1930) of 134 pages.

P M Riches's *Analytical bibliography of universal collected biography* (1930) of 709 pages.

T Chubb's *Descriptive list of the printed maps of Norfolk* (1928) of 208 pages.

There may similarly be document bibliographies of writings in other forms of exposition. We may denote a document bibliography, listing writings with a specific expositional feature, by the common name Expositional Bibliography.

23 NATIONAL BIBLIOGRAPHY

A National Bibliography is not confined to a single subject-field; on the other hand, it covers all subjects. This term too is a homonym. It may denote any one or any combination of the following:

1 List of all the books published in a country. Examples: *British National Bibliography*; *Ceylon National Bibliography*; *Indian National Bibliography*;

2 List of all the books on a country;

3 List of all the books published by all the citizens of a country; and

4 List of all the books published on all the citizens of a country.

3 Economico-Bibliographical Lists

The term 'Bibliography' may also denote a list of documents prepared by any of the ten possible agencies, occupying the different positions in the economico-bibliographical chain formed from the moment of the creation of documents to the time of their use. The links in the chain, the name of the corresponding bibliography, and the agency producing it are given below along with the essential interest of each agency.

1 Authorial Bibliography. Author. Production of idea and its expression.

2 Printer's List. Printer. Production of Physique.

3 Binder's List. Binder. Production of Physique.

4 Publisher's Catalogue. Publisher. Distributor of Physique.

5 Bibliophilic Bibliography. Bibliophile. Peculiarities in Physique.

6 Copyright List. Copyright Authority. Legal Right in the Document.

7 Book Selection List. Book Selection Librarian and Book Selection Agency, if any. Distribution of Ideas.

8 Library Catalogue. Library. Distribution of Ideas.

9 Reading List. Reference Librarian and Special Agencies, if any. Distribution of Ideas.

10 Source List. Readers and Authors. Distribution of Ideas.

4 Personal Bibliography

Another kind of Bibliography is a list of the writings by and on a person. This is denoted by the term 'Personal Bibliography'. Here are some examples:

1 Ebisch (Walker) and Schucking (Levin L). *Shakespeare bibliography*. 1931.

2 Thomas (Milton Halsey) and Schneider (H W). *Bibliography of John Dewey*. 1930.

3 Das Gupta (Arun Kanthi). *An essay in personal bibliography: Bibliography of the writings on and by S R Ranganathan*. 1967.

A personal bibliography of a purely "By" kind is Author Bibliography, as the person is the author of all the documents. So also, a personal bibliography of a purely "On" kind is Subject Bibliography, as the person becomes the subject of study.

5 Enumerative Bibliography

A generic name for all the kinds of bibliographies mentioned till now is 'Enumerative Bibliography'. This book does not deal with Enumerative Bibliography of any kind.

6 Existence Bibliography

61 Purpose

The primary purpose of the bibliographies prepared by all the agencies mentioned in Sec AB3 is to make available a list of books known to exist in a certain library or else in a certain field of study such as a definite period of time, or a specified subject, or a given language, or a certain form of exposition or an individual author, and so on. Noting the existence of books exhausts the purpose of such a bibliography. We may therefore call it an 'Existence Bibliography.'

62 Details Included in the List

Ordinarily the entry of a book in an Existence Bibliography will give only the minimum of details to identify it — say, name of the author, title, date, and perhaps series, if any, to which it may belong. In certain Existence Bibliographies, such as copyright lists or publishers' catalogues, the place of publication, the name of the publisher, the format, and the collation may also be given.

63 LOCATION REQUIREMENTS ONLY

In preparing some kinds of Existence Bibliography, the person producing it may or may not examine the book personally. No effort may be made to describe the physique of the book in detail, except in so far as it is inseparable from location-requirements. In the *Merchant of Venice,* Antonio pledged a pound of his flesh. Shylock earned a right to it. Portia's insistence that Shylock should take the flesh without a drop of Christian blood was a trickery. On the other hand, we have a proverb in Tamil that if a cow is sold, the buyer is entitled to the calf. In a similar way, some slight account of the physique of the book is an inseparable concomitant in any Existence Bibliography. But the physique does not occupy the centre of attention. This book does not deal with Document Bibliography of any kind.

CHAPTER AC

PHYSICAL BIBLIOGRAPHY

1 Definition

When Bibliography is concerned only with the gross body or physique of the book, we may call it Physical Bibliography. This deals with the process of the physical production of a book in a printed or other kindred form. This will have to deal with:

1 Paper;
2 Type-casting;
3 Composition;
4 Block Making;
5 Printing;
6 Lay-out of the book and of its pages;
7 Binding; and
8 New physical forms in which books are now being reproduced by several reprograph methods.

2 Three Varieties of Interest

Among readers, there may be three varieties of interest in Physical Bibliography. Arranged in the sequence of their evolution, they are

1 Craftsmen and technologists engaged in the physical production of the book;

2 Scholars engaged in evaluating the authenticity of a copy of a book, textual criticism, and related matters, as users of the book; and

3 Librarians engaged in the wide distribution of the idea embodied in a book to readers for their intellectual enrichment — not only to specialist readers but also to generalist readers.

3 Three Varieties of Exposition

The angles of approach of the three varieties of readers to Physical Bibliography are all different. The exposition of the

subject should be different for each of them. To use a classificatory term, the exposition should be differently biased to satisfy the three kinds of readers.

4 Bias of Craftsman and Technologist

The bias of a book on Physical Bibliography, intended for the craftsmen and technologists engaged in the physical production of book, should be severely towards the techniques of production, without regard to the idea contained in the book.

5 Bias of Scholar

Scholars are interested in the authenticity of the text of the book. This leads them to textual criticism. In its turn, it leads them to interest themselves in the dates of printing, the changes made in its successive editions, and also in the differences among the copies belonging to one and the same edition. Physical Bibliography for scholars consists of several species, such as Palaeo-Bibliography, Descriptive Bibliography or Analytical Bibliography resulting in Historical Bibliography, Textual Bibliography, and Taxonomic Bibliography.

6 Bias of Librarian

Librarians are interested in having books attractively and helpfully produced — attractive and helpful enough to hold the attention of specialist readers as well as of generalist readers. They need sufficient knowledge of Physical Bibliography to enable them to select the best edition suited to their respective libraries and to make sure that the copy of a book supplied to them conforms to the specification contained in the book-order and is complete in every respect. Physical Bibliography for librarians may be called Social Bibliography, as the librarians are engaged in developing social well-being through the use of books and for this purpose they socialise books and endeavour to get them used by all the members of the society.

CHAPTER AD

PHYSICAL BIBLIOGRAPHY FOR THE TECHNOLOGIST

1 Physical Bibliography Proper

Physical Biblography Proper is concerned with the technology of the physical production of a book. The production of the physical book calls for a team of craftsmen to work-in-series: 1 Paper-maker; 2 Type-caster; 3 Block-maker; 4 Printer; and 5 Binder. As in all other trades, the workers in these groups first began as craftsmen. These depended on tradition, apprenticeship with master-craftsmen, and on their own individual skill; they did all the jobs mostly by themselves. The work was a Small Scale Industry.

2 Change-over to Technology

In due course, machinery progressively replaced manual labour. The work became a Large Scale Industry. Production passed on from craftsmen to technologists. It became a matter for chemists and engineers — industrial chemist, cellulose chemist, size-chemist, colour-chemist, paper-chemist, leather-chemist, machine production engineer, power-engineer, electronics engineer, machine-man, and so on.

3 Emergence of Technocracy

It also called for entrepreneurs managing and conserving raw materials, capital, scientific and technical man-power, and wholesale and retail distribution, and thereby increasing productivity. It became a matter of technocracy.

This book does not deal with Physical Bibliography for any technologist involved in the production of the physical book.

CHAPTER AE

PHYSICAL BIBLIOGRAPHY FOR THE SCHOLAR

1 Palaeo-Bibliography

Book is a medium of communication. Faults and frauds are possible in the medium. These should be detected and corrected or allowed for in picking up the communication. When the original producer of the ideas, communicated through a book, belonged to a past age and is dead and gone, there is no chance for getting to know his mind and intention by direct personal intercourse. His ideas are to be reconstructed as well as possible from what is expressed in the book. In this reconstruction, there are two stages. The expression in the subtle medium should be retransformed into ideas. This needs competence in linguistics and in scholarship in the subject concerned. But prior to the retransformation of the recorded words into ideas, it must be ensured that the recorded words are authentic in the particular copy serving as the physical medium. It must be ensured whether the

1 Printer had not inadvertently introduced anything not meant by the author;

2 Printer had not deliberately made any changes in the subtle or the gross body, with or without fraudulent intention;

3 Persons, through whose hands the copy might have passed, had not made any alteration, intentionally or unintentionally; and

4 Persons connected with its production of any of the chain of the earlier editions had not made deviations from the first edition, intentionally or unintentionally.

To pick up the communication correctly, every effort will be made by a meticulous scholar to guard himself against every such possible distortion. In this respect, a scholar's reconstruction of the original author's ideas, from his intellectual remains petrified in book-form, is very much like that

of a naturalist's reconstruction of the body of an extinct animal from some of its remains petrified in rock-form. This branch of a naturalist's work is called Palaeontology. So also the branch of bibliography forming the field of a scholar's work may be called 'Palaeo-Bibliography'.

11 Aristocracy of Scholarship

Palaeo-Bibliography is a high-water mark in the aristocracy of scholarship. The immediate motive, putting a scholar in its pursuit, is the joy of knowing what looks like unknowable. Many are the hurdles in the path of his pursuit. Very exacting and varying have been the devices made to cross the hurdles.

12 Oral Communication

When the medium of communication was the spoken word, as it was in the communication of the Vedas in the ancient days, the skill, needed in maintaining the correctness of the text of a work, was largely linguistic with emphasis on phonetics. It also required a considerable insight into the cultural ethos of the periods not only of the author but also of each of the epochs through which the book has been communicated.

13 Manuscript

When the medium of communication was the manuscript, the hurdles took a new shape. Calligraphy became a point of emphasis in linguistics. The determination of the date of the manuscript came to engage a considerable attention. Collation of all available manuscripts became the bed-rock of reconstruction. I remember the thrill which problems in manuscripts used to induce in Mahamahopadhyaya S Kuppuswami Sastriar, a prince of aristocracy in Sanskrit scholarship. I remember the ecstacy into which he used to go, when he hit upon the right emendation in the last letter of a verse in a manuscript he was reconstructing. His delight was unbounded when, years

later, an old manuscript was found containing his emendation.

14 PRINTED BOOK

When the medium of communication became the printed book, there came the fond belief that the original had been once for all frozen and there was no longer any question of reconstructing the original author's draft of the book. But it all turned out to be a false belief. On the other hand, new hurdles appeared. There was still need to examine every available copy of an edition of a book in order to reconstruct the ideal copy of that edition. The scholar had still to explore and describe the textual history of the edition and to put it in correct relation to other editions. The reconstruction of the true text of the original of a book continues to be still a lure for the aristocracy in scholarship. In his presidential address to the British Bibliographical Society (*Library*, S 4, v11;1931; 250-1), W W Greg said, "Books are of importance only as the vehicle by which (their) contents reach us. Books are our main link with the thought and action of the past. Bibliography is the study of the material translation of literary and other documents; its ultimate aim is to solve the problem of origin, history, and text so far as this can be achieved through minute investigation of all the material means of transmission." Greg had invented the stimulating term, 'Calculus of Variants' to denote the methodology used in reconstructing the text of a book.

15 THREE SPECIES

Aristocracy of scholarship has given rise to three species of Palaeo-Bibliography: 1 Descriptive Bibliography; 2 Historical Bibliography; and 3 Textual Bibliography.

2 Descriptive Bibliography

Descriptive Bibliography deals with books as material objects formed by the mechanical process of printing. It is not often concerned with the text of the book. Even when it does, it does not do so from the critical or literary angle. It

merely treats it as paper impressed with certain symbols. It concerns itself only with the mechanical relation of these symbols. Its aim is to give complete facts about the gross body, the physical dress, of the text.

21 Definition of Field

Descriptive Bibliography usually sets forth with a definition of its field. It may confine itself to

1 Single work (e g Stack (J S). *Dryden's Indian Emperour: The early editions and their relation to the text*); or

2 Single author (e g Johnson (F R). *Critical bibliography of the works of Edmund Spenser printed before 1700*. 1933); or

3 Single printer (e g Hazan (A T). *Bibliography of the Strawberry Hill Press*. 1912); or

4 Binding in a single country (e g Thomas (H). *Early Spanish book bindings, XI–XV centuries*. 1939. 46+65); or

5 Single subject and period (e g Greg (W W). *Bibliography of the English printed drama to the Restoration*); or

6 Any other limited field.

22 Objective

The objective of Descriptive Bibliography is:

1 Standard description, according to a formula, of a series of books within the defined field;

2 Setting up a description of the Ideal Book in the said field;

3 Listing all kinds of irregularities — that is, deviations from the ideal;

4 Determining the method of production of each forme of each volume; and thereby

5 Clarifying and explaining the differences in the texts of the several copies of each book in the series; and

6 Interpreting features bearing on the method of printing and publication of the entire book or any part of it.

23 Completeness of Coverage

Descriptive Bibliography cannot reach its ideal unless every existing copy belonging to the defined field is physically examined. The discovery of even a single copy with special features of its own may upset the description already set up for the ideal copy. This has often happened. Such completeness of coverage will obviously be impossible if any time limit is put on the work. Greg's *Bibliography* mentioned in Sec AE21 is said to have taken more than twenty years.

24 Arrangement

No single mode of arrangement can be prescribed for all Descriptive Bibliographies. The arrangement will have to depend upon its defined field. It may have to be on the basis of author, edition, chronology, paper-maker, printer, binder, water-mark, type-face, or any other characteristic germane and essential to the objective of the bibliography. It may have to be done even on the basis of the compositor.

25 Notation

The method of description used in a Descriptive Bibliography is according to certain recognised principles of bibliographical notation. The notation should generally fall within the stream of tradition. The conventions should be respected. Unless this is done, a Descriptive Bibliography will not be normally intelligible, precise, and concise. To have recourse to non-technical, non-notational description is wrong. It is usually advocated in the interests of the so-called general reader — who is either a myth or in such a minority that his requirements should not be met at the cost of the convenience of the more numerous scholarly readers. A detailed bibliographical description is really a substitute for a personal examination of the book by a scholar who may not have access to the book itself.

26 Minimum of Details

From the point of view of the minimum of details to be included in Descriptive Bibliography, three periods should be recognised in the history of book-production:

1 Fifteenth century;

2 Sixteenth, seventeenth and eighteenth centuries; and

3 Nineteenth and twentieth centuries.

261 *Fifteenth Century*

The Books of the fifteenth century are called Incunabula (= cradle books). The literary urge is least incident in their study. The sole objective in the Descriptive Bibliography of incunabula is virtually the reconstruction of the history of printing and book-building. In their case the description must have the fullest details. This field has been explored more or less thoroughly. The results are embodied in the *Catalogue of fifteenth century books in the British Museum* and in the *Gesamtkatolog der Wiegendrucke*. The first volume of the former and the third of the latter contain excellent full descriptions. Standard rules of description for incunabula will be found in Henry Guppy's *Rule for the cataloguing of incunabula* (1924). As the number of books published in the fifteenth century is relatively small, both complete coverage and fullness of details are possible in a Descriptive Bibliography of that period.

262 *Sixteenth to Eighteenth Centuries*

In the second period, however, the number of books published was far greater. The number of printing presses also was far greater. This makes complete coverage more arduous. Moreover, in respect of this period there was a shift of interest from the history of printing to the problem of the text and its relation to the manuscript from which the book

was set. All these factors have resulted in reducing the number of details in the description.

263 *Nineteenth and Twentieth Centuries*

In the third period, the numbers involved have grown even to greater dimensions. This by itself has called for further reduction in the details to be given in a descriptive bibliography. Another factor, which has influenced it, is the virtual abandonment of printing by hand and the advent of machinery into the book-trade. At the beginning of the nineteenth century, laid hand-made paper began to give place to machine-made paper. The former was in definite and small sizes. The latter is produced in extra-large sizes and in rolls. At about the same time, machinery for printing also came in. A book can be printed from plates such as stereotype, electrotype, or by photo-lithography. The power press used may be either flat bed or rotary. About the end of the nineteenth century, machinery was invented for type-setting also. Two kinds came in — linotype and monotype. There is difficulty in recognising the precise method by which a book was printed. The materials involved do not present sufficient individuality challenging identification. The relation between compositor and press-man to the copy has been standardised. So also the relation between the author and the publisher is more regular. These factors do not create sufficient problems for solution by methods of Descriptive Bibliography. Further, Descriptive Bibliography has to depend upon aristocracy in scholarship. Bibliographical scholars are always too few for the work in hand. Scholarship in Physical Bibliography by its very nature turns to the past rather than to the present. There is always a casual feeling that the present can be managed without the special training which students dealing with the past must undergo. The craze for first edition is often motivated by cold-blooded commercialism. Scholarship fights shy of anything smelling of commercialism. Moreover, scholars prefer

to work on a fairly stabilised body of materials. The whereabouts of copies of the books of earlier periods are truly recorded in the printed catalogues of the libraries in which they had settled down. The same facility to locate the required number of copies for examination is not available for modern books. The result of all this is that the Descriptive Bibliography of the books of the third period is not as highly organised as that of the earlier periods. There is more of descriptive cataloguing than of Descriptive Bibliography. Even where Descriptive Bibliography is attempted, the details given are comparatively few.

3 Analytical Bibliography

Since Descriptive Bibliography is based on a meticulous analysis of every physical feature of a book, it is also called Analytical Bibliography. It may be again repeated that the term Descriptive Bibliography may denote either a book which actually describes a series of related books or the art of composing such a book.

This book is not concerned with the Descriptive Bibliography in either sense. A full account of its technique and the convention about the notation will be found in F Bower's *Principles of bibliographical description* (1949).

4 Historical Bibliography

If we have several descriptive bibliographies worked out with care, it is possible to collate them and to distil out of them a history of printing and book production. The term 'Historical Bibliography' denotes this branch of Physical Bibliography.

This book does not deal with Historical Bibliography.

5 Textual Bibliography

Another use to which descriptive bibliographies can be put is the determination of the original text as it left the author's

hands. This is of vital interest in editorial work. Indeed the reconstruction of the author's text is regarded as the highest aim that a bibliographical scholar can set before himself. Some, however, equate textual criticism of this kind with pedantry. They say that this is the result of the dead hand of a tradition which originated in the reconstruction of manuscripts where calligraphic vagaries were unbounded. Such a criticism fails to recognise that mechanical means of reproducing books is not any less free from human fallibility. In transfer from manuscript to print and from edition to edition there is as much chance for distortion in text as there has been in transfer through a series of manuscripts. Printing involves a whole series of processes often carried out by persons of no literary knowledge and interest. The printer's devil can appear from many a corner and distort the text. The compositor, the proof-reader, the forme-maker and the designer of the title-page of the first edition as well as each of the later editions can introduce intentional and/or unintended deviations from the original. The author as well as the editor of any of the editions may contribute his own deviations. The elimination of the deviations is the province of textual criticism. It can proceed along two lines — literary and textual. To proceed along literary lines, we invoke the aid of higher criticism. We speculate. We ask, "Could this author have used these words in this context?" We put the challenged words against the background of our knowledge of the author, of his other works, and of the state of his contemporary society and its knowledge, beliefs, and usages. To start off in this way from the very beginning is liable to lead us astray. The risk is less if textual criticism completes its work first and establishes the ideal copy, and higher criticism steps in thereafter. When the ideal copy has been correctly established, higher criticism may apply its own methods to amend doubtful words, sentences, and passages, and to test authenticity — whether the author to whom the work is attributed or the year in which its composi-

tion is placed is genuine. The work in the first of these stages has to be based on descriptive bibliography. The result of this work as well as the methodology of this work may be denoted by the term Textual Bibliography. On account of its being tied up with higher criticism, it is also called Critical Bibliography.

6 Work Done and to be Done

Textual Bibliography is the fruit of Palaeo-Bibliography, even as Descriptive Bibliography is its stem. A considerable amount of work has been done in Textual Bibliography in many Western countries during the last hundred years or more. Many are the Bibliographical Societies — more than a dozen — which inspire and coordinate work of this nature. Even more are the organs embodying the results of research. India has done much in the field of manuscripts. The colossal work done at the Bhandarkar Oriental Research Institute, Poona, to establish the text of the *Mahabharata* is at the apex of Sanskrit scholarship in India. But nothing worth mentioning has been done in regard to printed books. Time has, however, come for it. The writings of Tagore and Gandhi call for it. I remember the need I felt to apply its methods to determine the question of priority in regard to Raman Effect. There was discrepancy between the page-number of the *Indian journal of physics* cited by some and that which occurred in the complete volume of this periodical. Raman himself told me that pre-prints were paginated differently and sent out to safeguard priority, which was exposed to danger as a result of Reuter's Agency having flashed news to foreign countries about his speech on it. If I had not had this help from Raman, it would have needed all the aid of the technique of Textual Bibliography to settle the question.

This book does not deal with the technique of Textual Bibliography.

7 Taxonomic Bibliography

If Historical Bibliography and Textual Bibliography are the fruits and Descriptive Bibliography the stem of Palaeo-Bibliography, there are several roots which feed and support the tree. These roots are concerned with the following categories some of which are described in later chapters.

1 Paper-making

11 Paper mill
12 Water mark
13 Paper size
14 Paper quality

2 Typography

21 Type-caster
22 Punch
23 Matrix
24 Type family
25 Type size
26 Type font

3 Composition

31 Number of columns
32 Compositor's measure
33 Justification
34 Side notes
35 Box rules
36 Number of lines
37 Leading
38 Punctuation

4 Imposition

41 Type-page
42 Opening within the furniture of chase and margin
43 Number of lines in a page

44 Headline including running title and pagination or foliation
45 Direction line including catchword and signature

5 Preliminary Pages

51 Half-title-page
52 Title-page
521 Borders, compartments, and frames
522 Rules
523 Devices
524 Cuts
525 Ornaments
526 Mottoes
527 Imprint
528 Interpolated notes
53 Dedication
54 Contents

6 Extra-Textual

61 Tables
62 Appendices
63 Index

7 Colophon

71 Printer
72 Scribe
73 Title
74 Author

8 Title

81 Of the text
82 Of the sections

91 Assemblage

911 Format
912 Collation and gatherings
913 Insertions

9131 Outside the gatherings
9132 Inside the gatherings
914 Cancels

92 Illustrations

93 Binding

A considerable amount of work has already been done on most of these categories. Standard dictionaries exist. Dated descriptions are found in them. Each of these may be called a Taxonomic Bibliography. These are results of extensive research of an empirical kind. All the three branches of palaeobibliography are now rooted on the approved standards regarding most of the categories enumerated above.

This book does not deal with any of these species of Taxonomic Bibliography.

CHAPTER AF

PHYSICAL BIBLIOGRAPHY FOR THE LIBRARIAN

1 Democracy in Education

In Chap AE and its sub-divisions, we saw the ramifications of Physical Bibliography in the sphere of Aristocracy in Scholarship. Those pursuing them have been drawn mostly from scholars themselves, particularly from scholar-custodians of collections of books, for nearly the first five centuries of the Gutenberg era. These ramifications were turned into the past. That is why we denoted the resulting branches of bibliography by the generic term 'Palaeo-Bibliography'. We shall next turn to the ramifications turned into the future. These are in the sphere of Democracy in Education.

2 Socialisation of Library

Democracy has been asserting itself in recent years. It asks for equal opportunity for one and all. In the first instance, the emphasis has naturally to be on those that had been denied opportunity in the past. The result is that the term 'Democracy' is also taken to mean the under-privileged masses as against the privileged classes. The backing of the democracy in the second sense by the democracy in the first sense is visible in all spheres of life today. Democracy is asserting itself in regard to political rights, standard of living, distribution of wealth, dispensation of justice, and every other factor emerging from the living of man in organised society. Education is no exception to this. Democracy in education is one of the outstanding social happenings of the last hundred years. Schools were the first social institutions thrown open to respond to its call. At the call of democracy, library too is being transformed into a social institution. It is now putting equal emphasis on service to the severe scholar and on service to democracy. The outlook of library authorities is being changed. The resistance of the old guards among librarians to the pres-

sure of democracy is melting away. The new generation of librarians is responding to the call of democracy in library service. They realise that service to the common man — be it for information or recreation or inspiration — is as important as service to the severe scholar. To meet this new demand, library organisation itself is introducing, in an informal way, division of functions among libraries. It is charging a few libraries in each country to specialise in the old aristocratic function of giving service to scholars interested in Palaeo-Bibliography. At the same time, it is also promoting a nation-wide network of libraries to discharge the new democratic function. This change-over in the outlook of library authorities, in the attitude of the library profession, and in the set-up of library organisation, had taken nearly a century in the countries which began to develop earlier.

3 Social Bibliography — What it is

Time has come to develop the topics enumerated in Sec AC1 from the new angle of the democracy — from the angle of the socialisation of books. Treating those topics as for Palaeo-Bibliography should no doubt be continued; for this purpose, it should be consigned to the care of a few scholars and scholar-custodians working in or caring for the few necessary antiquarian libraries; this is necessary but not sufficient. Treating those topics as for technology and useful arts should be continued by technologists and business organisers; this too is necessary but not sufficient. The new approach to Physical Bibliography should be towards the book of the future. It should be along the path of making the book an effective tool in self-education and self-entertainment as much for the democracy as for the aristocracy (in the intellectual sense). It should examine the ways and means of making books readily acceptable to the common man and even to those in the lowest quartile of the intellectual scale; they should be made capable of luring them into their use. In addition, it

should explore also the ways and means of making books conserve the time, the tempo, and the energy of the specialists in picking up communication from one another. The study of Physical Bibliography from this angle — the angle of the future, the angle of the democracy, the angle of the teamwork of specialists working-in-series — in short the angle of the library as a social institution charged with serving books for the self-education and self-entertainment for the masses as well as the classes and for the conservation of the research potential of humanity — such a study of Physical Bibliography may be called Social Bibliography. It is Physical Bibliography for the Librarian.

4 Social Bibliography—What it is not

The new exposition of Social Bibliography — that is, Physical Bibliography for the Librarian — should not be as for the paper manufacturer, type-caster, printer, binder, or publisher — as for the book-trade in short. Nor should it be as for analytical, or descriptive, or historical or critical or textual bibliography — as for the scholars turned on the study of the books of the past as a foundation and as a means for reconstructing the original texts of books of the past and thereby capturing the details of the culture of the past connected with the printing of books as a social activity.

5 Physique of the Book as a Container

The value of a book as a physical commodity consists only in its being the container of systematized ideas. What is contained in it does not easily arrest the attention of the consumers. It does not entice them. For, the hunger for ideas is feeble and fleeting. It is not compelling. The consumer would therefore be helped if the container is inviting and comfortable to handle. In the individual reader the feeling that certain improvements in the physique of books will make them more acceptable and add to his comfort — that feeling is fleet-

ing. One man's feeling is too feeble to reach the notice of the book-trade engaged in the production of the physique of books, and to produce an effect on it.

6 Responsibility of the Library Profession

Therefore, the library profession — particularly those in the profession that do reference service — who are the ultimate distributors of the ideas, have a special responsibility in improving the attractiveness of the physique of the book. They see the momentary feelings of each reader whether they are expressed verballly or not. They see it continuously when they are on floor-duty. They can integrate all these feeble feelings into one with a considerable strength. An individual librarian cannot effectively carry it to the book-trade and influence it. But he can pass it on to his own professional body. The professional body can digest the reports of its individual members and press its findings effectively on the book-trade.

7 Library as Observatory and Laboratory

The resulting digest made by the library profession will perhaps lay bare points requiring further observation and perhaps even experimentation. In that case, the profession can formulate specific problems for investigation by individual libraries. Field-study can be conducted in libraries. The readers can be observed unobtrusively to know the comparative efficiency and appeal of the

1 Qualities of the jacket, the binding, the size, the shape, the weight, and other physical qualities of the book;

2 Qualities of the paper, the type-face, the illustrations, the lay-out of the page, and its total colour-effect;

3 Adequacy, sequence, and design of the parts of the book such as contents, preface, and index — in other words, the lay-out of the book as a whole;

4 Balancing of the letter-press with the graphic aids such as maps, pictures, histograms, and schematic diagrams; and

5 Alternative physical forms for reading materials, designed for reasons of economy or of the requirements of special classes of people or even for greater effectiveness in meeting the requirements of normal users.

Pure observation without manipulation of any sort can be reinforced by manipulation of the factors concerned and observations under control — by experimentation, in short. In other words, the library can be used both as an observatory and as a laboratory. The library profession can thus make an empirical study of problems in Social Bibliography and pass it on to the producers in the book-trade. The book-trade can with advantage be brought in even at the stage of the design of experiments. Psychologists, statisticians, and other specialists too may have to be brought in for specific technical aid. This is a possible line of work in Social Bibliography in which the library profession should play the primary role.

8 Selective Aspects

What the technicians in the book-trade can learn from the empirical study conducted under the auspices of libraries will cover only a few selective aspects of the crafts forming the book-trade. For, the readers are not the only consumers of their produce. Paper is not used for printing alone; it is used in several other ways — such as for packing, toilet, and decoration of walls and furniture. Printing is not used for producing books and periodicals alone; it is also used for producing posters, forms and registers, and for diverse other purposes. Binding is not used merely for books in public use in libraries; it may be used by some for sheer aesthetic purposes. Thus, the book-trade's interests are diversified. Therefore, the selective aspects of Physical Bibliography, which affect readers and thereby the library profession, should be taken charge of by librarians and pressed on the attention of the book-trade.

CHAPTER AG

NEED IN NEWLY DEVELOPING COUNTRIES

1 Work Done in Western Countries

Empirical study of Social Bibliography through observation and experimentation is necessary. It has not yet been done on an adequate scale by the profession. It has not yet been planned and pursued in a comprehensive manner, nor in an objective manner in conformity to the principles of scientific method. No doubt, some investigations have been and are being made on paper, printing, and binding. But these are largely from the angle of strength, durability, and preservation. But concerted and continuous work from the angle of Social Bibliography still awaits to be done in an adequate measure. The delay in its being started is traceable to the delay in recognising the educational and other social functions of libraries. The delay in their recognition is traceable in its turn to the delay in the emergence of the idea of democracy — in the sense of equal opportunity for education, particularly self-education, and for self-entertainment for all. Democracy in education and intellectual entertainment has been emerging in slow stages in the Western countries during the last century. When there is a slow emergence, thinking and re-adjustment can be done slowly, casually, and even without a plan. They can be left to flair and some intuition. They need not necessarily be based on deliberate experiment and observation. They can be left to the effort of isolated individuals who are more sensitive than others to the new situation which is emerging. They need not necessarily be done as a public project, under the auspices of a learned body or at the level of the Government. This is what has happened in the countries which began to develop a century or two ago.

2 India's Opportunity

The pace of the study of Physical Bibliography from the angle of the librarian should be different in a country which had been resting for centuries and is waking up late in the day. Under the pressure of what has happened elsewhere, the emergence of democracy in such a country is explosive and precipitous. What was achieved in countries of "slow" emergence in the course of a century, has to be achieved within a single generation or perhaps even within a decade in countries exposed to a "sudden, explosive, and global" emergence of democracy. India and most of the Asian countries are experiencing a sudden and global thrust into democracy. Equal opportunity for self-education and intellectual self-entertainment has to be provided all at once to hundreds of millions of people with the widest imaginable scatter of self-educability and capacity for self-entertainment through books and kindred reading materials. Consequently, India's opportunity to pursue Social Bibliography empirically, according to scientific method, backed by observation and experiment and to pursue it as a public project is unique. Will India — its library profession, its Ministries of Education and Natural Sciences, and its Planning Commission — rise to the occasion, grasp the opportunity, and do its duty demanded by the present phase of renascence?

3 Social Education Literature

India must do so. It has a unique opportunity to do it on a large scale. It lends itself to become a huge laboratory and observatory for investigation in Social Bibliography. For, independent renascent India has inherited 85 per cent illiteracy. Although it has managed polling without literacy, it cannot use its independence effectively without liquidating the appalling illiteracy which prevails. It may be that the present talk of "liquidating illiteracy" among the adults within a few

years proves to be vain; perhaps it will. But it must be possible to start compulsory education immediately. If this is done and if the new generation is raised as a literate generation, within fifty years, illiteracy will be liquidated by sheer efflux of time — the old illiterates disappearing and the new generation rising fully literate. In this transitory period, some illiterate adults too are sure to become literates. There will thus be need for producing books suited to neo-literates. When literacy becomes universal, there will be need to produce books suited to the lower quartiles in the intellectual scale. Books for the neo-literates and for the lower quartiles go by the name of Social Education Literature. India has now to face the problem of social education literature. This problem has indeed caused a crisis in India's book production. The novelty of the crisis dazes people. It blinds. It paralyses. It is making people insensitive to its implications. It is not known how to set about to meet the problem. There is considerable confusion in thinking. The questions of discovering authors of the right sort and of finding illustrators who can work with the authors on the one hand, and the problems of physical production of books so as to appeal to the neo-literates and the lower quartiles on the other, are not separated. They ought to be separated. Their solution will have to proceed along different lines. They will have to be tackled by different techniques. If they are, India will create for itself the opportunity to pursue Social Bibliography empirically, according to scientific methods backed by observation and experiment. It is only if that opportunity is created and seized that the problem of social education in the colossal scale, which it has assumed in India, can be solved with success.

Such is the need in India and the other newly developing countries, for a scientific study of Physical Bibliography from the angle of Librarians.

CHAPTER AH

METHODS OF STUDY

1 Scientific Method

Experiment and observation form only one of two possible methods in the scientific pursuit of a discipline. For, the line of development of most disciplines lies along the Spiral of Scientific Method. This spiral discloses another possible method of study. Each of its cycles moves amidst

1 Facts observed by the senses with or without instrumental aids;

2 Empirical laws cooked out of a vast set of observed facts by the intellect with the aid of inductive logic and statistical analysis;

3 Fundamental laws sublimated by intuition from a vast set of empirical laws, and pressed out of intuition by teleological analysis;

4 Deduced laws derived by the intellect, from the fundamental laws, with the aid of deductive logic.

5 Observation, once again, of the world of facts for confirmation of the deduced laws or for their denial;

6 Reconciliation of the deduced laws and the observed facts in case of non-conformity, by the elimination of any possible flaw in the logic on the one side and the observational and experimental technique on the other;

7 Building up new data in case of a crisis created by the unbridgeable gulf between deduced laws and observed facts;

8 Formulation of new empirical laws from the new observed facts; and

9 Repetition of the cycle in this manner *ad infinitum*. In this infinite process, there can be neither a beginning nor an end. We have to begin our pursuit anywhere and at any stage in the spiral.

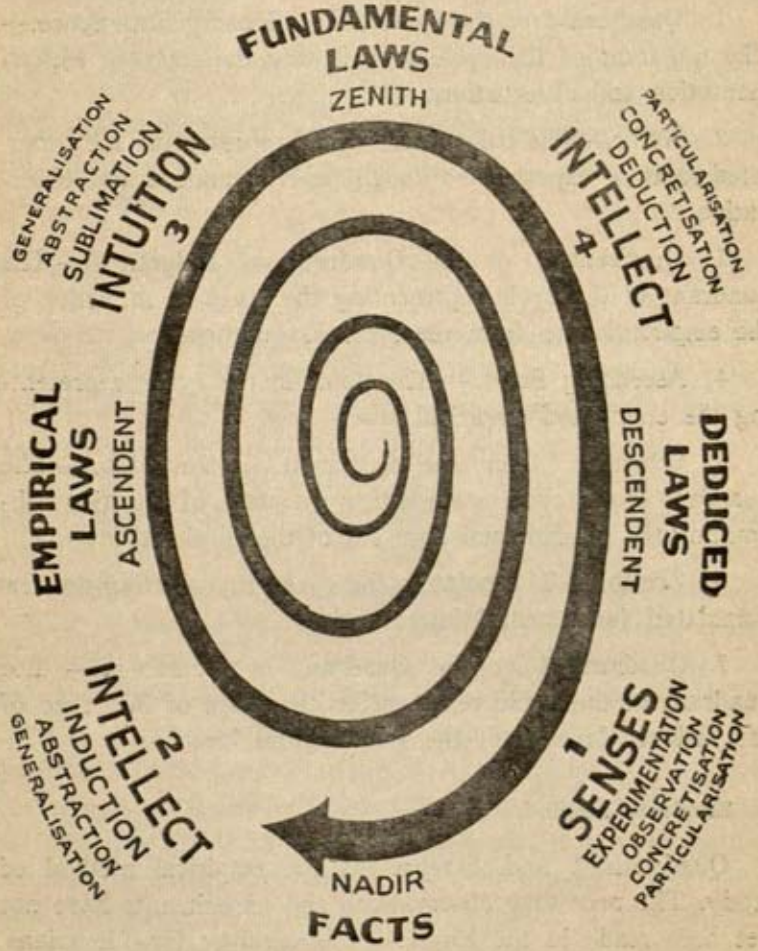


Fig. 1. Spiral of scientific method

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2 Schematic Representation

The diagram on the previous page is a schematic representation of the Spiral of Scientific Method. For definiteness, but without loss of generality, the spiral is taken to move in the clockwise direction. To facilitate communication, the following terms may be used, as indicated in the diagram:

1 Quadrant 1 or the Quadrant of Sensory Experience.—The quadrant of the cycle representing the stage of experimentation and observation;

2 Nadir.—The point in the cycle, representing the cumulated facts of experience through experimentation and observation;

3 Quadrant 2 or the Quadrant of Induction. — The quadrant of the cycle representing the stage of induction of the empirical laws from the facts of experience;

4 Ascending Point. — The point in the cycle, representing the cumulated empirical laws;

5 Quadrant 3 or the Quadrant of Intuition. — The quadrant of the cycle representing the stage of intuition sublimating the fundamental laws out of the empirical laws;

6 Zenith. — The point in the cycle, representing the few cumulated fundamental laws; and

7 Quadrant 4 or the Quadrant of Deduction. — The quadrant of the cycle representing the stage of inference of the deduced laws from the fundamental laws.

3 Empirical Method

Quadrants 1 and 2 represent the empirical method of study. The necessary observations and experiments have not yet been made in the Physical Bibliography for Librarians, to an appreciable extent. At any rate, there are not sufficient

data available. Therefore, the empirical method is not followed in this book. Only some conjectures about the possible results of observation and experimentation are mentioned here and there; and an appeal is made for the pursuit of the subject by the empirical method.

4 A Priori Method

The library profession has now some normative principles which serve as its springboard. It is therefore possible for it to start with the *a priori* method in the study of Physical Bibliography for Librarians. This book is confined only to such a method.

5 Laws of Library Science

Every problem in Library Science stems from its Five Laws. Physical Bibliography for Librarians is no exception to this. These Five Laws are the normative principles behind all library practices. These are briefly discussed in my *Library manual*, 1962 (Ranganathan Series in library science, 6, Asia Publishing House), and were first stated and elaborately studied in my *Five laws of library science*, 1931 (Madras Library Association, publication series, 2), and now in edition 2 of 1957 brought out by the Asia Publishing House. These Five Laws contain every possible library problem in a potential, invisible form. They hold it in secret. This secretive habit is a characteristic of the fundamental laws of every discipline. These laws often appear quite trivial. The greater the triviality, the greater is our wonder that they could secrete so much within themselves. The pursuit of any discipline involves the extortion from its fundamental laws all that they hold in secrecy. The history of a science is, in a sense, the history of this extortion. It looks as if we can never see the end of it. This is the same as saying that the implications

of the fundamental laws are infinite. No student of any discipline need to fear that his subject will be exhausted at any time. In the succeeding parts of this book, we shall probe into the secrets of the Laws of Library Science in respect of Physical Bibliography for Librarians.

6 Empirical Corrective

While teaching the subject, the teacher should back the *a priori* method with some empirical corrective. It can be done as suggested in the subsections of this section.

61 Observation Work

The students should be taken out to observe the processes of paper-making, type-casting, block-making, printing, reprographic work, and binding in the respective places of production. Arrangements should also be made to show the students motion-films or still pictures of the operations taking place in each of such places of production.

62 Practical Work

Students should also be asked to collect from the library and elsewhere samples of books, in order to get experience of the following physical features of books, be made to annotate on them, and should be given other similar exercises:—

11 Paper of different sizes of books of different formats;

12 Paper of different qualities;

21 Type-faces of different families, series, styles, and sizes for Roman script and other scripts current in the country;

22 Illustrations of different kinds;

3 Aesthetics of the book;

4 Lay-out of the page and of the book as a whole;

5 Reprographs of different kinds; and

6 Binding of different kinds, qualities, and strength.

63 Museum of Physical Bibliography

Each School of Library Science should also build up a museum of physical bibliography in order to show the historical development of each of the crafts and technologies making up Physical Bibliography. It should contain specimens of all the materials used and of finished products of all kinds. This will facilitate making the teaching of the subject realistic.

CHAPTER AJ

GENERAL PREDISPOSING CAUSE FOR THE BOOK

0 Family of Books

This book belongs to a large family of books. Indeed anybody can easily trace its ancestry to the first member of the family, the *Five laws of library science* (1931; 1957). That book contains in germ form practically everything more elaborately elucidated in one or other of the succeeding books of the family.

1 Unity in Diversity

Unity in Diversity characterises this large family of books. This character of my books as a whole and of each book, has been due to the influence of Edward B Ross, my professor. He initiated me in the art of thinking during the six years of my course in mathematics. I had intimately experienced his way of developing ideas not only in his lectures on any particular subject, but even in every conversation I have had with him — I have had them from 18 March 1909, the day of his capturing my mind, to 14 April 1932, the day of his retirement and leaving Madras for his home-town, Edinburgh. This intimate experience has produced a lasting impression in my mind. That impression had been given a name by another respected friend of mine, Mahamahopadhyaya Professor S Kuppuswami Sastriar. That name is *Ekavakyata* (= Unity of Idea). According to it all knowledge is one unit. The Vedas form, in a sense, a single sentence. So does every chapter of it form a single sentence. Of course, every sentence of it is a single sentence. Each of these holds a unit idea of its own level. *Ekavakyata* is seeing the unity hidden behind diversity.

2 Experience of Unity in Library Work

When Providence transferred my field of work from Mathematics to Library Science, this *Ekavakyata* tradition of the Vedic ancestors — demonstrated in daily life by my Professor — came with me. When I spent a year wandering amidst diverse libraries in Great Britain in 1924-25, in order to prepare myself for my new work, the light of this *Ekavakyata* principle was disclosing the integration, into a grand unity, of all the tiny unities inherent in each of the several of the minutest imaginable details in library practice. It illuminated the individuality of each of them, and at the same time threw them into a coherent whole. I felt the *Ekavakyata* pervading all that I saw in the British library world and all that I read in the splendid library on Library Science found in the School of Librarianship of the University College, London. I still find it guiding me in all my thought and life. I often realise that all experiences — even apparently trivial occurrences — are organically fused into a single life-experience. Occasionally when immersed in thinking out ideas, all the long years of life fuse into a single moment. Such is the potency of *Ekavakyata*. It has helped me to realise the profoundness and the supreme truth embodied by Francis Thompson in the rapturous lines forming stanza 21 of his *Mistress of vision*:

> All things by immortal power
> Near or far,
> Hiddenly
> To each other linked are,
> That thou canst not stir a flower
> Without troubling of a star.

3 Development of the Family of Books

I have described in my *Preface to library science* (Delhi University publications, library science series, 1), 1949, my

struggle in giving expression to this feeling, the help given by my Professor in overcoming the struggle, and the great release I had when the *Five laws of library science* finally took shape in mind. That book is a verbal record of the *Ekavakyata* of library practice and science, as it revealed itself to me. As stated in Sec AJ0, each one of my later books has come out as but an elucidation of one section or another contained in that first book. It is in this way that the family of my books has been developing. It has developed along different lines — into different subfamilies. There has been a considerable in-breeding among them. The result is that some friends find apparent repetition in several books and at the same time others find some elements of incompleteness in each of them. This book also may appear differently to different people. This is unavoidable when we look at any one member of a family and compare him with the others in the lineage. It naturally embodies in its own distinctive way the features of all its ancestors. From the first ancestor downwards, all the books of this group have family resemblance, each with its own individuality but bringing out, now more now less, one or another characteristic of the original ancestor.

4 Facility for Development

The Madras University Library was the first to provide me with unhampered facility to live library service and library science as a unity in diversity. The facility to live it a second time from 1947 to 1953, I owed to Sir Maurice Gwyer, one of the greatest friends of Education and of Library Science I have known. He invited me to come to Delhi and start a Department of Library Science. Pursuit of the several branches of Library Science in Delhi was thus a continuation of the thinking that had taken some shape prior to coming to Delhi. Facility came to me a third time in 1962. This was provided by Professor P C Mahalanobis, F R S, the

Founder of the Indian Statistical Institute, well known for his work in the Perspective Planning of India's development. He had the far-sightedness to realise that the industrialisation of the country could not be carried out effectively unless it was backed by efficient documentation service and that in order to provide this there should be an advanced centre for research and training in documentation. Accordingly, with the concurrence of the Government of India, the Indian Statistical Institute established the Documentation Research and Training Centre as an adjunct to its Research and Training School. I was asked to organise its work and develop it. Being a residential institution, it provided me with opportunity to teach the subjects at deeper levels and to continue doing research in the company of a new set of brilliant young colleagues dedicated to the subject. Thus, the facility to teach and to do research which I have been having from 1925 onwards provided a rewarding contact with growing minds. Most of my books are the result of such a contact generating the glow necessary to light up any line of intellectual pursuit.

5 Subfamily of Three Books

This is one of three books that came out together in 1952:

1 *Social education literature*;

2 *Library book selection*; and

3 *Social bibliography or physical bibliography for librarians.*

These form a subfamily of the larger family.

6 'Social Education Literature'

This book is turned mainly on authors, publishers, and governments. It endeavours to formulate some principles for the guidance of the "new voices" being thrown forth by New

India in the unfoldment of her current renascence. Without any intention of affecting the spontaneity which is of the very essence of true writing, it presses on the attention of authors the great social purpose which the writings of today are destined to serve. It also discusses how the publishing partner should bring about the production of books in standards and forms acceptable to the whole spectrum of readers from the neo-literates onwards. Lastly it examines how the lateness of the awakening of India finds her in an age which has left *laissez faire* almost a century behind and which calls for planned, steady action in almost every sphere affecting the life, not only of the community as a whole, but whenever unavoidable, even the life of individuals. From this angle, this book formulates some principles of policy to be implemented by the governments in the country.

7 'Library Book Selection'

This book is turned on librarians and library authorities. Its revised edition came out in 1966. It endeavours to formulate some principles for guidance in the selection of books for libraries of various kinds. It derives these principles systematically from each of my Five Laws of Library Science. It shows also what additional factors — organisational as well as administrative — are imposed on book selection policy by limitations of finance. After a brief chapter on sources for book selection, the book concludes with a chapter on the routine of book selection extracted from my *Library administration* (1935; 1957). This book may be described as a book on books from the angle of the distributor of the ideas embodied in them.

8 'Social Bibliography for Librarians'

This book assumes many of the details worked out in the above two books. The presence of those two books makes

it possible to make this book briefer than it would have been otherwise. The present book is a revised edition of this book, with its title changed into *Physical bibliography for librarians*. It is turned on the elements in the physical production of books, viewed from the angle of librarians.

CHAPTER AK

SPECIFIC CAUSE FOR THE BOOK

1 Experience as a Student

My first training in library science was in 1924 at the School of Librarianship of the University College, London. Bibliography was one of the subjects in the curriculum. It was presented in the lectures as a mixture of Document Bibliography and Physical Bibliography. Many of the students felt this unsorted mixture somewhat revolting. The development of Physical Bibliography was even more of a puzzle. For, paper-making, printing, and binding were taught to the very end, without our being enabled to see their relevance. Then came in succession Descriptive Bibliography of incunabula and other early books and editions, samples of Textual Bibliography, Historic Bibliography, and Taxonomic Bibliography — all belonging to Palaeo-Bibliography. Quite a number of bibliophilic anecdotes and incidents in book-auction were given. The textual criticism of Shakespeare's plays, memorised in my degree course twelve years earlier, came to mind. It began to have some meaning. But "What has all that to do with work in a modern service-library as distinct from the few national depositories where scholars attempt to reconstruct the originals of books!" — that was the feeling and even bewilderment of some of the students. The teacher in me revolted.

2 Preparation for Teaching

Even then I decided, "If ever I have to teach bibliography, I shall avoid creating this sense of puzzle and revolt in the students." During the next four years, one part of my mind was exploring how this could be done. In 1929, I opened a

School of Library Science in Madras. This forced me to make the decision without any further delay.

3 Decision 1

Document Bibliography and Physical Bibliography were first separated out. To avoid the confusion caused by the word 'Bibliography' occurring in both the terms, I grouped the former with Reference Service in the examination scheme and the latter with Book Selection.

4 Decision 2

Physical Bibliography with bias to Descriptive Bibliography and its associated fields was not necessary for librarians in general. It should be relegated to a course for scholars reconstructing original texts.

5 Decision 3

The curriculum in Physical Bibliography should be fully biased towards the needs of librarians — to the needs of book selection work, to the promotion of the physique of the books being attractive and comfortable to readers all down the intellectual scale, and to the lay-out of the book.

6 Experience as a Teacher

All the three decisions were implemented in the curriculum prepared for the Course. Teaching was done in the spirit of this new curriculum.

61 Genesis of Edition 1

The *a priori* method of development was adopted, starting from the Five Laws of Library Science. Many of the results were inferred as implications of these fundamental laws. The students were taken round to printing presses and binderies for demonstration and observation, in order to make the *a priori* development realistic. We had no paper mills in Madras and this was a weak point. But later, I managed to borrow

moving pictures of paper manufacture and show them to the students. This was a compensation. I checked up, now and again, the reaction of the students. I did not find in them the sense of puzzle and irritation, which some of us had felt in 1924. Then, I decided to publish the experience in a book. But, it could get its turn only in 1952. This was the genesis of Edition 1 of this book.

7 Testimony of Other Students

In 1956, I accepted the invitation of my British colleagues to visit their Library Schools and conduct a few classes. Before starting on the work, a senior colleague met me at the Chaucer House and said, "Do not assume that our students know your Five Laws." I said, "My teaching is always shaped jointly by the students and myself. I am guided by their faces almost at every step." Then, I went to the first School. I asked the students what they would like me to discuss with them. Spontaneously, they began with the Five Laws! The students said, "We like your book *Social bibliography*. It has made paper-making, printing, and binding meaningful to us. We now see these subjects in a new light. Can you not ask your friends in the Chaucer House, to make our courses in these subjects and the examination too conform to this exposition of yours?" This made me feel that even after thirty years the students of library science had the same attitude towards Physical Bibliography as we had in 1924. It also amounted to a testimony that my *a priori* development of the subject was along acceptable and helpful lines.

8 Genesis of Edition 2

One of the students also said that the book had gone out of print and asked me to bring out a new edition. But like its predecessor, this edition too had to wait for fifteen years to get its turn.

CHAPTER AL

CONSPECTUS

1 Organisation of the Text

The presentation of the text of this book conforms to the standard which is being developed by me during the last few years. The basic feature of this standard is the Principle of Unity, pervading each sentence, subsection, section, chapter, part, and the book as a whole, in a measure appropriate to each level (*See* Sec AJ1 and AJ2). To respect this Principle, the book has been divided into 16 parts. Among themselves, these parts share 127 Chapters.

2 Notational System

The notational system used consists of Roman capitals and Indo-Arabic numerals. A single Roman capital represents a part. A second Roman capital is added to it to get the number of a chapter. A single-digited Indo-Arabic numeral is used to represent a section of remove 1 from the chapter as a whole; a two-digited number for a subsection — that is, a section of remove 2 from the chapter as a whole; and so on. A number is to be read as a pure decimal fraction. For example, 2, 26, 261, 27, 3 is the correct sequence.

21 Full Section Number

For citation, a Full Section Number will consist of two Roman capitals followed by Indo-Arabic numerals. Here are a few Full Section Numbers with their digit by digit interpretation:

A = The part "Demarcation of the area of the subject"

AE = The chapter "Physical Bibliography for Scholars"

AE2 = The section of remove 1, "Descriptive Bibliography"

AE26 = The section of remove 2, "Minimum of Details" for above

AE261 = The section of remove 3, "Books of the Fifteenth Century"

AE3 = The section of remove 1, "Analytical Bibliography"

AF = The chapter "Physical Bibliography for Librarians"

B = The part "Law 1 and the Wonder Material"

The sequence of the above items shows the effect of the decimal fraction notation.

22 INDEX NUMBER

The Index Number given in the index part of the book is the Full Section Number and not the page number. In each open double page, the inclusive Full Section Numbers are given at the left end of the left hand page and at the right end of the right hand page. Page numbers are given in the bottom lines.

3 Lay-Out

Parts B to E are on the implications of Law 1 of Library Science in respect of paper — the evolution of writing material from stone to paper, the history and the technology of paper-making, and the responsibility of library profession with regard to paper-making.

Parts F to L are on the implications of Law 2 of Library Science in respect of printing — the history and technology of type-casting, printing, and block-making, and the responsibility of the library profession with regard to printing.

Part M is on the aesthetics of the book as viewed from Law 3 of Library Science.

Parts N and P are on the lay-out and on the index of the book as viewed from Law 4 of Library Science.

Part Q is on Law 5 and reprography.

Part R is on reinforced library binding.

The contents pages give a more detailed conspectus.

PART B

LAW 1 AND THE WONDER MATERIAL

CHAPTER BA

LAW 1 OF LIBRARY SCIENCE

1 Enunciation

Law 1 of Library Science is "Books are for Use." Let us coax it to give out its secrets. If there is a gang of persons to be tackled, a clever policeman deals with each separately. That is the way to success. In Law 1 there are two connecting words 'are' and 'for'; these seem to be innocuous and incapable of keeping any secret. The two substantive words needing close examination are 'Books' and 'Use'.

2 Book

In Sec AA2, we have already seen that a "Book" is a trinity consisting of

1 Subject;

2 Linguistic and/or graphic vehicle for the subject; and

3 Physique.

3 Use

31 Subject

Let us next ask the word "Use," about the constituent of a "Book," which it has in mind. Its immediate answer is "Subject."

32 Indirect Use of Physique

Let us threaten the word "Use" asking, "May we then burn away the physique?" Then the word "Use" will plead, "I was too hasty and thoughtless. The physique is a necessary

means in the communication of the subject to be put to use. But, this use is only the indirect one of serving as a physical package for subject and not a direct one — such as using it as a pillow, or sunshade, or even as part of pretty furniture. This restriction on 'Use' has to be recorded; because there are people putting a book to such direct uses."

4 Use of Physique as a Mark of Nobility

41 PERSIA OF THE TWELFTH CENTURY

In a Persian book-market of the twelfth century, a beautiful-looking book was being auctioned. Ultimately, there were only two bidders — one a famished person in rags and the other a fat nobleman in rich robes. After the bid had been taken up to a certain level, the man in rags told the one in robes, "I am too poor to outbid you. This is a rare book. I long to peruse it. By all means knock it down yourself. But will you kindly allow me to glance through it once?". "Certainly, my dear man," came the reply, with all the air of patronage, "I shall make a present of it to you next week. The king is visiting my palace this week. To suit the occasion, I fitted up my drawing room with fine book-cases and filled them with nice books. There is just one gap which this book will fittingly fill and fillingly fit. I do not want the book beyond this week."

42 SOUTH INDIA OF THE NINETEENTH CENTURY

I have heard of a similar anecdote in the South India of nineteenth century. The scene was in the house of a rich illiterate landlord. He desired to fit up his drawing room to receive the Governor of the Province. He had heard of Vatsyayana's specification for the drawing room of a nobleman, "A lute hanging from an elephant tusk, a drawing board, a pot of perfume, some books and some garlands of the

yellow amaranth flower." He, therefore, got some handsome rose-wood book-cases and filled them with books cased in glittering ornamental binding.

5 Concern of Law 1

Law 1 is concerned not only with the intangible subject contained in the book but also with its tangible physique.

CHAPTER BB

CONFLICT OF QUALITIES OF PHYSIQUE OF BOOK

1 Anti-First Law

Law 1 has had difficulty in reconciling durability and easy-to-handle quality in a book. In ancient days, the physical basis of a book had to be some material found in nature and not needing much of processing. Moreover, the physical production of a book by writing was a long and costly process. Therefore, a single copy had to be shared by many readers. It had also to be passed on to successive generations. These two factors led to greater emphasis on durability than on the easy-to-handle quality. In fact, it is the Anti-First Law — "Books are for Preservation" — that decided the issue.

2 Durability and the Material Basis

21 Stone

It is believed that the urge of durability had sought the stone as the first material upon which letters were chiselled and through which ideas were communicated to contemporaries as well as to succeeding generations. The stone walls, the stone steps, and the pillars in the temples of India are books. These are called 'Inscriptions' and 'Epigraphs'. The Department of Epigraphy of today is engaged in conserving the originals in stones and making photographic and printed copies of them for distribution among scholars. These form the bed-rock of historical research. The Rossetta Stone with its trilingual inscription, found in 1799 near a mouth of the Nile, is a famous example of this kind. It has proved to be an extraordinary means of communication between the ancients and the moderns.

22 Metal

Metal plates — brass, copper, bronze — had also formed the physical basis of books. Some books in copper plates have been preserved in museums. They are also found in some of the monasteries and temples of India. The Buddhist *Tripitakas* inscribed in copper plates during the reign of King Kanishka (about 120 A D) is a well-known example. Since 1945, numerous Hebrew and Aramaic writings in copper plates have been discovered in Qumran, near the western corner of the Dead Sea. These are the famous Dead Sea Scrolls.

23 Bricks

The urge for ease of writing was probably responsible for the brick-books of the Chaldeans. They engraved their writing in soft clay-bricks, and then baked or sun-dried them. Specimens of Assyrian and Babylonian tablets are found in museums. Historians mention the existence of libraries of them in the past.

24 Wood

Books in wooden slabs had been in vogue in Greece and in India. Aurel Stein discovered many such books in the deserts of Turkistan. This practice seems to have been in vogue in India even in the early nineteenth century. One well-known example is associated with Tyagaraja, the great musical composer of South India (1767–1846). His compositions numbered several thousand pieces. Paper was not easily available then. Therefore, his disciples wrote the pieces on slabs of wood blackened with charcoal, with small pieces of magnesite picked-up from broken utensils.

3 Easy-to-Handle and the Material Basis

A book written on stone, metal, or wood is difficult to handle. Law 1 had to wait for the discovery of a fairly durable material lending itself to be written upon and yielding a book easy-to-handle.

4 Physical Qualities

What are the factors that can make or mar ease in handling a book as a physical entity? What are the physical qualities of a book that will recommend its acceptance? The same qualities, more or less, that play a prominent part in the selection of many other things in life.

41 Analogy of House

Suppose we have to select a house. Surely, we should like the house to have a suitable size. A house of twenty rooms will be suitable for a large family; but no wise man will select such a house for a family of four; nor will one select a single-room house for that family. Comfort in size is uniquely determined in each context.

42 Analogy of the Physique of a Person

Again, take the case of determining the physical qualities which normally weigh in the selection of personnel. We would reject a Brobdingnagian at one end and a Lilliputian at the other. The optimum size for a human body goes perhaps with a height lying between $5\frac{1}{2}$ and 6 feet and the other dimensions in graceful proportion. Again, we would all prefer a straight body to a hunch-back.

5 Three Physical Qualities of a Book

Let us pursue the physical qualities of a book in a similar way. From the point of easy-to-handle quality, three well-known physical qualities of any physical body including that of a book are: 1 Weight; 2 Shape; and 3 Size.

CHAPTER BC

WEIGHT OF A BOOK

0 Light Material

As against the heavy materials mentioned in Sec BB21 to BB24, man has always been on the look-out for light materials as the physical basis for a book. A few convenient ones were found very early.

1 Leaf

11 South India

Perhaps the light materials used earliest were leaves of trees. The leaf of the palmyra palm tree came to be used very early in South India. The feathers of this leaf have a smooth surface. These feathers were cut into convenient uniform sizes. The width used to be between 5 cm and 10 cm; and the length between 25 cm and 50 cm. After being cured, it was fairly stiff for handling. Letters were cut into the leaf with a sharp iron stylus. These cuts were filled with a black or green pigment mixed with oil. This made the characters show up distinctly. Being pure cellulose it preserved very well. Two holes were pierced in corresponding positions in each leaf; and a gathering of leaves was strung together with strings passing through these holes. The resulting gathering was protected by wooden boards on both sides. Some of the ancient classics of South India and Ceylon are still preserved in such palm-leaf books. Fifty years ago, it was the palm-leaf book that was used in initiating a child in the art of writing and reading. I was myself initiated in that way in 1897. I preserved my first book in palm-leaf for a long time. Merchants kept their accounts in palm-leaf books till about

fifty years ago. When the fishermen of Calicut presented an address to me in 1945, they chose the palm-leaf as its material basis. Instead of engraving with a stylus, the address was printed in gold colour on the palm-leaves. The Government Oriental Manuscripts Library at Madras is very rich in palm-leaf books. So are the manuscript libraries at Mysore and Trivandrum.

12 Assam

In Assam leaves of the aloe were used.

13 Egypt and Greece

Pliny has recorded that the Egyptians too wrote on palm-leaves. It is said that sentences of banishment were termed petalism from the Greek word *petalon* meaning leaf, as such sentences were written in Greece on the leaves of the olive tree.

14 The Term 'Leaf of a Book'

Perhaps the use of the term 'Leaf of a book' is traceable to this use of leaves of trees for writing books on in the far-off days.

2 Bark

21 North India

In North India, books were written in ancient times on the inner bark of the birch tree (= Bhurja) growing abundantly in the Himalayas. This bark was cut into strips of 8 cm to 20 cm width and 50 cm to 100 cm length. The strips were coated with oil and polished. These bark-books are found in Buddhist stupas. There are many such books in libraries of Indian manuscripts. The writing on this bark was with a stylus. This bark is not, however, pure

cellulose as the leaf of the palmyra. It therefore cracked and peeled when dried; it also attracted fungus when damped.

22 America

The Red Indians and the other old races of America used to write on the bark of the white birch tree with sticks and some liquid pigment.

23 Rome

The ancient Romans too used the inner bark of certain trees as writing material. The bark was known as Liber.

24 The Term 'Library'

The modern term 'Library' is traceable to the use of the bark (= *liber*) for writing books in the Roman Period.

3 Papyrus

31 Egypt

One of the materials used in ancient Egypt for writing books was Papyrus. It was made from the stem of a plant growing in the delta of the Nile and other rivers. The stem was cut into pieces of about 60 cm length and split down the centre. Strips were cut into thin sections. Two such sections were laid across each other with their fibre running at right angles. The fibres were immersed in the Nile water, laminated, and then dried in the sun. The sheet was given a high polish using a piece of bone or stone. Thus, the preparation of the Papyrus required a little more of craft than that for the palmyra leaf or bhurja bark. It was fairly strong and pleasant to the eye. It was written upon with a pigment. Pieces of Papyrus were pasted together in one long strip and rolled into a volume. The longest of such a roll now surviving is the

Harris Papyrus (40.5 x 5.1 m). Sheets were also folded once into groups or quires of 10 to 12 sheets. These were sometimes stabbed together with a binding cord. Such a form of the book was called a codex. Documents in Papyrus, dating from third millennium B C have survived. Such a quality of long preservation has been ascribed to the peculiar climatic conditions of Egypt. Elsewhere the humidity of the climate has led to the deterioration of the Papyrus. Its last recorded use for writing was in 1057 A D. Among the well-known Papyrus documents are the Papyrus Ebers (1150 B C) and the Edwin Smith Papyrus (1600 B C).

32 The Term 'Paper', 'Bible', and 'Volume'

The term 'Paper' is traceable to the word *papyrus*. 'Bible' and 'Biblia' are traceable to the Greek word *bubloy* which denoted the inner fibre of the Papyrus plant. The word 'Volume' is traceable to the Latin word *volumen* which denoted a roll as the Papyrus book was.

4 Amatl

Amatl was the writing material used by the Mayas and Aztecs of America. Its preparation needed more manipulation than Papyrus. It was made from the inner bark of a tree belonging to the same family as mulberry. The bark is about 2.5 cm in width. After removing the outer bark, the fibrous inner bark is boiled over a slow fire. This process disintegrates the fibre to some extent. The disintegrated fibres are laid side by side on a rectangular board. Several strips are put on the same board, each strip slightly overlapping the next. The strips are then beaten until they are united into a sheet. The beating has to be done for several hours spread over more than one day. The Mayas and Aztecs wrote their books on surfaces made in this way. Books were formed with several such strips. The book was folded like a screen

to form distinct pages. Such books may be as much as 30 cm high when folded, and 4 to 6 m long when spread out. It is said that the Mayas had extensive libraries of such books.

5 Textile

The invention of camel hair brush in the third century B C led the Chinese to the use of cloth as material to write upon. But cloth was too costly to be spared for this purpose. Nor did it have the necessary rigidity. It was not therefore widely used. Cloth, considered as material to write upon, required more fabrication than any of the materials described in the preceding sections.

6 Skin

61 Not Leather

In the sixth century, skin of animals became another material basis for books. The flesh side of the split skin of sheep is Parchment. Skin of calf is Vellum. It is not split as in the case of parchment. The use of these materials began about two thousand years ago. The term 'Uterine' denotes the delicate vellum used for illuminated manuscript. It is so called because it is believed to have been the skin of unborn calf. Vellum or parchment is not leather as it is not tanned. They are prepared with lime. It is this which gives it the nice surface. Parchment continued to be in use even after the invention of printing. It is said that the skins of 300 sheep were used to produce one copy of the Gutenberg *Bible*. Although parchment is still used for writing documents and diplomas on account of its durability, it ceased to be used for printing from about 1500 A D.

62 THE TERM 'PARCHMENT PAPER'

The term 'Parchment Paper' is traceable to the use of parchment in the earlier days as the material for writing books.

7 Optimum Weight

None of the above-mentioned materials give full satisfaction to Law 1 in regard to weight. A book built out of these materials will be too heavy to handle if the number of words exceeds about 100,000. Law 1 would like to have some material such that books of 100,000 to 200,000 words weigh only between 0.5 and 1.5 kilograms. Man had been for long in search of such a material.

CHAPTER BD

SHAPE OF A BOOK

0 Shape of the Leaf

Shape also determines the easy-to-handle quality of a book. The shape of a book is determined by the shape of each of its leaves.

1 Palm Leaf Book and Birch Bark Book

Palm leaf is a natural material. Each leaf is a narrow rectangle. A pile of such leaves with such a rectangle as the cross-section does not have a shape easy-to-handle. Such a palm-leaf book cannot be made to stand on its larger cross-section as its smaller cross-section is too small. Further, the economical space, between one shelf-plank and the one above it will be too small for the hand to go in. It will have to be made much bigger. The result is that the shelf-space required becomes inordinately great and expensive. All these remarks apply also to birch-bark books.

2 Papyrus

Books of papyrus also present a similar rigidity in regard to shape as a result of the natural dimensions of its basic material.

3 Amatl

Amatl made by beating several strips of fibrous bark into a continuous sheet is even worse in regard to shape. We saw in Sec BC4 that it had a longish narrow shape when folded, and that it became a single sheet several metres in

length when spread out. A book of such a shape is difficult to handle.

4 Textile

Cloth has no rigidity. Each leaf of a cloth-book folds and crumples. Therefore, though cloth of any basic shape can be had a cloth-book is not suitable for handling.

5 Roll

With papyrus as well as with vellum as the basic material, a book was made in the distant past by pasting all the leaves so as to form one long strip. Each end of the long strip was pasted to a wooden handle. The strip was kept rolled up on the handles. I saw in the Public Library of Philadelphia an Indian book in the form of a roll. Its title was *Janmapattrika or Horoscope of Rajah Jadunatha Simha, one of the Tippoo Sahib's officers at Lucknow*. The size of it was 37 m x 27 cm. A book of that form was called a 'Roll'. It is naturally difficult to consult a book in such a roll form. Though we still keep maps in the form of roll, Law 1 of Library Science long ago ruled out roll as a form for books. The word 'Roll' is still preserved in the designation of a British Officer — Keeper of the Rolls — and in the name of a British learned body — Pipe Roll Society.

6 Codex

The modern form of the book was originally called 'Codex'. Because blocks of wood were used as their protecting covers. The term 'Codex' means block of wood. The term 'Codices' to denote law-digests is traceable to this practice.

7 Optimum Shape

After centuries of trial, it is now felt that a cuboidal shape is the most easy-to-handle and also the most pleasing

to work with. The height and the width of the book are more dominant than its thickness in determining the helpfulness of its shape. Its shape is therefore normally determined by the ratio of its height to its width. This ratio is called Aspect Ratio. Column 4 of the following table gives the Aspect Ratio of commonly occurring octavo books:

Conventional Name	Height	Width	Aspect Ratio
Demy Octavo	22.2 cm	14.3 cm	1.5
Crown Octavo	19.4 cm	12.7 cm	1.5
Foolscap Octavo	17.2 cm	10.8 cm	1.7
Royal Octavo	25.4 cm	15.9 cm	1.6

From the above we can say that the optimum shape is that with Aspect Ratio between 1.4 and 1.6. Taking all the three dimensions into consideration a pleasing shape is that in which

Thichness : Width : Height = 2 : 10 : 15

71 Unsuitability of the Materials of Ancient Days

A crown octavo book of 2.54 cm thickness has this shape. Natural materials, such as leaves, barks, and skins, cannot give this optimum Aspect Ratio without either reducing the size to beyond what is easy-to-handle or without wastage of material. In the case of papyrus, we can secure the desired Aspect Ratio by adjusting the number of strips pasted one to another. But Law 1 of Library Science would like to have some material which can be had as a single, smooth, foldable but noncrumpling sheet. Nature does not provide such a material. Man has to make it.

8 Invariant Aspect Ratio

Any book with an Aspect Ratio within the range 1.4 to 1.6 may be easy-to-handle. But simplification and standardi-

sation are demanded by the Law of Parsimony. For this, the Aspect Ratio should be invariant irrespective of the number of times of folding a sheet to arrive at the ultimate leaf to be written or printed upon. Such an invariant Aspect Ratio is the natural ratio determined by Algebra and the Pythogorean Theorem in Geometry.

81 Measure of Invariant Aspect Ratio

Let x be the Aspect Ratio of the unfolded sheet. This is secured by taking its width to be one unit and its length to be x units. If we fold it along a line which is parallel to and exactly midway between the two shorter edges, the length of the resulting sheet is one unit and its width becomes $x/2$ units. The Aspect Ratio of this folded sheet also should be x. Putting this in symbols, we get

$$x = \frac{1}{x/2};$$

that is, $x^2 = 2$;

that is, $x = \sqrt{2} = 1.4$

This invariant Aspect Ratio was advocated by Alfred Watkins. It has been accepted by the International Standards Organisation. Whatever be the area of the basic sheet, if after any number of times of folding, the resulting leaf is to remain unchanged, then its shape is what corresponds to the Aspect Ratio of $\sqrt{2}$. We have already seen that the crown and demy octavo books have nearly this shape. There is, however, resistance both from vested interests and from theoreticians. The former argue that paper-making machinery will have to be changed. The latter argue that such a theoretical uniformity in shape will deprive one of the power to vary the shape of page according to the particular matter

which has to be printed on it. The former difficulty can be got over in course of time, if all new machinery are made to conform to this requirement. The latter difficulty can be got over by, say, doubling the height of the book to meet such occasional needs.

CHAPTER BE

SIZE OF A BOOK

1 Undesirable Extreme Heights

In addition to prescribing the range for optimum weight and shape, Law of 1 Library Science would also prescribe upper and lower limits to the size of a book, in order to make it easy-to-handle. We have seen in Sec BD7 that the cuboidal shape is desirable. We have also seen in Sec BD81 that the natural Aspect Ratio is $\sqrt{2}$ or approximately 1.4 The determination of the size of a book is therefore reduced to determining its height and its thickness. A miniature book, 2.54 cm in height, will not certainly be accepted by Law 1. But there are many such miniature editions of the *Koran*, the *Bible*, and the *Gita*. At the other extreme, I remember seeing a giant book in the Royal Library of Stockholm, Sweden. Its pages were of donkey's skin. It measured 76 x 38 cm. There are even bigger giants. In 1859, just one issue of a newspaper was produced measuring 250 x 180 cm.

2 Anti-First-Law Tradition

In the days when books were costly to produce, the primary motive was their preservation. It is easier to preserve a heavy giant folio than to preserve a light small-sized book. The books were even chained to the shelf to prevent its removal beyond the length of the chain. One had to read the book, on a desk close to the book shelf. There was no urge to give the book a size making it easy-to-handle. A size of 8 cm x 22 cm x 34 cm was common. Many such books are preserved in some of the libraries of the West.

3 Natural Materials

As seen in Chap BC, the natural materials fit for use as writing surface allow only a very limited range in size. If we impose on them the requirement of Law 1 regarding shape, the range of size available is still more limited. Vellum did provide leaves of proper size. But it turned out to be very costly. As stated in Sec BC6, the skins of 300 sheep had to be used to produce one copy of a book. Papyrus was not so costly and it did make optimum size possible in regard to height and width; but the thickness became rather more than what is easy-to-handle for a book of 100,000 words.

4 Optimum Size

The following table gives the new popular book sizes:

Conventional Name	Size of Octavo in cms	Size of Quarto in cms
Demy	22.2 × 14.3	28.6 × 22.2
Crown	19.0 × 12.7	25.4 × 19.0
Foolscap	17.2 × 10.8	21.6 × 17.2
Royal	25.4 × 15.9	31.8 × 25.4
Imperial	27.9 × 19.0	38.10 × 27.9

Thus, the range for optimum height of a book is from 22 cm to 32 cm. The range for optimum thickness is from 1.5 cm to 4 cm. According to Law 1 of Library Science, a book with about 100,000 to 200,000 words should have a size lying within the above-mentioned range and a weight between 0.5 and 1.5 kilograms in order to make it easy-to-handle. None of the natural materials fit for printing or writing upon satisfied this test. Man had to fabricate a material to this demand of Law 1 of Library Science.

CHAPTER BF

FURTHER MATERIAL QUALITIES OF A BOOK

1 Physical Property

The material basis of a book — that is, the paper — should have the following physical properties:—

11 Foldability. — It should be sufficiently yielding to allow folding without breaking.

12 Strength. — It should not easily tear or break. It should be supple but not brittle. There should be a good compromise between toughness and softness.

13 Smoothness. — It should have a smooth surface. It should not spread out the colouring material used for writing or printing on it.

14 Pleasant Appearance. — It should have a pleasant appearance by itself; otherwise, it must at least admit of being properly tinted or decolourised for that purpose.

2 Chemical Property

For the material basis of a book to be durable, its strength should not deteriorate with time by the effect of the atmosphere; that is, it should be chemically inert.

3 Fabricated Material

None of the natural materials fit for printing or writing upon have all the qualities enumerated in this Chapter and the preceding ones. Man had to take suitable raw materials found in nature and fabricate the same in such a way that all these qualities get impregnated into the resulting commodity.

CHAPTER BG

PAPER: THE WONDER MATERIAL

0 Web of Vegetable Fibres

Paper is the wonder material invented by man, coming nearest to the requirements of Law 1. The dictionary defines 'Paper' as a web composed of vegetable fibres, roughly oriented and matted together so as to form a sheet. This is an oversimplification for the paper to be used for books. We should add that the sheet be treated with size and calendered to fill the pores and make the web present a smooth surface and prevent ink from spreading.

1 Physics of Paper

The core of paper is cellulose. Its physics is best brought out by cotton fibre. For, it contains 90 per cent cellulose, 7 per cent moisture, and only 3 per cent of non-cellulose matter. Seen through a microscope it looks like a twisted, flattened, hollow tube with thin outside wall. Hollow spaces remain when these fibres are matted together. It is this physical structure that gives to paper the characteristic bulky appearance and low density. The requirement of Law 1 about weight is thereby satisfied.

2 Chemistry of Paper

The chemistry of paper is essentially that of cellulose. Cellulose is a carbohydrate with the empirical formula $(C_6H_{10}O_5)n$. When burnt, it gives carbon. It is tasteless, odourless, and white. It is quite insoluble in water. It very nearly resists oxidisation. It is also extremely resistant to alkalis. It is the basis not only of paper, but of many other industrial products. Apparently it is nothing more than six atoms

of carbon chemically combined with five molecules of water. Yet treated with nitric acid it leads to gun-cotton. Addition of camphor to gun-cotton gives celluloid. Again, treating celluloid with mineral acid gives glucose. Dissolving nitrated cellulose in alkali and other chemicals and squirting it through fine holes produce threads of artificial silk. But in paper, cellulose remains as cellulose. It does not get chemically transformed. It is this that makes paper durable.

3 Biochemistry of Paper

Biochemically viewed, cellulose is the main product produced by vegetable life. The walls of vegetable cells are built of cellulose. These cells are generally longish ones. When the cells are emptied of protein and other biochemical contents, they look like flattened tubes. It is to this form that we owe its felting properties. These cells form the frame of woody structure. The cells are cemented together with a complex of biochemical substances — lignin in some cases and pectin in others. The cells are made water-proof by another substance called resin.

4 Ills

Cellulose is prone to bacterial attacks. It is also liable to become a diet of insects.

5 Dangers

Cellulose yields to the action of inorganic acids and to some extent to organic acids too. If brought into contact with these, the cellulose deteriorates and becomes unfit for paper-making. The cellulose found in grass, straw, jute, and wood is not sufficiently resistant to strong alkalis and bleaching powder. Therefore, paper made from such materials is weaker than that made from cotton, linen, linseed, and sun-hemp.

6 Half-Stuff

To be fit to be used as the basis of paper for writing or printing, cellulose must be separated from lignin, pectin, resin, and other non-cellulose incrustations. For, these will oxidise and make paper brown and brittle. They will also make it perish if allowed to remain. These adherents are attacked by chlorine, bleaching powder, and potassium permanganate. But cellulose is not. This fact is used to separate cellulose from the unwanted adherents. The process of separation consists roughly of the following seven stages.

1	Fibre	= Cellulose + non-cellulose matter
2	Fibre + water (hot or cold)	= Cellulose + water-insoluble non-cellulose + water-soluble non-cellulose
3	Fibre from (2) washed	= Cellulose + water-insoluble non-cellulose
4	Washed fibre from (3) + alkali (boiled)	= Cellulose + residual non-cellulose + alkali-soluble non-cellulose
5	Fibre from (4) washed	= Cellulose + residual non-cellulose (Useful for making wrapping paper, etc).
6	Fibre from (5) + bleaching powder (boiled)	= Cellulose + residual non-cellulose destroyed by bleaching
7	Fibre from (6) washed	= Cellulose for making paper

The term 'Half-Stuff' denotes the fibre in stage 7. It can be seen from the above equations that plenty of running water is essential for paper-making. Therefore, most of the paper-making centres are on the banks of rivers and streams. The preparation of the Half-Stuff is the first broad stage in paper-making.

7 Textile *vs* Paper

The next stage is the conversion of the half-stuff into dry sheets of paper. Though textiles and paper both use cellulose as the basis, there is a fundamental difference. The textiles are made only of cotton, flex, and certain other leaf fibres. In textile manufacture, the long fibres or filaments of cellulose are spun and twisted in series so as to form a thin, strong, and long yarn or thread. The yarn is then woven.

8 From Pulp to Paper

But in paper-making, the opposite takes place. The fibres and filaments are separated from one another, cut, and bruised. The long thin walls of the fibres and filaments are more or less completely separated from one another, bleached, and then beaten so as to break the individual cells into fragments about 1 mm in length. The term 'Pulp' is used to denote the resulting stuff. Wood-fibres too may therefore be used for paper but not for textiles. During the beating operations, all the loading, sizing, or colouring materials are added to the pulp. The pulp is then diluted with water to one per cent consistency, screened, and passed into a vat. This stuff is lifted in a mould consisting of a frame across which reed-mat or wire-cloth is tightly stretched. As the water of the pulp drains through the mat or cloth, the mould is continuously shaken and thereby the fibres are made to felt together at all angles to one another. This produces the wet sheet of paper. This is then pressed between felts so as to squeeze out the surplus water. Thereafter, it is dried. Again it is pressed to remove all irregularities and dried. Finally, it is calendered. The calendering changes the dull rough surface into a more or less polished and smooth one.

PART C

HISTORY OF PAPER MAKING

CHAPTER CA

PAPER-MAKING OUTSIDE INDIA

1 Paper and Renascence

The history of the shifting of the focal centres engaged in paper-making will be an interesting index to the history of the migration of renascence across the surface of the earth.

2 China

As present knowledge goes, the wonder material of paper was invented in China at a time when it was bubbling with intensive life during the first few centuries of the Christian Era. The writing of books on wooden strips was cumbersome; and the writing of them on silk cloth was expensive. The resulting social pressure led the Chinese to the invention of paper. Its invention in the year 105 A D is attributed to Ts'ai Lun. The raw materials used are said to have been old rags, hemp-waste, fishing nets, and bark of trees. In the succeeding years the new craft spread throughout the Chinese Empire including Korea. The Swedish explorer Sven Hedin had unearthed, from Loulan, paper dated 264 A D. The invention of making ink from lamp-black in 400 A D made writing easier and brought paper into universal use in preference to the older materials. By 674 A D, China felt the incidence of ravage by insects on paper. There was therefore an edict making it compulsory to use a toxic vegetable substance for the colouring of paper.

3 Japan

In those far-off days, Japan was perhaps depending on China for its inspiration. This led to the migration of paper from China into Japan via Korea, at about 610 A D.

4 Samarkand

The Chinese defeat in the battle of 751 A D in Turkistan led to some Chinese paper-makers becoming prisoners in Samarkand. With their help, Samarkand used its abundance of hemp and its numerous irrigation canals to make paper. By about 800 A D, Samarkand paper found its way into Baghdad and Egypt and by 950 A D as far west as Spain. Even as late as the sixteenth century, Samarkand paper elicited the praise of the Moghul Emperor Baber.

5 Migration of Paper-Making

The following table indicates the migration of paper-making westward along the caravan routes.

Year	Paper mills established in	Year	Paper mills established in
105	China	1270	Italy
250	Niya	1322	Holland
399	Turfan	1348	France
610	Japan	1390	Germany
751	Samarkand	1405	Belgium
793	Baghdad	1420	India
850	Damascus	1491	Poland
	Egypt	1495	England
1100	Morocco	1575	Mexico
1102	Sicily	1576	Russia
1150	Spain	1690	United States

Gutenberg's discovery of printing from movable metallic types in 1440 A D and the renascence increased the demand for paper and led to a widespread establishment of paper mills in Europe.

CHAPTER CB

PAPER IN EARLY INDIA

1 Imported Paper

P K Gode of the Bhandarkar Oriental Research Institute of Poona gives some references to articles dating certain paper manuscripts of India before the fifteenth century. Here are some of the references:

1180 R A Sastri: *On old mss* (*Bulletin* of Rama Varma Research Institute, 6, 1938).

1223 K Bühlar: *Indian palaeography.* (*Indian antiquary*, 33, 1904).

1310 Gough mentions a paper manuscript of *Bhagavata.*

1320 A dated manuscript of Vangasena's *Vangadatta vaidyaka* exists in the Bhandarkar Oriental Research Institute, Poona.

1396 A M Shaw mentions in page 82 of his *Prasasti sangraha* of a manuscript of *Rishaba Deva charitra* being partly on paper. It denotes that material by the term 'Kagad'.

The existence of these paper books does not warrant the inference that paper was made in India in those days. It might have been imported paper.

2 Bengal

It is said that a Chinese traveller visiting Bengal in 1406, refers to paper made in Bengal which was as smooth and glossy as a deer skin. But there is no continuity of tradition leading us back to this centre for paper-making.

CHAPTER CC

PAPER-MAKING IN INDIA IN MUSLIM PERIOD

1 Kashmir to Hyderabad

The craft of paper-making is believed to have come into India about 1420–70. King Buddshah of Kashmir encouraged some paper-makers from Samarkand to settle down in Nowshara. Although the craft is now nearly dying in Kashmir, this place still drags on to be a paper-centre. From Kashmir the craft migrated to Sialkot, Lahore, Delhi, Multan, Mutra, Bengal, and Hyderabad. There is, for example, a village in Bengal by name 'Kagaziguda'. In Bengal 'Kagazi' had become a surname.

2 Confinement of the Craft to Muslims

The craft of paper-making was largely confined to Muslims. It is conjectured that the Hindus of that period of cultural exhaustion avoided it since it involved the handling of used rag which was ritually unclean. Further in its decadent phase, the community rejected anything foreign; and paper was foreign. Even at the turn of the present century, temple priests refused to accept camphor if given in paper packets.

3 Scarcity of Paper in South India

At that time, accounts were largely written on palmyra leaves. I remember the annual destruction of old records in palmyra leaves; these were thrown into the river when it was in high floods in August. My father used only a palm-leaf manuscript of the *Ramayana* handed down from generation to generation. Even letters were often written on palm-leaf.

CHAPTER CD

PAPER-MAKING BY HAND IN INDIA DURING BRITISH PERIOD

1 Paper from Europe

There was no urge to make paper in India during the British period. It was largely sent from England. For example, to print the *Bible* in Tranquebar in 1711, the English Society for Promoting Christian Knowledge got from U K a hundred reams of paper along with a Printing Press. However, the Danish Mission of that place built a paper mill on 13 January 1716 and used oxen to drive it. But by 1722, the mill was closed down and the printing press again looked to Europe for its paper.

2 Prison-Made Paper

In 1870, the government began to employ convict-labour for making paper. In fact, it became one of the chief industries of prisons. It was ordered that public offices should use only prison-made paper for all records in Indian languages. This policy is said to have unfairly affected the development of private enterprise in paper-making.

3 Revival of Paper-Making as Cottage Industry

As a result of Mahatma Gandhi's drive for cottage industry, the All-India Village Industries Association (1935) developed tools and techniques for making hand-made paper. In 1939, the Association set up the Hand-Made Paper Research Institute at Poona. The Regional Research Laboratory in Hyderabad developed improved production techniques. By 1963, its pilot plant demonstrated the economic feasibility of the production of hand-made paper. By 1966, the All-

India Khadi and Village Industries Board (1953) increased the number of centres for hand-made paper from 35 to 250.

CHAPTER CE

MACHINERY FOR PAPER-MAKING

1 Limitations of Hand-Made Paper

Till the beginning of the nineteenth century, all the world over all paper was hand-made. The invention of rotary machine for printing demanded rolls of paper four to five miles in length. As stated in Sec BE1, the largest size of hand-made paper ever made measured only 2.5 m × 1.8 m. Also, the quantity required for books exceeded the capacity of making by hand. In fact, legal restrictions were put on the number of pages for newspapers early in the nineteenth century.

2 Fast Machinery for Paper-Making

Social pressure was not long in leading to an invention. After years of trial and error, N L Robert of Paris took a patent for paper-machinery on 9 September 1798. But F Didot, his sponsor, fell off from him and induced, in 1803, Henry Fourdrinier, London, to build a paper-making machine. His name has been immortalised in the term Fourdrinier Machine; but as for material fruits, he too went the same way as Robert.

21 Other Developments

The table on page 104 gives a chronological list of the important developments in paper-making machinery during the period 1820–1850.

3 Present-day Machinery for Paper-Making

By 1851, 190 paper-machines were turned out. One of these was brought to India. The speed of production reached

Year	Device	Introduced / Patented by
1821	Dry felt and drying cylinder	T. B. Crompton
1825	Dandy roll	Phipps brothers (Earlier introduced by John Marshall)
1826	Suction box used under the wire (information kept secret)	Canson of France
1828	Reversing press	John Dickinson
1830	Two-cylinder mould in combination with wet sheets for making two-jely paper. (Forerunner of the multi-cylinder board machine)	John Dickinson
	Water-marking device	Thomas Barratt
1832	Inward-flow revolving drum strainer	Richard Ibotson
1836	Suction box	James Brown
1838	Formation table	
1846	Fixed deckle	Alexander Cowan
1850	Nearly all the standard paper mill equipments including reeler, calender, cutter, etc., had been developed by this date	

by a machine today has exceeded forty kilometres of paper per hour. In 1940, the machines in America were able to produce 15,000,000 tons per annum, which are roughly equivalent to 150 kg per-capita.

CHAPTER CF

WASP SHOWS THE WAY

1 Auxiliary Machinery in Paper-Making

The machinery mentioned in Sec CE2 could only convert diluted pulp into paper. To feed the machinery with pulp at the proper speed, it was necessary to introduce other machinery for all the operations in the first stage — cleaning, cutting, cooking, breaking, and beating. The resulting all-by-machinery paper increased the annual output of paper to a great extent.

2 Need for Raw Materials Other Than Cotton and Linen

The great increase in the quantity of reading materials produced and the application of paper to other uses, created shortage of linen and cotton rags. This shortage led scientists to look for other raw materials.

3 Conjecture of Reaumur in 1719

A shrewd observation made a century earlier by R A F Reaumur, a French naturalist, had suggested the use of wood-fibre. While observing the habits of wasp, he was attracted by the way of their constructing their nests with wood-fibre. The walls of the nests resembled paper; and he wrote to the French Royal Academy in 1719, "They teach us that paper can be made from the fibres of plant without the use of rags and linen and some of them invite us to try whether we cannot make fine and good paper from the use of certain woods." He adds with great concern, "This study should not be neglected, for it is, I dare say, important. The rags from which we make our paper are not an economic

material and every paper-maker knows that this substance is becoming rare. While the consumption of paper increases every day, production of linen remains the same. The wasp seems to teach us a means of overcoming this difficulty." Even as bats are said to have shown us the way to radar during our days, wasps had became our teachers two hundred years before bats!

4 Corroboration From an Ancient Indian Classic

The wasp showing the way to Reaumur, the naturalist, recalls to memory an interesting episode in the *Bhagavata-purana*, an ancient classic of India. Yadu, the King, is crossing a forest. He hears sweet music, born of supreme delight. He soon finds a radiant sage singing in ecstasy. He asks, "How, O Sage, did you acquire without effort the wide and clear wisdom by whose light you wander like a child?" The Brahman replies, "Many are my teachers, O King, whom I adopted by my own understanding. With the wisdom imbibed from them I go free from attachment." Then he names twenty-four teachers — from the earth to a wasp — and adds, "My own body also is a teacher. Knowledge from one source only can never be firm and complete." The *Purana* does not specify what exactly the sage learnt from the wasp. But Reaumur learnt from it that wood could be pulped for paper-making.

5 Machinery for Wood Pulp

It took nearly a century for this conjecture of Reaumur to be established in reality. In 1801, M Koops took patents for making paper of different kinds of wood. The extraction of pulp from wood required special machineries. These subsidiary machineries came to be invented and improved upon in regular succession. The result is that paper-making has

now become a branch of technology in which the engineer and the chemist work side by side and have equal responsibility.

6 Chronology of Development

The following table gives a chronological list of the important developments in paper-making.

Year	Particulars	Introduced by
c 1495	Fine white paper made in England	John Tate
1588	John Spilman's Dartford Mill supported by a Royal monopoly (1589) to collect rags	
Mid-18th century	Variety of hand-made paper produced	JohnWhatman
1765	Experiments with vegetable raw materials	Jacob C Schaeffer
1800-02	Use of wood for paper-making Pulping of straw	Mathias Koops
c 1807	Loading	Cockworthy
1840-4	Mechanical pulping of wood	Friedrich G Keller
1850	Ground wood mixed with rag fibre made commercially	

Year	Particulars	Introduced by
1852	Coating of paper with brush	G Cummings
1854	Soda process Use of esparto grass	Walt and Burgess Sponsored by *The Times*
1857	Sulphite process Commercial use of esparto grass	B C Tilghman Thomas Routledge
1872	Development of Tilghman's Sulphite process	C D Ekman
1884	Sulphate process	C F Dabil
1888	Production of sulphite pulp on a commercial scale	Riordon of Canada
c 1895	Glue replaced by Casem as adhesive and fine art paper became practicable	

CHAPTER CG

PAPER MANUFACTURE IN PRESENT-DAY INDIA

1 Beginning of Paper Mills in India

Machinery for paper-making was first established in India in 1825 by Marshman of Serampur. But it did not meet with success. Another machine was brought to the country in 1851; that too did not make a success. By 1880's, machineries had been established in Calcutta, Lucknow, and Poona.

2 List of Major Paper Mills and Their Annual Output

SN	Year of foundation	Name of the firm	Place	Capacity per annum
				IN TONS
1	1879	Upper India Couper Paper Mills Co Ltd	Lucknow	4,000
2	1882	Titaghur Paper Mills Co Ltd	Calcutta	60,000
3	1885	The Deccan Paper Mills Co Ltd	Poona	18,000
4	1889	The Bengal Paper Mills Co Ltd	Calcutta	
5	1918	Indian Paper Pulp Co Ltd	Calcutta	6,600
6	1931	Punalur Paper Mills Ltd	Punalur, Kerala State	50,000
7	1933	Gujarat Paper Mills Ltd	Ahmedabad	18,000

SN	Year of foundation	Name of the firm	Place	Capacity per annum
				IN TONS
8	1936	Oriental Paper Mills Ltd	Brajrajnagar, Sambalpur Dist, Orissa	50,000
9	1936	Shree Gopal Paper Mills	Yamunanagar, Punjab	36,000
10	1936	Star Paper Mills Ltd	Saharanpur, UP	24,000
11	1938	Sirpur Paper Mills Ltd	Sirpur, Kaghaznagar, Hyderabad, AP	100 tons per day
12	1938	Straw Products Ltd	Bhopal	24,000
13	1942	The Arivind Boards & Paper Products Ltd	Antalia, Billimora	
14	1942	Bholanath Paper House Pvt Ltd	Calcutta	18,000
15	1945	The Ballarpur Paper & Strawboard Mills Ltd	Ballarpur, Maharashtra	120 tons per day
16	1946	Pudukotah Paper Mills Ltd	Umayalpuram	50,000
17	1947	The National Newsprint & Paper Mills Ltd	Nepanagar, MP	30,000

SN	Year of foundation	Name of the firm	Place	Capacity per annum
				IN TONS
18	1951	The Ratlam Strawboard Mills Pvt Ltd	Ratlam	25 tons per day
19	1954	The Dehanu Strawboard Works Ltd	Bombay 16	18,000
20	1954	Thakur Paper Mills Ltd	Samasthipur, Bihar	3,000
21	1955	West Coast Paper Mills Ltd	Dandeli, Mysore	4,000
22	1957	The Mandya National Paper Mills Ltd	Bangalore	70 tons per day
23	1959	The Afsons Ind Corporation Ltd	Bombay 2	2,400
24	1960	Jayant Paper Mills Ltd	Bombay	10 tons per day
25	1960	Rohit Pulp & Paper Mills Ltd	Bombay 1	3000
26	1960	Seshasayee Papers & Boards Ltd	Tiruchirapalli	
27	1961	Ashok Paper Mills Ltd	Calcutta	15,000
28		Hindustan Cellulose and Paper Mills Ltd	Brajarajnagar, Sambalpur Dist, Orissa	
29		D Pudumjee Paper Mills Ltd	Bombay	

PART D

TECHNOLOGY OF PAPER-MAKING

CHAPTER DA

FACTORS FOR CONSIDERATION

1 Enumeration of the Factors

Paper-making involves six factors with which the library profession should acquaint itself in order to make its own contribution to Physical Bibliography. They are:

1 The raw material out of which paper is made;
2 The half-stuff and pulp made from the raw material;
3 The transformation of pulp into paper;
4 Finishing and the secondary materials used in it;
5 Varieties of paper; and
6 Sizes of paper.

2 Role of the Factors

The first three of the above factors have to do with the strength of paper. On the second factor depends the extent of the chemical neutrality of paper. This will determine its durability. The fourth factor will determine the readability of what is printed on paper. The last two factors affect the economics of paper. They ask for simplification and standardisation.

CHAPTER DB

RAW MATERIAL

1 Ease of Exploitation

The carbohydrate cellulose, produced by vegetable organisms to build the "steel-frame" of their physical structure, is the raw material needed to build the "steel-frame" of the physical structure of paper also. Perhaps, it may be uneconomical for man to synthesise into cellulose the elements carbon and hydrogen in their native state, even though he can do so. He has therefore to take cellulose from the vegetable kingdom. Practically all higher forms of plants make cellulose. Some have it in a nearly pure condition. Others have it in various degrees of physical and chemical bondage with other organic substances — such as lignin, pectin, and resin — which bind the cellulose fibres together, make them waterproof, and protect them in other ways. There may also be some residue of the original contents of the cells. Durability of paper will decrease with the amount of chemical action needed to separate the cellulose from other incrustations. The table on page 117 gives the percentage of cellulose in the decreasing sequence of ease of exploitation. Of the twelve kinds of helpers of the vegetable kingdom mentioned above, it is only cotton, wood, bamboo, and grass that give fibres suitable for printing-paper. Paper made from other fibres is fit only for packing and other uses.

2 Cotton

Of the four sources mentioned in Sec DB1 as useful for making printing paper, cotton fibre is the longest and purest. But it is all required for the manufacture of cloth. It can be had only in the form of industrial waste and rags of

SN	Plant	Organ	Percentage of cellulose
1	Cotton	Seed hair	83
2	Sun-hemp	Seed hair	66
3	Jute	Inner bark	58
4	Wood, such as pine, spruce, fir, and other conifers	Stem	55
5	Linseed	Inner bark	50
6	Bamboo	Stem	46
7	Grass, such as esparto, munja, and sabhai	Stem	35
8	Rice	Stem	35
9	Wheat	Stem	33
10	Sugarcane	Stem	33
11	Plantain	Stem	30
12	Bul-rush weed	Stem	29

worn-out clothes and cloth. The result is that the cotton fibre brought to use for paper-making, would have accumulated other accretions such as dirt, oil, grease, buttons, and pins. These will have to be removed. Even in the form of rag, the quantity of cotton fibre available has long ago lagged behind the needs of paper-making. Even assuming that all the rag from cities, villages, and factories are collected in spite of the price offered for them in cash and kind, cotton cellulose has become too scarce to be used for any copies of books that need not be permanently preserved. A practice, induced by the scarcity of cotton cellulose, is that the copyright copies of books intended for preservation for posterity are printed on rag-paper, while the copies for trade are printed on less lasting paper. The *Times* newspaper, for example, prints a

special issue on all-rag or part-rag paper for preservation in national central libraries.

3 Grass

Paper made of esparto grass gives a good smooth surface for picture magazines. The *Illustrated London news,* the *Graphic,* and the *Sphere* are said to use esparto paper. But grass that is suited for printing-paper is not in sufficient plenty. Therefore, it has to be used only for paper for special purposes.

4 Wood

The most plentiful natural product available for making paper is wood. In temperate regions — the Scandinavian countries, Kashmir, and the Himalayas, for example — the coniferous trees promise unending supply. But the Himalayas are now inaccessible to admit of economic exploitation. India has therefore to depend on bamboo for raw material. The Forest Research Institute at Dehra Dun owes a great responsibility in this matter. It should find out by experiments the best wood that can be had for paper-making and take steps for the perpetual growth of the trees selected as most suitable.

5 Broke

Paper-waste formed at the time of paper-making or printing as well as printed paper in discarded books and newspapers can be ploughed back into the paper-mill. Such materials are called 'Broke.' Broke is naturally weaker. In addition, printer's ink is not easily removable. Therefore paper made of broke is inferior in every way.

CHAPTER DC

HALF-STUFF AND PULP

0 Seven Operations

The conversion of the raw material into half-stuff involves the first four of the operations mentioned below. Making pulp involves the last three operations also.

1 Cleaning and Cutting;
2 Boiling or Retting;
3 Washing and Breaking;
4 Bleaching;
5 Purifying;
6 Beating; and
7 Loading, Sizing, and Colouring.

1 Cleaning and Cutting

In the case of such raw materials as rags and grass, the first operation is to clean out any adventitious foreign matter, such as dust, metal pieces, clay-clots, roots, etc. In the case of wood, the trunks should be sawed up into pieces of log about 60 cms long; each piece should then be debarked; then all the knots should be removed. Finally, dusting should be done. After cleaning, rags and grasses are chopped into small pieces. Logs are cut into chips. In small-scale work, only simple tools are used for these operations. In large scale manufacture, suitable machinery is employed.

2 Boiling or Retting

The cleaned chops or chips are next boiled or digested under pressure in an alkaline solution, usually of caustic soda or its mixture with sodium sulphide. The chemical function

of the boiling process is to convert all the non-cellulose part into soluble compound and to split up the cellulose nearly completely into its constituent fibres by dissolving out the cement holding them together. When caustic soda alone is used, the process is 'Soda Process'. When sodium sulphite also is mixed, it is 'Sulphate Process'. A generic name of the two is 'Alkali Process'. An alternative to the boiling process is the Retting or Cold Process. In this, the material is mixed with a paste of slaked lime in the proportion of 100 to 15 and kept overnight. Next day, it is pounded lightly and kept in a heap. Water is sprinkled over it and the material is stirred from time to time. It is better that the heap is exposed to sunlight. Retting will have to be repeated until the material is reduced to a homogeneous stuff. This is a slow process; it often takes one to three months. But the boiling process may not take more than eight hours. When the raw material is wood, bisulphite of lime is used instead of caustic soda. In this case it is 'Sulphite Process' or 'Acid Process'. The pulp is 'Sulphite Wood Pulp'. In either case, it is called 'Chemical Pulp'. There is also a Chlorine Process.

3 Washing and Breaking

After the material had been boiled, it is usual to give it a preliminary rough washing in the boiler itself. The caustic soda solution still remaining in the fibre has to be very thoroughly removed. This is necessary both for the fibre and in the interests of economy. It is also necessary to satisfy Public Health Regulations such as the Rivers' Pollution Act. The process of washing takes a long time. After boiling, the fibre is apt to be formed into masses or clumps and has to be broken up and reduced to an aqueous mass of the required uniform consistency. In small-scale work, the washing is done in rivers and canals. The breaking is done by churning the

material in a vessel containing water. In large-scale manufacture, washing and breaking is done by machinery. The essential part of it is the washing drum consisting of a series of paddle blades. Clean water is continuously added to the fibre inside the vat through a pipe situated at one end of the tank. The washing drum is rotated slowly and the dirty water is drained out at the same rate at which clean water is being added. This is done until the last trace of caustic soda or bisulphite is removed. The breaking of the clumps is done by rotating the drum faster. When the breaking is complete, the charge is drained off for bleaching, through an outlet in the bottom of the vat.

4 Bleaching

40 Two Methods

Two methods of bleaching are possible: Sun Bleaching and Chemical Bleaching.

41 Sun Bleaching

In Sun Bleaching, the material is moistened with water and spread out on a stone or cement floor or mats of close texture for some days. This process is slow and not as efficient as chemical bleaching. But the cellulose will not be harmed.

42 Chemical Bleaching

In Chemical Bleaching, the bleaching liquor is poured into the vat containing the broken material and the whole is kept in circulation for the required length of time which may vary from 12 to 24 hours. Unless the engineer and the chemist cooperate in adjusting the strength of the bleaching liquor, the rate of stirring, and the time, the bleaching will not be uniform; and the cellulose may be injured.

5 Purifying

After the completion of the bleaching, the material is more or less white. Physically it is in a state of broken-up fibrous substance suspended in water, with impurities consisting of surplus bleaching liquor and other soluble and insoluble substances formed by the action of bleach. The quality of the paper depends upon the thoroughness of removing the impurities. If any residue of bleaching powder is left, it will in due course oxidise the cellulose and the paper will turn yellow and crumble away. Thus durable paper requires perfect purification of the material after bleaching is over. The purifying process consists of draining off of the dross liquid from the fibrous matter and the washing of the latter subsequently in clean water.

51 HALF-STUFF

The form to which the cellulose has been brought by the above-mentioned processes is called 'Half-Stuff'. When rag is the raw material, the half-stuff is prepared by the paper-maker himself at the very place where he makes paper. It usually has a concentration of 3 to 5 per cent.

52 CHEMICAL PULP

When wood is the raw material, since 50 per cent of it consists of non-cellulose matter, it is found to be economical to get the half-stuff made near the spot where the trees are felled. The water in the half-stuff is squeezed out until the moisture is reduced to 10 per cent. In this state it is packed into bales and sent to the paper-maker. This is called 'Chemical Pulp'.

53 MECHANICAL PULP

Mechanical wood pulp is nothing else than ground-up wood. More than 50 per cent of it is made of non-cellulose

matter: the lignin, the pectin, the resin, and all the other substances of the original wood. The process employed in its preparation is simply to grind the prepared pieces of wood against a rapidly revolving sandstone. The grinding is carried out in the presence of water. The stuff is screened to remove the coarse material and formed into slabs. These contain 50 per cent of water. These sheets are sent in bales to the paper-manufacturer. This is called 'Mechanical Pulp'. Here, we save the cost of boiling, washing, breaking, bleaching, and purifying. But the quality of the paper made out of mechanical pulp is correspondingly poor. Its life is very short indeed. It is used only to print impermanent reading materials such as newspapers. But people who do not understand this weakness in paper but are carried away by its cheapness, unfortunately use it to print books on. This is often happening in regard to books in Indian languages today. Mechanical pulp is resorted to just to reduce cost of books. There is no doubt that this is penny-wise and pound-foolish. The Indian public should be aware of the blindness involved in allowing production of books on mechanical pulp paper.

6 Beating

The process of beating is the most important one in the series of steps involved in the preparation of the pulp. It is even said, "Paper is made in the 'Beater' ". By beating, the fibres are bruised and reduced into fragments of about 1.5 mm in length. For this purpose, the purified material is passed into the beating engine. The material is made to circulate between a bed plate and a drum both of which have knives. The sharpness or bluntness of the knife, the speed of the drum, the temperature at which the beating is carried out, and the length of time taken in beating, determine the quality of the product. It requires a high degree of skill on the part of the beaterman. For good paper with sufficient lightness,

the material should be beaten slowly with dull knives allowing the fibres to assimilate water. The short fibres of grass and wood can be beaten in a shorter period than the long fibres of cotton. For thin paper, more prolonged beating is necessary than for thick paper. The beating may require as much as eight hours in the case of cotton. In the case where a blend of pulps made of cotton and of other materials is required, each constituent is separately beaten for the appropriate time and they are blended subsequently in a suitable machine.

7 Loading, Sizing, and Colouring

Nearly all classes of paper have to be treated with certain substances before they are fit for use in writing or printing. Two kinds of materials, at least, must be incorporated in it. In the first place, the interstices between the fibres must be filled up with some mineral matter such as calcium sulphate, or china-clay. Secondly, the paper must be sized so as to convert it from something absorbant like blotting paper to something that will not absorb printing or writing ink. In certain cases, it may even be necessary to add some colouring matter. It is customary to add the loading, sizing, and colouring material to the pulp during the beating operations.

CHAPTER DD

OPERATIONS IN PAPER-MAKING

1 Six Operations

The conversion of the pulp into paper can be made by hand as well as by machinery. Both the methods are schematically similar. They involve the following operations:

1 Straining
2 Felting
3 Couching
4 Drying
5 Smoothing
6 Calendering

2 Schematic Diagram

The following is a schematic representation of the flow of the operations:

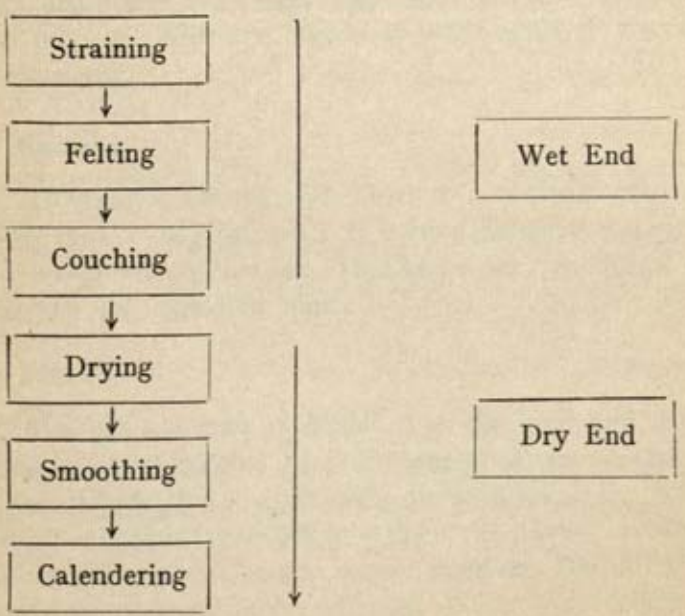


Fig 2. Paper making: Flow of operations.

3 Function of the Operations

Of the six operations mentioned in Sec DD1, the first four are inevitable in getting the consistency necessary to have paper formed as a permanent surface to print or write upon. The efficiency of the second operation determines also the strength of paper. The fifth and the sixth operations make the surface of paper take the ink properly without spreading it.

CHAPTER DE

HAND-MADE PAPER

0 Hand-Mould

The basic tool in making paper by hand is the Mould. It is a shallow sieve set in a rectangular wooden framework. The sieve, called Mould-Cover, is a bamboo mat. It is made of thin strips of rounded bamboo placed about eight strips to a centimetre. They are laced together with horse hair at regular intervals of 2.5 to 5.0 cms. The mat may also be of grass or of wire. Fibres cannot pass through the space between the strips but water can drip down. Such a mould is a 'Laid-Mould'. The mat is flush with the frame. A second, loose, and removable frame — the 'Deckle' — fits on to the first and forms the raised edges of the mould. It will hold the pulp in. With the deckle on, the mould is virtually a shallow tray.

1 Straining

The pulp is diluted with water to a consistency of about 2 per cent — say, like gruel. It is run, through a screen, from the storage chests to a vat. This keeps out any foreign material and the oversized fibres.

2 Felting

The shallow tray is dipped into the pulp and is lifted with just that amount of pulp needed for the thickness of paper. As the water of the pulp drains through the mat, the vatman shakes the mould laterally and causes the fibres to felt together at all angles to one another. The strength of the paper depends on this shaking. It is a very delicate and subtle craft; it is done best by hand.

3 Couching

When the water is fully drained away, the deckle is removed and the mould passed across to a second workman called the Coucher. He couches (transfers) the wet sheet of paper on to a piece of felt of about equal size. He then places another piece of felt over it. When a pile of such felts and sheets has been accumulated, it is transferred to a press where the surplus water is squeezed out and the paper compressed.

4 Deckle Edge

The lapping of the liquid pulp against the sides of the deckle causes the sheet of paper to have a rough and wavy edge, which uncut books have. It is called 'Deckle Edge'.

5 Water-Leaf

After the water is squeezed out from the pile, the felts are removed. The sheets by themselves are pressed to remove all irregularities. They are then hung in a loft to dry. When dried, it is still called 'Water-Leaf,' because it will readily absorb water. When paper is made by hand, the size which makes paper water-proof is not added at the beating stage. It is added only after the paper is formed, by dipping the dry sheets into tubs containing the size.

6 Calendering

The paper is again air-dried. It is then glazed or 'Calendered'. This is done by passing a pile of sheets each separated by a copper polished plate through a heavy board of rolls. It makes the surface of the paper polished and smooth. The greater the pressure applied and the more thorough the rolling, the higher will be the polish. The surface may be further improved by heating the metal plates. Further, calendering

compresses the paper to very nearly a half of its thickness. This increases its tensile strength. However, if calendering is overdone it bruises and breaks the paper. At any rate, it will make it brittle and liable to crack when handled.

61 Uncalendered Paper

Uncalendered paper has a rough surface and might rightly be taken at first sight for a piece of fine blotting paper. It actually has some 'blotting' power. On the one side, it appears fibrous even to the unaided eye. On the other side, it shows the pattern of the mould on which it was formed. The calendered material does not show the individual fibres and is almost identical on both sides. It is easy to write with a pencil on the uncalendered paper. But on the calendered one, the pencil grips the harder surface with difficulty.

62 Machine-Finished Paper

The degree to which calendering is carried out is varied with the requirement of the paper used. For many purposes, what is known as 'Machine-Finished' paper is sufficient. Here the calendering is confined only to a very few calenders. When a higher finish is sought, super-calenders are used. These are larger and heavier. It is found that, if the paper is slightly damped before it is passed through super-calenders, the finish on its surface is greatly improved.

7 Water-Mark

It is usual to attach to the mat of the mould the design of the paper maker. It is made with twisted wire. When held up to the light, the finished sheet of paper shows the impression of the design more transparent than the rest of it. This is the 'Water-Mark.' This is of importance in collating books in palaeo-bibliography.

8 Laid Paper and Wove Paper

In the same way in which the water-mark is formed on paper, the lines of the strips in the mould will also produce their impression on the wet pulp. Paper made with 'Laid Mould' is therefore called 'Laid Paper'. Laid paper will also show 'Chain Lines' which are the impressions of the horse hair used to tie together the strips in the mould. When woven wire-mat is used, laid-mould is replaced by a 'Wove Mould'. The wove mould also will show similarly a faint network of diamonds. Such a paper is called 'Wove Paper'.

CHAPTER DF

MACHINE-MADE PAPER

0 Machine

When paper is made by machine, practically all the stages mentioned in the making of paper by hand are gone through. The difference is that making by hand is a slow process; not more than 300 sheets can be made by a single person in one day. But as it has been already stated in Sec CE3, a machine can make over 40 kilometres of paper per hour. The machine takes the diluted pulp at the Wet End and delivers the finished paper at the Dry End.

1 Straining

As the pulp is delivered from the beating engine, it is diluted with water to a consistency of about one per cent. It is first caused to float through a sinuous sand-trap. The pulp flows over small ridges provided across the channel. Any large-size pieces of sand or dirt, flowing in with the pulp, are kept back by this trap. The pulp then passes on to a strainer consisting essentially of a plate with many narrow slits. Only properly pulped fibres can pass through it. The pulp then passes through a sluice which regulates the quantity of pulp in accordance with the thickness of the paper to be made.

2 Breast Box and Felting

The pulp passes through the sluice into a 'Breast Box'. From there, it passes on to an endless travelling band of wire-cloth. As the stuff is carried forward on this moving wire-cloth, much of its water drains away through the interstices. The wire-cloth is being continuously shaken laterally; and

the fibres felt together; in this case, it is not at all angles as in the case of hand-made paper, but it is only across the width of the mould. As a result, machine-made paper will tear more easily in one direction than along a direction perpendicular to it. The width of the finished paper is settled by means of "Deckle Strips" made of India Rubber. These are also endless bands which travel with the wire-cloth.

3 Water-Mark

Near the dry end, the wire-cloth passes over two vacuum boxes connected to a suction pump. Thereby the wet sheet is still further freed from water. At this stage, the sheet is soft enough to receive any required water-mark. This is effected by means of a "Dandy-Roll" placed between the vacuum boxes. Dandy-Roll is a light cylinder bearing on its surface the required design in raised wire. It presses gently on the wet paper and thins it very slightly beneath the wire pattern.

4 Couching

The wire-cloth with the wet sheet then passes through a battery of "Couch Rolls" covered with felt. It is then turned round the lower couch roll and laid back towards the breast. Thereafter, it leaves the wet end and re-enters the dry end freed from the wet sheet.

5 Pressing

By now the paper sheet is well-formed and moves forward independently of the wire-cloth and passes through a series of "Press Rolls." In this way, it is freed from all loose water, and consolidated into a strong sheet.

6 Drying

The paper is, however, still moist and has to be thoroughly dried. For this purpose, it is passed round a series of steam-heated drying cylinders.

7 Calendering

Thereafter, the paper passes through the rolls of a calender and gets smoothened, polished, consolidated, reduced in thickness, and increased in strength. As the sheet leaves the calender, it gets wound on to a reel. Super-calendering is not usually done at the dry end of the Fourdrinier machine. It is done in a different part of the paper mill.

CHAPTER DG

FINISHING

0 Five Processes of Finishing

In the making of paper, the finishing may consist of the following processes:

1 Tinting;
2 Loading;
3 Sizing;
4 Calendering; and
5 Cutting.

The first three processes are usually done at the beating stage. In certain cases sizing is done at the finishing stage. In art paper, coating, instead of loading, is done at the finishing stage. It is often done as a separate process. The other two processes have necessarily to be done at the very last stage.

1 Tinting

Practically every kind of paper, except a very few varieties, is required to be tinted to some degree. Even the so called white paper is not an exception. For, paper made from bleached white pulp is yellowish and has to be toned with the addition of some colouring matter, in order to produce white effect in the paper. For tinting hand-made paper, smelt (very finely powdered glass coloured with cobalt) is used. This is permanent and non-injurious. For all-rag machine-made, and all other good quality paper, ultramarine (azure blue) is used. This also is permanent if the paper is not exposed to acid fumes. For cheap paper, such as newsprint, cheap light-fugitive methyl and ethyl colours are used. The

colouring materials, other than smelts, are sensitive to acid. When they are used, all traces of bleaching powder, used while beating, should be washed out thoroughly before tinting material is put into the pulp. For this reason, it is put only at the last stages of beating the half-stuff.

2 Loading

To make the paper opaque, it must be loaded with a suitable mineral substance. Hand-made paper is seldom loaded. In all other paper, 2 to 10 per cent of loading is common. The loading material is usually an admixture of china-clay, which is made to occupy the interstices between the fibres.

21 Imitation Art Paper

Super-loading amounting to 24 to 30 per cent of the total weight of the paper is used in making Imitation Art Paper. The basic material is usually esparto and sulphite wood, the former being four to nine times the amount of the latter. This was first introduced by Thomas Routlege to print the popular illustrated weeklies. This paper is made, dried, and calendered in the usual way. The calendering is done with the surface of the paper damp. It closely resembles "Art Paper" which is described in the next section. But it is cheaper. As it is weak paper, it cannot be used for permanent record.

22 Art Paper and Coating

Genuine Art Paper is finished and dried paper coated with china-clay or "Satin White" (a compound of aluminium sulphate and lime). An adhesive such as glue or casein is added to the coating solution. Paper may be coated on one or both sides. But the coating is confined to the surface. It does not saturate the paper as in imitation art paper. In

printing, the type of block is confined only to the coat of mineral matter. The ink does not penetrate into the fibrous part of the paper. The fibrous part therefore merely serves as carrier. Therefore, it is sometimes of very poor quality. Art paper is unpleasant to handle although at first touch the soft feel may be agreeable. Art paper is, however, a necessity nowadays for halftone illustrations.

3 Sizing

There are four groups of materials which can be used in preparing the size: 1 Starch; 2 Glue; 3 Rosin; and 4 Casein. For hand-made paper and for the best quality of machine-made paper, the size used consists of gelatine and alum. As gelatine is of animal origin this mode of sizing is called 'Animal Sizing'. In all other kinds of paper the size used is rosin and alum. Rosin is a residue of turpentine distillation. It is therefore slightly acidic. It should not be applied before the couching process is at least two thirds of the way through. Unless great care is taken, contact of this with the residual alkali in the pulp may produce globules of salt. These globules will cause specks in the finished paper.

31 Engine-Sizing and Tub-Sizing

When the size is applied at the beating stage, it is called 'Engine Sizing'. If it is applied by dipping each sheet of dry paper into a tub containing the size, it is called 'Tub Sizing'. If paper is made by machinery and tub sizing is wanted, the sizing tub is set between two stacks of drying cylinders. Rosin admits only of engine sizing.

32 Sizing for Writing Paper

Writing paper requires harder sizing than printing paper. The degree of sizing can be smaller when the pulp is beaten

with blunt knives than when it is freely beaten. Generally, thick paper requires less of sizing than thin ones.

33 Relative Values of Sizing Material

Paper sized with starch attracts rats, worms, silver fish and other insects. Gelatine size is preferable for paper intended to last long. Paper with rosin size is not durable.

4 Calendering

An account of calendering and super-calendering and of the need for it, has already been given in Sec DE6 and DF7.

5 Cutting

When paper is made by hand, the sheets are sold without cutting. This is because the size of the paper is comparatively small. But when paper is made by machinery, it is made in a continuous sheet of a length of four or five miles. But the width is limited by the distance between the deckle traps. It is found more economical to adjust this distance for making the width of the paper a multiple of the width finally required than to adjust it for the finished width straightaway on the machine. For, it takes practically the same amount of power and the same attendance-charges to work the machine, whatever be the width. Therefore, in practice the width of the paper as it leaves the machine is several times the width in which it is marketed. Before marketing, the paper is slit to the desired width. Printers, who use rotary machine, prefer to have the paper in rolls. But others want it in the form of sheets. To meet the latter demand, the web is usually cut by machine to the required size.

CHAPTER DH

PAPER TERMINOLOGY

0 Introduction

The following definitions of terms connected with paper-making are taken largely from the British Standard 3203:1960.

1 Paper Pulp

11 PULP

Fibrous cellulose material of natural vegetable origin, prepared for the manufacture of paper.

12 CHEMICAL PULP

Pulp obtained from wood or other raw material of vegetable origin by a chemical treatment, eliminating the greater part of the non-fibrous components. The fibres so obtained can generally be easily separated without the necessity for further mechanical treatment.

13 SODA PULP

Chemical pulp obtained by the digestion of the raw material (wood or other vegetable material) with a liquor containing caustic soda.

14 SULPHATE PULP

Chemical pulp obtained by the digestion of the raw material (wood or other vegetable material) with a liquor consisting essentially of a mixture of caustic soda and sodium sulphide, and possibly of other sulphur compounds.

16 Sulphite Pulp

Chemical pulp derived from wood or other vegetable material by digestion with a bisulphite liquor.

17 Woodpulp

Pulp obtained from wood.

18 Mechanical Woodpulp

Pulp obtained from wood by entirely mechanical means, such as the action of a grindstone.

19 Stuff or Stock

An aqueous suspension of one or more pulps and other material from the stage of disintegration of the pulp to the formation of the sheet of paper.

2 Auxiliary Material

21 Filler

Fine and generally white mineral powder, incorporated in the stuff or stock.

22 Alum

A term, commonly but incorrectly used by papermakers to denote various qualities of aluminium sulphate. The material is known as alum because it is used for purposes for which alum was formerly used.

23 Coating Slip

Mixture, generally of mineral base with an adhesive or a binder, for application to the surface of paper. Other materials, such as colouring matter, may also be incorporated in the mixture.

3 Paper

31 Sheet of Paper

A piece of paper generally of rectangular shape.

32 Machine Direction

The dimension of a paper corresponding to the direction of the flow of the stuff on the paper machine.

33 Cross Direction

The dimension of a paper at right angles to the machine direction.

34 Wiremark

The impression left in the paper by the mesh of the wire on which the sheet was formed.

35 Dimensional Stability

Behaviour of a paper in respect of its dimensions and its 'flatness' with variations in its moisture content.

36 Broke

Paper which is discarded at any stage during its manufacture; it is usually re-pulped.

4 Treatment of Paper

41 Sizing

The addition of materials either to the stock (engine sizing) or to the surface of the paper or board (surface sizing), in order to increase its resistance to the spontaneous penetration of aqueous liquids, particularly writing ink, and the resistance to the surface spreading of such liquids.

42 SURFACE APPLICATION

Any operation consisting of the deposition of a coat of an appropriate material upon the surface of paper.

43 COATING

The process of covering the surface of paper with one or more layers of coating slip.

44 CALENDERING

A process carried out on partially dried paper in order to improve its surface finish or smoothness. It is carried out by means of a calender.

45 CALENDER

A machine consisting essentially of a certain number of superposed rolls (bowls) of which only one is power-driven.

46 STACK

A type of calender, generally situated at the end of the paper machine, of which the rolls are of metal only. It is used for imparting a finish to paper.

47 SUPERCALENDER

A type of calender in which some of the rolls are of compressed fibre and the others of metal.

5 Classes of Paper

51 PAPER

A sheet of material essentially made up of felted and interlacing cellulose fibres of natural origin, not rigid and weighing not more than 250 grams per square metre.

52 Coated Paper

Paper which has undergone a coating process on one or both sides.

53 Imitation Art Paper

Paper with a very high filler content and heavily calendered in order to give it a surface akin to that of a coated paper.

54 Light-Weight Paper

Paper substance weighing less than 40 grams per square metre.

55 Vegetable Parchment

Paper that has acquired, by the action of sulphuric acid, a continuous texture. This texture gives it a high degree of resistance to penetration by grease and also renders it resistant to disintegration by water even at boiling point.

6 Appearance, Composition, Finish

61 Look-through

Structural appearance of a sheet of paper observed when viewed by transmitted light.

62 Watermark

A design in paper which can be seen by holding the paper against light. It is formed during the formation of the moist sheet on the wire by means of a raised or recessed pattern.

63 Laid Lines

A continuous water-mark consisting of very close parallel lines, generally associated with spaced lines (chain lines) at right angles to these.

64 LAID PAPER

Papers with laid lines.

65 WOVE PAPER

Papers without laid lines.

66 MACHINE FINISHED PAPER

Paper treated mechanically on a paper-machine to obtain a smoother and more uniform appearance on both sides than on the unfinished paper.

67 MACHINE-GLAZED PAPER

Paper which has had one side made smooth and glossy by drying on a heated, polished metal cylinder forming part of the drying section of the machine. The other side of the paper remains relatively rough.

68 CALENDERED PAPER

Paper subjected to calendering.

69 SUPERCALENDERED PAPER

Paper highly calendered in a supercalender, in order to obtain a smoother surface and higher gloss than machine-finished paper.

7 Presentation

71 SIZE OF A SHEET

Dimensions of an unprocessed (for example, unprinted, unruled) sheet of paper expressed in the following sequence: width, length, the width being the smaller dimension.

72 REEL OF PAPER

Continuous sheet of paper wound on a core.

73 Width of a Reel of Paper

The dimension of a web of paper measured in the direction across the machine.

74 Untrimmed Size

The size of a sheet of paper, untrimmed and not specially squared, sufficiently large to allow a trimmed size to be obtained from it, as required.

75 Trimmed Size

The size of a sheet of paper ready for use.

PART E

LIBRARY PROFESSION AND PAPER

CHAPTER EA

POINTS OF CONTACT IN DAY-TO-DAY WORK

0 Introduction

A general knowledge of paper-making, an understanding of the physical and chemical qualities of paper, and familiarity with the defects of the different varieties of paper will stand a librarian in good stead in doing his daily work. Library work and the qualities of paper come into close contact at different stages.

1 Book Selection Section and Paper

In respect of the contact of the Book Selection Section and paper, there are both negative and positive hints.

11 Negative Hints

Here are some "Don'ts," prescribed by Law 1.

1 Don't buy an edition in feather-weight paper; don't be carried away by its bulk;

2 Don't buy an edition in India paper; don't be carried away by its being thin and handy; it is suitable only for sparing private use;

3 Don't buy an edition in art paper; don't be carried away by its smoothness and glossiness; and

4 Don't buy costly editions in all-rag paper for books which are of temporary value.

12 Positive Hints

Then come some positive hints for the National Librarian.

1 Persuade the book trade to produce the copyright deposit copies in at least Grade 2 paper;

2 Persuade newspaper offices to print a few copies in Grade 2 paper for preservation for future use; and

3 Persuade the Parliament to introduce the necessary clause in the Delivery of Books Act and the Copyright Act to secure these ends.

2 Accession Section and Paper

21 Conformity to Specification

While receiving ordered books and accessioning, familiarity with the qualities of the different varieties of paper will be of help in deciding whether the copy supplied is of the quality of paper specified at the time of ordering.

22 Cutting the Pages Open

The Accession Section should always make it a point to cut open the pages with a sharp-edged paper cutter, before releasing it. For, the fibres run continuously from one side of the fold to another. If pages are not cut open with a sharp edge, it may tear into the margin or flake. If the cutting open is left to the reader, he is likely to use his fingers or his pen for the purpose. This will injure the page.

3 Periodical Publication Section

31 Rush-Work

The problem of cutting open the pages of the issues of periodicals received from day to day needs special attention. On the arrival of the periodicals, the processing has invariably to be rushed through as readers would press for their early

release. Registering and stamping, before the release of the issues, is obligatory for account and audit purposes.

32 Cutting the Pages Open

On account of the reception of the periodicals arriving in a day having to be rush-work, there is a temptation to skip over the cutting of the pages. This temptation should be strictly avoided. An alternative will be to ask the publishers to cut the edges with cutting machine while stiching the issue. But when the completed volume of the periodical is bound, the edges will have to be cut again. This double cutting will reduce the margin inordinately. This is not desirable. Further, all publishers may not comply with the request of the library profession.

33 Unavoidable Responsibility

Therefore, the library should be prepared for the issues to be supplied with uncut edges; and it itself should take the responsibility to cut open the pages with due care, before releasing the periodicals for use. This is an unavoidable responsibility.

4 Library Civics and Paper

By suggestion and example, the library staff should train readers in handling books in the right way.

1 When suitable opportunities occur, the physical frailty of paper should be gently brought to the minds of readers.

2 They should be made to realise the need for clean and dry hands while touching books.

3 They should be trained to turn the pages without the help of their saliva.

4 They should be weaned away from the habit of folding the corners of leaves to mark pages.

5 A book-mark should be provided in each book.

5 Maintenance Section and Paper

Paper is the foundation of the whole structure of a book. Therefore, the importance of the care in handling books should be realised by the Maintenance Section of the library.

51 Airy and Well Lighted Stack Room

The stack room should be well-lighted and airy, and not the dark and dismal dungeon as it often is.

52 Air-Conditioned Stack Room

The temperature should be kept constant corresponding to 65 per cent moisture saturation of air, which approximates to 6 per cent moisture contained in most papers. This indicates air-conditioning. It will also protect books against fungal attack.

53 Alternative to Air-Conditioning

If air-conditioning is too costly or is impracticable for other reasons, some help can be got by putting buckets of coal or trays of lime or any other water-absorbant in various parts of the stack room. This is necessary because paper picks up water from the atmosphere and changes its shape according to the humidity it absorbs.

54 Special Makes of Paper

Special makes of paper will need to have more than ordinary care. Dampness is fatal to books printed on art paper.

When the atmosphere becomes dry, paper loses some of this water and again shape alters.

55 Protection Against Insect

As paper is a carbohydrate, certain insects would seek to live on the pulp. This is a great danger in tropical countries where insects are prolific. Frequent cleaning and dusting is the most effective remedy. Of course, in an open access library, insects will withdraw themselves from regions which are frequently disturbed by readers. But in regions which are not popular, the cleaning will have to be done frequently, in the measure of the frequency of use. The larvae of the insects should be traced from inside the books and removed. If there is evidence of too many insects, fumigation may be necessary.

CHAPTER EB

PROMOTION OF QUANTITY

1 Renascence and Paper

H G Wells said, "Paper made the Renascence possible." In this statement, he voiced a fundamental truth of Physical Bibliography. But by the use of the capital 'R', Wells meant the European Renascence which had already reached its culmination. Therefore, this statement is only retrospective. It describes what had happened. The message of Physical Bibliography to India and many other countries is, "You have now started in the upward phase of your current cultural renascence. You have started rather late. Therefore, do not allow under-production of paper to retard the progress of your Renascence. On the other hand, make the quantity of paper produced by you comfortably abreast, if not slightly in advance of, the demands of your Renascence."

2 World Production

Metric tons of Paper Produced in 1962

SN	Country	Paper produced
0	World-Total	90,000,000
1	United States of America	38,000,000
2	Canada	9,000,000
3	Japan	6,000,000
4	United Kingdom	4,000,000
5	USSR	4,000,000
6	West Germany	4,000,000
7	France	3,000,000
	* *	*
24	India	500,000

3 Consumption of Paper Per Capita

Kilograms of paper consumed per capita during 1962

SN	Country	Paper consumed
1	United States of America	205
2	Canada	134
3	Sweden	128
4	United Kingdom	106
	* * *	
96	India	1.2

4 Poor Plight of India

The total quantity produced as well as the per capita consumption of paper per year given in the Tables in Sec EB2 and EB3 show the poor plight of India today. This has been due to the negligibly small literacy even as late as 1947. It was not more than 15 per cent. Even for this small percentage of literates, India depended on imported books for general reading as well as for advanced studies and research. Nay, it largely depended upon imported books even for study by the students at university level. All this is changing rapidly as India approaches the crest of her Renascence.

5 Full Literacy and Its Demand

India's Constitution includes among the Directive Principles of State Policy the provision that "The State shall, within the limits of its economic capacity and development, make effective provision for securing the right to education. The Constitution further directs that "The State shall endeavour to provide, within a period of ten years from commencement of the Constitution, for free and compulsory education for

all children until they complete the age of 14 years." It further directs that "The State shall promote with special care the educational interests of the weaker sections of the people" who form nearly half the population of India. These provisions for education are only steps towards provision for the lifelong self-education of every citizen. Such a lifelong self-education will have to depend to a considerable extent on the availability of books of all standards in all subjects and in all the languages of the country, sufficient in quantity to satisfy the needs of every citizen. This constitutional provision contains and implicitly carries with it a message about the quantity of paper to be produced annually in India. Even taking 100 kilograms as the average annual per capita consumption, India should produce as much as 40 million metric tons of paper. The library profession as a whole will have to play its part effectively to promote the production of paper in this measure.

CHAPTER EC

VARIETIES OF PAPER

1 Causes for Varieties of Paper

It is said that there are about 2,000 varieties of paper in the market. This is due to different causes in the

1 Primary raw material used for the cellulose — cotton, hemp, and flax, grasses of various qualities, and bamboo and wood of various qualities;

2 Process of extracting the cellulose — in the chemicals used and in the speed of extraction;

3 Bluntness of the knives used and speed of beating;

4 Chemical nature of the subsidiary materials used for tinting, sizing, and loading or coating;

5 Speed and shaking at the felting stage;

6 Pressing and calendering; and

7 Proportion of the pulps of different qualities mixed. Pleasing appearance, strength, and durability vary with the different varieties. I saw a feast of paper varieties in the Hunter Museum of Paper in the Massachusetts Institute of Technology, collected by Dard Hunter, during a lifetime devoted to the work.

2 Library Profession and Standards of Paper

By far the greatest portion of the paper produced is used for printing. Enormous quantities of paper are stored in the shelves of libraries as books, periodicals, and newspapers. It is in the library that paper is handled without necessarily destroying it in the process. It is again there that it has to

be preserved long in spite of frequent handling. Beyond all that, the lasting beneficial social use to which paper is put is in the library. Therefore, the library profession should take part in the improvement and maintenance of the standard of paper used for printing.

3 Research on Paper-Making

Between 1885 and 1896, the Government of Germany set up extensive research on paper used for printing. In 1898, the Royal Society of Arts of UK set up a Committee on it. Its findings were published in the *Deterioration of paper* (1898). The investigations made in USA between 1904 and 1909 were summarised in the *Durability and economy in papers for permanent record* (1909) (Report of 89th Department of Agriculture). In 1913, the Book Production Committee of the British Library Association had a chapter of its *Interim report* on paper.

4 Standard on Paper-Making

In 1928, the International Committee of Intellectual Cooperation took up the standard for paper. In the same year the British Library Association appointed a Committee of Experts by the following resolutions:

"The Library Association, agreeing that the present position as regards deterioration of documents and printed matter in Public Record Offices and Libraries threatens to become extremely grave and that practical steps might be taken without serious difficulty to remedy this situation, hereby expresses its emphatic approval of the resolutions and recommendations of the Committee of Experts approved by the International Committee on Intellectual Cooperation at Geneva, August 1928, namely:

'That the attention of Governments should be drawn to the necessity of using for documents (and printed matter) of permanent value, and especially for those of an official character only papers manufactured according to (given) specifications'.

In support of the foregoing it is further resolved:

1 That HM Government be petitioned to consider the establishment by HM Stationery Office of standards of durability for papers and other writing materials to be used for public documents of permanent importance.

2 That the Paper Makers' Association be requested to consider the establishment, either in conjunction with HM Stationery Office or independently, of a public testing station, in order to fix similar standards for commercial use, and to publish the results of investigation into the subject. That the Publishers' Association be requested to confer with the Library Association

(a) as to the possibility of issuing on papers of approved durability copies of books for subscription by public, university, and other libraries; and also

(b) as to the terms on which a statute might be framed so as to ensure, without hardship to the book trade, the printing on such papers of those copies of books and other publications destined for preservation in the copyright libraries."

Its report entitled *Durability of paper* (1930) was published as a supplement to the December issue of the *Library Association record*. Robert P Walton has given a bibliography on the subject in his *Causes and prevention of deterioration in book materials* (1929). The Barrow Research Laboratory, Richmond, Virginia, has published valuable test results on

the qualities of paper (*Test data of naturally aged papers* (1964) in the series "Permanence/Durability of Book."

5 India and Simplification

It is high time that the Library Profession, the Printing Trade, and the Paper-Manufacturers apply their mind to the problem. After Independence, India has begun to produce books in large numbers. In the early stages, there will be a tendency to overlook the problem. But India has already realised the value of simplification and reduction in the number of varieties in respect of commodities and processes. The Indian Standards Institution has been established to take charge of the problem. It has already done some work. But the Library Profession should urge on it the problem of simplification in respect of varieties of papers for printing books.

CHAPTER ED

PAPER OF OBJECTIONABLE QUALITY

1 Mechanical Pulp Paper

Mechanical Wood Pulp Paper should not be used except for ephemeral books and periodicals.

2 Feather-Weight Paper

A more deceptive kind of paper is the one known as Antique or Feather-Weight. It is so called as it is bulky and light. It has a high percentage of esparto which is beaten off very quickly. It is machine-made. It is not well-pressed. There is little or no calendering. Chemically there is nothing wrong in this paper. The fault is all physical. The texture is loose. The leaves are therefore liable to "Fluff." It is easily frayed during handling. Its fragments scatter when cut open with a paper knife. It accumulates dirt very easily. It does not take sewing. Its bulk is deceptive. It misleads readers about the number of pages in a book. It occupies 40 per cent more space than one printed on Grade 2 paper.

3 Art Paper

Another weak paper is the Art Paper described already in Sec DG22. As it is heavily loaded with clay, its sheets stick together if exposed to damp. Folding cracks the coated surface. It does not take sewing. It is taken to be a necessary evil. The smoothness of its surface is necessary to reproduce sharply the excessively shallow relief of halftone blocks. If the screen is more than 120 lines to the inch, even esparto paper does not print well. But screens of 175 lines are commonly used, while screens of 250 lines are not unusual. New modes of printing such as the offset process are rendering a

glossy surface like that of Art Paper unnecessary even for fine illustrations.

4 Imitation Art Paper

As stated in Sec DG21, Imitation Art Paper is even more heavily loaded with clay than Art Paper. It is therefore cheaper. It is also weaker. Therefore, books printed on Imitation Art Paper should be avoided by a library.

5 India Paper

India Paper is all-rag paper with moderate loading. It is well pressed. It is very thin but very strong. It makes a book only one third as thick as ordinary paper. It is not suitable for public library use since the leaves are apt to get folded and crumpled. They are also apt to stick together.

6 Misnomer

India paper has little to do with India. In this term "India" stands for "Asia." The Japanese make fine strong paper with a creamy tint and a delicate and smooth surface which is admirably suited to print engravings. The Chinese too make very thin paper with a silky finish. They are also beautifully suited for the reproduction of wood-cut. This class of paper was first brought to England in 1842. With its light loading and calendering it proved to be a strong paper. It was used by the Clarendon Press. On account of its Asian origin, it was christened "India Paper."

CHAPTER EE

STANDARD FOR QUALITY

1 Spectrum of Quality

As stated in Chapter ED, papers of different qualities are being produced today — some good and permanent, some medium and lasting only for a generation or two, and some bad with very short life. Between these two extremes we have a regular spectrum of quality got by mixing different qualities of pulp. Books printed some centuries ago still preserve very well; because all-rag paper was used. The greatest catastrophe occurred in the latter half of the nineteenth century when the extremely poor mechanical pulp paper came into vogue. The 19 volumes of the monumental Royal Society's *Catalogue of scientific papers, 1800–1900* (1867 and 1925) used this paper. It now breaks into pieces at the very touch.

2 Library Profession

The Library Association of each country and the International Federation of Library Associations should individually and collectively persuade the book trade to use the proper quality of paper in printing books and periodicals.

3 Standards Bodies

The Library Associations should work in intimate co-operation with the Standards Bodies and establish standards for the quality of paper to be used for books and periodicals of different expectations of life, frequency of handling, and value of the subject-content. Indeed, the certificate system coming into vogue in respect of other commodities should be developed in respect of printing paper also.

CHAPTER EF

SIZES OF PRINTING PAPER

1 Format

The term 'Format' denotes the shape and size of a book. It is determined by the size of the whole sheet and the number of times it is folded to form leaves and pages. Generally, if the sheet is folded n times we get 2^n leaves and 2^{n+1} pages. Each of the fold halves the measurement in one direction only. The following diagram is a representation of the result.

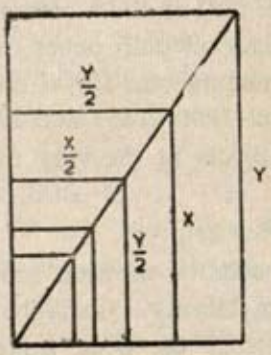


Fig 3. Printing paper format

The above is the regular sub-division of a sheet normally used for a book. It is possible to have alternative forms. These are called irregular sub-divisions.

It can be easily seen that the chain lines will run parallel to the longer side of the sheet in the folio. In a quarto they will run parallel to the shorter side of the sheet; in the octavo parallel to the longer side of the sheet; and so on. The water-mark also will shift its position among the leaves with each folding. The following terms are in vogue.

1 Broad-Side.—The open sheet is often used for printing maps, proclamations, and similar purposes. It is then called 'Broad-Side' or 'Open-Sheet-Folio'. A broad-side has two pages.

2 Folio.—If the sheet is folded once, we get two leaves or four pages. This is called 'Folio'. The folding is done along a line midway between the two shorter sides of the sheet.

3 Quarto.—If the sheet is folded twice, we get four leaves or eight pages. This is called 'Quarto'.

4 Octavo.—If the sheet is folded thrice, we get eight leaves or sixteen pages. This is called 'Octavo'.

5 Section.—A folded sheet is called a 'Section'.

2 Multiplicity of Sizes

More than 240 different sizes of paper are now being produced. In the past, the sizes of the sheets came to be denoted by different trade names. These were derived from the watermark used. The following table shows the different conventional sizes and their measurements.

SN	Trade name	Size of sheet in inches	Size of octavo in inches
1	Pott	15½ x 12½	
2	Foolscap	17 x 13½	6¾ x 4¼
3	Crown	20 x 15	7½ x 5
4	Demy	22½ x 17½	8¾ x 5⅝
5	Royal	25 x 20	10 x 6¼
6	Large Royal	27 x 20	10 x 6¾
7	Imperial	30 x 22	11 x 7½
8	Atlas	34 x 26	13 x 8½
9	Antiquarian	53 x 31	15½ x 13¼
	To this may be added the following two sizes in which hand-made paper is made in India.		
10	Sahiste Khani	28 x 21	10½ x 7
11	Bahadur Khani	38 x 31	15½ x 9½

CHAPTER EG

SIMPLIFICATION OF SIZES OF PRINTING PAPER

1 Work of ISO

Some of the varieties of sizes of paper vary from one another only by about one centimetre. Nothing is gained by such a multiplication of sizes. Reducing them only to a few will lead to simplification in the sizes of books and book shelves, facilitate the manufacture and sale of paper, and reduce the cost of production. Therefore, in 1934 the ISA (International Federation of National Standards Associations), introduced a simplified standard. This has been adopted by the ISO (International Standards Organisation) and the National Standards Bodies of several countries, including India.

2 'A' Series (Trimmed Sizes)

Designation	Size in cm	Rounded inches
A0	84.1 x 118.9 (Area 1 Sq m)	33 x 47
A1	59.4 x 84.1	23½ x 33
A2	42.0 x 59.4	16½ x 23½
A3	29.7 x 42.0	11½ x 16½
A4	21.0 x 29.7	8½ x 11½
A5	14.8 x 21.0	6 x 8½

Note.—The untrimmed size of A0 is 86 × 122 cm.

3 Other Sizes

As a transitory measure, the following sizes are allowed:

Existing Size			Equivalent Standard Size		
Designation	cm	inches	Designation	cm	Rounded inches
Crown	31.1 x 50.8	15 x 20	B3	35.3 x 50.0	14 x 20
Foolscap	34.3 x 43.2	13½ x 17	C3	32.4 x 45.8	13 x 18

PART F

LAW 2 AND THE MIRACULOUS ART

CHAPTER FA

LAW 2 OF LIBRARY SCIENCE

1 Enunciation

Law 2 of Library Science has two enunciations — "Books for All" and "Every Reader His/Her Book." The chief contribution of Law 1 to Physical Bibliography has been seen to be the use of paper as the basis of the physical medium for recording. We shall next ask Law 2 about its own contribution to Physical Bibliography.

2 Answer of the First Enunciation

In the form "Books for All," Law 2 bases its contribution on every book having to serve a large number of readers. It is to serve all of them within a short time after its publication. Therefore, Law 2 demands a large number of copies of a book to be produced in order to serve all possible readers. It also demands the production of a large number of copies at a great speed.

3 Answer of the Second Enunciation

In the form "Every Reader His/Her Book," the term 'Every' emphasises the unsparing democracy of Law 2. It includes also abnormal persons as well as persons obliged to read in abnormal conditions. Therefore, Law 2 bases its contribution on the individuating reading peculiarities of different persons. A book has therefore to be produced in different ways in respect of size of the letters, proportion of illustrations, and publisher's casing. From this point of view, the following groups of readers may be recognised:

1 Children and Neo-literates;
2 Old Readers;
3 Strap Hangers; and
4 Physically Handicapped.

CHAPTER FB

SPEEDY PRODUCTION OF MULTIPLE COPIES

1 Manuscript Days

When the Anti-Second Law "Books for the Chosen Few" was dominant, a few copies of a book proved sufficient. Sometimes even a single copy proved sufficient. This was reinforced by the low level of literacy that prevailed till our own times. In such circumntances, writing with hand proved to be an adequate process for recording a book. Delay in the starting of recording also did not stand in the way. For, in those days the content of a book was usually first communicated to the interested people by word of mouth. It is only later that it was recorded for study at leisure and also for study backwards and forwards. The writing of a book by hand often took a few months, if not years; the writing, by hand, of the text of the *Mahabharata*, for example, should have taken a few years.

2 Inadequacy of Manuscript Copies

When Law 2 "Books for All" gained dominance, a few copies of a book proved totally insufficient. 500 to 1,000 copies mark the minimum required. In respect of certain books the maximum goes beyond 50,000 copies. In respect of newspapers, the number required is very large indeed. Increasing percentage of literacy continuously swells the number of copies required. To copy them by hand is impracticable. Add to this the speed at which the copies should be produced so as to be released simultaneously. The man-power needed for this goes beyond what any community can afford to spare.

CHAPTER FC

PRINTING, THE MIRACULOUS ART

1 "Necessity the Mother of Invention"

Social pressure in the East Asian countries of Japan and China stepped up the necessity for speedy production of multiple copies of a book even in the eighth century. As usual necessity played the mother of invention. The Miraculous Art needed was invented. It is 'Printing'.

2 Continuous Improvement in Printing

Since then there has been a continuous improvement in reducing the cost of multiplying copies and also in speeding up the process. The improvement passed on —

1 From Block Printing through Printing from Movable Metallic Type to Printing without the mediation of the Metallic Types;

2 From Hand Press to Power Driven Press such as Steam Power, Electric Power, and perhaps Electronic Power; and

3 From Single Cylinder Machine through Two Cylinder Machine to Rotary Machine.

The chapters of Part G are devoted to the history of the march of the Miraculous Art of Printing through different stages.

CHAPTER FD

CHILDREN, NEO-LITERATES, AND THE OLD

1 Books for Children

The eyes of children cannot accommodate themselves to read small letters. Therefore, on behalf of the children the demand of Law 2 on Physical Bibliography is for the use of large letters, be it in manuscript or in print. I remember the revulsion produced in my mind when I had to read my first lessons from a palm-leaf book in which the words were all in small letters. Perhaps it would have been difficult to make the letters large enough on a palm-leaf. But this difficulty is removed in a printed book. The types can be made as large as necessary. In fact, there should be gradation in type-size for use in children's books, beginning with very large types — say 72 point — in books for infants and moving progressively to smaller types — say, 12 point — till the teenage is reached. Secondly, children do not easily take to the artificial phonetic symbols. Till half a century ago, children went through the torture of having to begin their schooling with the boring, meaningless task of learning the writing and the pronunciation of each individual letter of the alphabet. My hatred of this in my childhood made a deep impression on my mind. Years later when my interest was shifted to the subject of education, I discovered that the children pick up words first, and not the letters. While taking a child down the bazaar street, they discover the special commodities in each shop such as toys, cakes, and clothes. They associate the name of the commodity appearing in large glittering words on the sign-boards of the shop. So also, while learning to read, a well-illustrated book helps the child. Its page should have a picture extending through three-fourths of the page and its name

printed below in large type; he knows the pronunciation of its name; and he associates this pronunciation with the word giving it in phonetic symbols. A child usually does this for nearly a year. As children grow they pick up the individual letters in a word and combine them to form the pronunciation. As this develops, the proportion of the area of the picture and the area of the letter-press in a page may be gradually lessened. Book illustrations — attractive life-like pictures — should form then an important feature in books for children.

2 Neo-Literates

During the last forty years, I have had some connection with adult education in India. Till recently, this term largely meant teaching reading to the illiterates and to help the neo-literates to practise reading. It struck me that whatever has been said about children would apply also to adults. Their eyes too cannot immediately adapt themselves to pick up small letters. Their mind too cannot pick up and learn individual letters in the beginning. For them, each page should correlate an attractive life-like picture with the word denoting it. Here also, the proportion of the picture-space to the letter-press-space in a page can be progressively reduced till the stage is reached for reading ordinary adult books.

3 Old People

So far as the accommodation of the eye is concerned the old people suffer as much as children. Therefore, they too require books printed in large type. This has been neglected all along. There is one difference. In the case of children's books, the subject-content itself is such that there is no use of printing the adult books for them in large types. Therefore, no extra cost is involved. But, in the case of the old people, it is adult books that should be brought out in an

Old People's Edition. This is a question of finance, supply, and demand. The publishing trade should investigate this question. The University Microfilms of USA arranged for the production of large type editions made from microfilm copies. The cost ranges about 10 pages per dollar. The *New York Times* produces a large type weekly edition of 24 pages. This edition is in 18 point type. It is produced by a photographical enlargement of selected columns in the regular editions. In UK the Ulvercroft series of large-type books for those with poor eyesight is a noteworthy venture.

CHAPTER FE

STRAP HANGERS

1 Boredom

In the modern housing arrangement, business houses are concentrated in the heart of a city and the persons employed in them live in distant suburban and even rural areas. Everyday they are obliged to commute from home to office and back from office to home. This often entails travelling by crowded trains, trams, or buses for nearly an hour in the morning and in the evening each day. Nearly a third of the passengers have to stand holding the strap during the rush hours.

2 Relief from Boredom

The passengers' boredom is not relieved by looking through the window. For, the landscape is monotonously the same — day after day. Those who find seats together, sometimes manage to escape the boredom by playing cards or chess. This is not possible for Strap Hangers. One of the means available to them to escape from boredom in this unenviable posture is reading a book.

3 Demand of Law 2

Law 2 pleads with Physical Bibliography on their behalf. With the left hand holding the strap, the book is to be held in one hand; they, therefore, need an edition lighter than the usual one. Further, a book with a stiff binding will not lend itself to this. It is therefore necessary to have the copies printed on thin paper and either paper-backed or provided with a limp cover. Another desirable feature in the Edition for Strap Hangers should be that they should be small enough in size, to allow of being pushed into the pocket when they get off from the vehicle.

CHAPTER FF

PHYSICALLY HANDICAPPED

1 Exacting Democracy of Law 2

The term 'Every Reader' in Law 2 cannot exclude the physically handicapped. The democracy of Law 2 would insist upon the provision of books suited to them.

2 The Blind

The blind form a large group of physically handicapped readers. They have been trained in their schools and colleges to read braille books with their fingers. Law 2 insists that braille books should be printed for the blind. Here it is difficult to match the supply and demand on a commercial basis. Therefore, the practice has been for the National Library for the Blind to produce them. Nowadays sound records of books are also made for the use of the blind. In 1950, I saw it in the Cleveland Public Library; the Department for the Blind utilises the impulse for social service among their normal readers and uses their services to produce sound records of books. The National Libraries for the Blind are now regularly producing such sound-records.

3 Cripple

Another class of handicapped literate readers are the cripples having to spend their time always in bed. For their benefit, the "Ceiling Book" is being produced. A film reprograph is projected on to the ceiling above the bed. The film box is fitted with a suitable mechanism for the pages to be turned by the cripple with any of his limbs, for use.

PART G

HISTORY OF PRINTING

CHAPTER GA

BLOCK PRINTING

1 Phase 1 of Printing

The first success of Law 2 in the mode of recording began in Japan. Between 767 and 780, Empress Schotoku ordered the preparation of a million copies of a *Dharani* (a Sanskrit prayer book in Chinese script). For, her guiding principle was "Prayer Book for All." Even if a scribe could write two copies a day, it would have needed a hundred thousand days. Even if a thousand scribes had been put on the job, it would have taken a hundred days. But thousand scribes could not be found. Therefore, the inventor cut the letters of the prayer in reverse on a block of wood. To'ul Lun's invention of paper in 105 A D and the subsequent invention of ink from lamp-black in 400 A D were used, and the miracle of producing a million copies of a piece of writing in a short time with only a few hands happened. This was "Block Printing." Copies of this first printed book are said to be still available in certain Japanese temples. A few copies are also said to have been acquired by museums in Western countries.

2 March of Phase 1

The march of Phase 1 of the Miraculous Art conjured by Law 2 was extended by the cultural leaven of Buddhism spreading out from India. Here are some dates of printing:

780	*Dharani* (Japan)	972	*Tripitaka* (China) a book of 130,000 pages
868	*Diamond sutra* (China), a 16 feet roll found by Aurel Stein	994	*Dynastic History* (China)
932–53	Work of Confucius	1250	Begun in Egypt
950	First folded book (China)	1423	Begun in Europe

CHAPTER GB

MOVABLE TYPE

1 Phase 2 of Printing

The pressure of Law 2 went on increasing in intensity for about three hundred years. But as social decadence set in thereafter, the pressure began to decrease. Still the momentum of Phase 1 led to the invention of movable types in China in 1049. This was Phase 2 of the art of printing. The momentum was so weak, however, that it took four centuries for three founts to be made.

These were all in Korea. Here are the dates:

1049 Invention of movable type.
1390 Type-foundry established by order of the king.
1409 A book printed from types in this year is known to exist.
1420 Second fount of types made.
1434 Third fount of types made.

2 East Goes to Sleep

By this time, the force of inventive spirit had spent itself out. Eastern society had gone to sleep. As a result, Law 2 lost its strength, and Physical Bibliography stagnated in the East.

3 West Wakes Up

However, as the renascence faded in the East, it rose in the West. The setting twilight of the East synchronised with the rising twilight of the West. As usual, the different parts of the world worked in relay, as it were. Travellers like Marco

Polo carried the pollen unconsciously in their feet from the mature flower of the East to the freshly blossoming flower of the West. The intangible way in which the relay is done is so inscrutable that mere intellectuals call it chance. But if happenings are seen in their global, infinite context, there is nothing that is a freak to be explained away as chance. As the East dropped into sleep, the West shook off from sleep. The movement of renascence was at a quicker pace in the West, as it belonged to a later cycle. Therefore, whereas the interval between the invention of paper and that of printing was seven centuries during the renascence of China, the interval between the acceptance of paper and that of printing was only one century in Europe. Physical Bibliography began its work with redoubled vigour backed by the surging Law 2. As the mediaeval conceptions dissolved away before a new type of mind, the demand for books over-reached the capacity of scribes copying books one by one. Even making blocks and printing therefrom proved too slow for the rate of growth of demand.

4 Gutenberg

The right man appeared at the right time. Gutenberg of Mainz in Germany began somewhere about 1400 to grope for his type-mould and his punch-cutting device to make matrices to be used with his mould. As it happened later with the inventor of the paper-making machine, a capitalist first backed him, soon became impatient, and pursued him prematurely in a court of law. But Gutenberg persisted and completed the printing of the now famous *Mainz Bible,* also called *42 line Bible*. This was in 1455. Copies of this exist today.

5 March of Phase 2

The range and march of Phase 2 of the Miraculous Art conjured by Law 2 carried the printing side of Physical Biblio-

graphy throughout Europe with surprising rapidity in spite of slow-moving transport. Here are the dates:

1455 Germany	1474 Spain	1577 India
1465 Italy	1476 England	1589 China
1468 Switzerland	1482 Denmark	1591 Japan
1470 Holland	1483 Sweden	1593 Philippines
1473 Belgium	1483 Portugal	

The Jesuits were responsible to the dragging of printing into Asia, then lying in a state of cultural exhaustion. But this attempt of Physical Bibliography to come back to the East virtually fissiled out. For, the East had not yet recovered.

6 Incunabula

The books printed in the first fifty years of Phase *2* — that is printed, say, before 1500 — are called 'Incunabula' (= cradle books). Most of the extant copies of the incunabula have been rounded up. Paleo-bibliography has reconstructed every detail of the incunabula-age with uncanny thoroughness.

7 Separation of Type-Foundry Trade and Printing Trade

One of the first specialisations in the complex art of printing was the separation of the type-founding trade from the printing trade. This happened gradually in the sixteenth century. The type-founders went on improving the type-faces. The printers went on making minor improvements in the press. With the then knowledge of engineering, no revolutionary changes were possible. Further, the demand for more books for more people did not shoot up till the beginning of the nineteenth century. Social pressure was low. What little pressure there was could only lead to the establishment of more presses or the enlargement of existing ones. It took 200 years for wood to replace iron in the building of the press, and the lever to replace the screw.

CHAPTER GC

HAND-PRESS WITH PLATEN

1 Early Hand-Press with Screw

The major terminal operation in printing is in essence the transferring of ink from type-surface to paper-surface. Pressing the sheet of paper on the inked type surface was the obvious means. The press with platen — used for pressing linen or the screw press used by paper makers for nearly a century — was first adapted to this purpose. The first handpresses of 1440 were made of wood. They were massive in order to secure rigidity and to withstand the wear and tear of heavy use. In 1550, wood was replaced by metal.

2 Bed in Travelling Carriage

In 1620, the Platen was suspended and the bed having the forme to be printed slid under it in a travelling carriage. This was the Blaew Press.

3 Hand-Press with Lever

In 1800, Earl Stanhope introduced all-iron press with levers to work with Platen along with the screw. This increased the speed of production to 200 impressions an hour. The lever hand-press reached its zenith in 1823 when the Albion Press employed a lever with toggle-joint.

4 Hand-Printed Book

Printing with hand-press is not much in vogue since 1800. And yet, the hand-press was revived by William Maurice in his famous Kelmscott Press. Books printed with handpress were christened 'Hand-Printed Books'. No special quality attaches to a hand-printed book though "hand-made paper" has superior quality as against machine-made paper.

CHAPTER GD

POWER PRESS

1 Effect of Democracy

As the nineteenth century dawned, Europe was simmering with new life. Parts of Europe were bathed in a wave of democracy. There was a redistribution of wealth. There was a sudden rise in the standard of life. This included rise in the number of those looking for books. This called for production of a large number of copies of a book at a great speed. The call of Law 2 was intensified. Power Press was the only solution. And it was invented in 1812.

2 March of Phase 3

The industrial revolution which began about 1800 has passed through three stages and is entering stage 4.

1 Steam power and the grosser and massive engineering;
2 Electrical power and the finer engineering;
3 Chemical technology and photography; and
4 Electronics, with all its versatility.

These stages are found in Phase 3 of the development of printing. Steam-power led to the invention and continuous improvement of the Power Press. Electrical power led to the invention and continuous improvement of composing machine. Chemistry and photography first led to photo-chemical methods in the preparation of blocks for printing illustrations and then to planography or printing from plane surface as in offset printing. Electronics is now leading to a new flair of inventions, promising to fit Physical Bibliography to meet the most exacting demands which Law 2 has begun to make. Let us trace the march of Phase 3 of the Miraculous Art of Printing through all these four stages.

CHAPTER GE

CYLINDER MACHINE WITH STEAM POWER

1 Stop-Cylinder Machine

The replacement of a plate by a wheel has been the most outstanding mechanical aid invented by man. Printing press is no exception to this. However, it took three and a half centuries to be effected in the printing press. William Nicholson took a patent in 1790 for a Cylinder Machine. But it went unnoticed and unused for nearly twenty years. The increase in demand for books created by Law 2 had not then reached the necessary intensity to see the superiority of the value of the cylinder to the flat plate. A Cylinder Machine was first made in 1812 by Friedrich Koenig employed in the *Times*. The *Times* introduced also the newly invented steam-power. This increased the speed of production to 1,000 impressions per hour.

2 Two-Revolution Machine

Then came the "Two-Revolution Machine" in which the cylinder revolves continuously without stopping. It makes two revolutions for each impression. The sheet is printed during the first revolution. Then the cylinder is raised to clear the forme, to do inking by machinery, and to insert a new sheet. This increased the speed. In 1882, it was used to print the 41 volumes of Ree's *Cyclopaedia*. In contrast to this, the original cylinder machine was called 'Stop-Cylinder Machine'.

3 Perfectors

These machines print on both sides of the sheet not exactly simultaneously but consecutively before the next sheet is taken up. They are therefore called 'Perfectors'.

CHAPTER GF

PLATE MAKING

1 Printing in Gangs

Nearly a century before machinery made speed-printing possible, the demand of Law 2 for a large number of copies was met by printing the same book, at the same time in a number of different places. This is called 'Printing in Gangs'. To compose the matter *ab initio* in each of the places involved prohibitive cost.

2 Stereotype

In 1727, the stereotype was invented to meet the situation. William Ged of Scotland was the inventor. Incidentally, the stereotype method effected considerable saving of wear and tear on expensive type metal and the original block for illustration. For the relatively small cost of stereo, the original block is insured against the risk of deterioration or accidental damage which use on the machine would involve. Also the type is released much earlier for other purposes with a consequent economy in time and capital outlay.

3 Effect of Steam Power

These incidental advantages gained considerable weight when steam power was introduced in 1812. In 1814, this led to the invention of a cheap "Moulding Flong" called 'Papier-Mache'. It is made of tissue and blotting paper pressed together by a special paste in alternate layers. The *Times* of 29 November 1814 was the first newspaper to be printed with its aid. When the rotary machine came, the stereotype lent a helping hand in making cylindrical plates possible. Electro type, plastic, and rubber plates also are made now.

CHAPTER GG

ROTARY MACHINE AND SPEED LIMIT

1 Curved Stereotype

By the middle of the nineteenth century literacy had spread quite widely. Though books did not come to be widely read, newspapers became very popular. By their very nature, copies of newspapers had to be multiplied at a tremendous speed. With only 2,000 impressions per hour, several formes would have to be composed and printed simultaneously on several machines. This would involve more money and more man-power than society could afford. This social pressure created by Law 2 put the engineer on the alert. He found that he had done all that he could to increase the speed by making the pressing part of the machinery a cylinder. But the un-economical part was the printing-surface on the bed. This was in a flat form. If this too could be converted into a cylinder, the desired result would be got. So it was, Applegarth and Hoe prepared curved stereotypes of the type-surface.

2 Paper in Reels

To take full advantage of the two cylinders revolving at terrific speed, paper was made as a reel. The Web wound in cylinders could be fed by this reel between the type-cylinder and the press-cylinder at the right speed. Moreover, any number of units can be built up in decks or placed in line. This means any number of pages can be printed at a time. It is not unusual to have 64 pages of newspaper size printed at one time. Paper reels are made in suitable size for this purpose. To take full advantage of this terrific speed, the Hoe Press has also super-speed folders attached to it. It has also multicoloured units for colour work.

The speed attained was 25,000 copies per hour; 60,000 is now possible.

The speed of offset machine is even greater. In gravure-printing the speed has now been increased to nearly a 100,000 impressions per hour.

3 Supersonic Barrier

Increase of speed is really a matter of increasing the number of revolutions of the cylinder per hour. But there is a limit beyond which increase in the number of revolutions will land us in supersonic speed. For cylinders of three feet diameter, this supersonic limit will be reached with 400,000 revolutions or impressions per hour. If the number of impressions reaches that limit the surrounding air will cut away the paper and everything else that comes near it, as if it were the sharpest of the razors. If Law 2 wants a greater speed of production, Physical Bibliography should look forward to improvements of operations other than that of striking copies.

CHAPTER GH

PNEUMATICS AND ELECTRICITY HELP

1 Automatic Feeding

Though the speed of printing was satisfactory, the number of men needed to feed the sheets of paper to the gauges one by one by hand involved wastage of man-power. Several operatives were required to feed paper. To eliminate this wastage of man-power, the "Automatic Feeder" was invented in 1920. It was the creation of electrical and pneumatic engineering. It is truly a robot. It picks out each sheet from the pile, guides it carefully to the feed gauges, and sees that the grippers take safe hold of it. If two sheets are stuck together or if the sheet is torn or incomplete or it jams anywhere on the feeder because of crumpling and if the cylinder fails to take hold of it, or if anything else untoward happens, the robot stops the press. It also stops the press when the last sheet in the pile has been fed.

2 Electro Type

After entering the era of electricity, electrical method of preparing a solid plate as printing surface came into vogue. Electricity also helped in the strengthening of the face of the stereotypes as well as electro types with harder metals, like nickel and chronium, according to the number of runs. Here is a comparative table:

Metal of the face	Number of impressions possible
Lead	25,000
Copper	40,000
Nickel	300,000
Chromium	700,000

CHAPTER GJ

MACHINE COMPOSITION

1 Introduction

The art of printing has two stages:

1 Preparing the surface from which impression should be taken on paper; and

2 Taking the impression on paper.

For the work in the second stage, machinery was introduced in 1790. It has since been continuously improved. Today, the speed of taking impression has reached the ultrasonic level — the highest level now deemed practicable (*See* Chap GH). To make any further improvement in the speed of the total process of printing, machinery should be used in preparing the surface from which the impression should be taken — essentially in the composition of the matter for printing, as it is called.

2 Machinery for Composition

In hand composition, fixing each type in its position takes about four seconds. The machinery can do this at a much quicker rate, as the following comparative table shows:

Year of introduction	Mode of setting	Letters per hour in round figures
1440	Hand Setting	1,000
1890	Linotype Setting	10,000
1897	Monotype Setting	40,000
1954	Photo-Type Setting	90,000

The speed in Monotype Setting and in Photo-type Setting assume that the punched paper tape is supplied at the necessary speed — perhaps by using many keyboarding machines. In addition to increase in speed, there are also certain other advantages in machine setting.

3 Hand Setting

Hand Setting is also called 'Foundry Type Setting' or 'Cold Type Setting'. In hand setting, the type wears out while printing. After the printing, they must be distributed in the case for reuse. Some types might have been broken during the printing; and mistakes could have occurred in distribution. This will cause faults in later composing.

4 Hot Metal Setting

In Linotype and Monotype Machine Setting, these two diffculties are avoided. It is the matrixes — and not cold types — that are set into lines. Type is cast by pumping hot metal into these matrixes. Machine composition is therefore described as 'Hot Metal Setting'. The type is always fresh and free from broken types; and it also avoids mixing up of different letters. After the book is printed, the types are melted down for use as metal for the next book.

5 Photo-Composition

In photo-composition by machinery, lead is not at all used. With the aid of photography, letters are formed directly on the film through their respective matrixes. Thus, the difficulties arising with metal types are totally bypassed. There is a further gain in speed. When metal is used, time has to be spent in making plates for mass-printing at great speed. This is not necessary in direct film setting. The offset plate for printing is got directly from the film. This gives additional saving of time.

CHAPTER GK

MARCH OF PRINTING IN INDIA

1 Printing in Goa

In 1556, Portuguese Jesuit fathers established in Goa the first printing press in India. It was begun with a printing press brought by the Jesuits from Portugal. The first printer was John of Bustamente. He is said to have had an Indian printer trained in Portuguese to assist him. The first book printed in this press was *Conclusoes* of Antonio de Quardros, a professor in the College of St Paul. No copy of this book appears to exist now. In the next year, a catechism entitled *Dontrina Christo* by St Francis Xavier was printed at the College of St Paul. A copy of the third book *Compendio spiritual de vid a christao* by Gaspar de Leao printed in 1561 is said to be found in the New York Public Library. This press appears to have been closed down in 1573. Another press was opened in 1616 at Rachol near Goa. This press worked till 1668.

2 Printing in Malayalam

The first printing in Indian characters was done at a place called Ambalakkadu in Cochin, now a small village. About 1550, the Jesuits built here a seminary and a church. Sanskrit, Tamil, Malayalam, and Syrian were studied there and a press established where several important works were printed. In 1577, the first so called 'Malabar' types were cut by a lay brother, Joannes Gonsalvez. But, there is no evidence left to show whether the script was Tamil or what we now know as Malayalam. At that time, the word 'Malabar' seems to have been used by Europeans to denote both the languages; and even as late as 1809, the Tamil–English Dictionary of Fabricius

was described on the title-page as a 'Malabar and English Dictionary'. It has not been found possible to trace in India any of the books printed at Ambalakkadu; but there is said to be in Rome a list drawn up by Fr Paulinus. An Indian, who had seen it, has stated that the names of the books appeared in Malayalam script; the probability is that normally they were used for printing both Malayalam and Tamil books.

If this be the case, an interesting story lies behind a record left by Fr Paulinus. According to him, in 1679 a Tamilian, Ignatius Aichamoni, cut Tamil letters in wood for the printing of a Tamil–Portuguese Dictionary compiled by Fr Antem de Proenca of the Madura Mission. It would seem that the Madura Jesuits had discovered that the Malayalam script was not understood in the Tamil country proper; and Antem de Proenca insisted on Tamil script being used. He would probably have asked Ignatius, a local wood-carver, to cut the letters for the key-words. It would have been extremely difficult to produce separate letters in wood, so, probably, the words were carved on small type-high blocks. Type was cast at Amsterdam in 1678 to print the names of some plants in the book *Horti Indica Malabarici*. Ziegenbalg, the Danish missionary who worked at Tranquebar on the East coast, mentions the fact that Tamilians could not make them out. Here too it is probable that the first Amsterdam types were Malayalam. If so, the claim of Ignatius of Madura to be the first Tamil type-cutter seems well established. Unfortunately, Ambalakkadu was destroyed by Tippu Sultan during his invasion of Cochin and Travancore. He spared neither Christians nor Hindus; church, seminary, and press went up in flames; and practically all the books and valuable manuscripts perished.

3 Printing in Tamil

31 Tranquebar

311 *First Press*

A new era opened with the arrival of the Danish missionaries, Ziegenbalg and Plutschau, at Tranquebar in 1706. In 1711, the Society for the Promotion of Christian Knowledge (SPCK) in London sent out a press with Roman types to Tranquebar. Along with it came a German printer, Jonas Fincke. The ship was captured by the French off the coast of Brazil and taken to Rio. It was afterwards ransomed, and thus enabled to resume its voyage; but Fincke died off the Cape of Good Hope. The press and type, together with a stock of paper, were landed at Tranquebar in August 1712. The missionaries were able to secure the help of a Danish soldier to erect and manage the press. Some small books were printed in Portuguese. In the meantime, Ziegenbalg had sent specimens of Tamil letters to Halle in Germany, where a fount was cut and cast. The types were then sent out; and they reached Tranquebar soon after the press. The first book printed entirely in Tamil was the *Apostle's creed*. Two more printers came. One of them, Adler, was of great help both as a type founder and as a mechanic. The Tamil types sent from Halle were rather large, so Adler set to work on the preparation of a smaller fount. He also set up the first paper mill in India at Poraiar.

312 *First Printed Book*

The printing of the Tamil *New testament* was completed in 1715, and the translation of the Old Testament followed. This was completed by Schultz after Ziegenbalg's death. Its printing was completed in 1727. A copy of this first edition, in five volumes, is still extant in the possession of the British

and Foreign Bible Society in Madras. The Tranquebar Press continued to function for nearly 200 years; and the bulk of Tamil printing was done there during the eighteenth century. The Tamil type used in this period was upright and somewhat

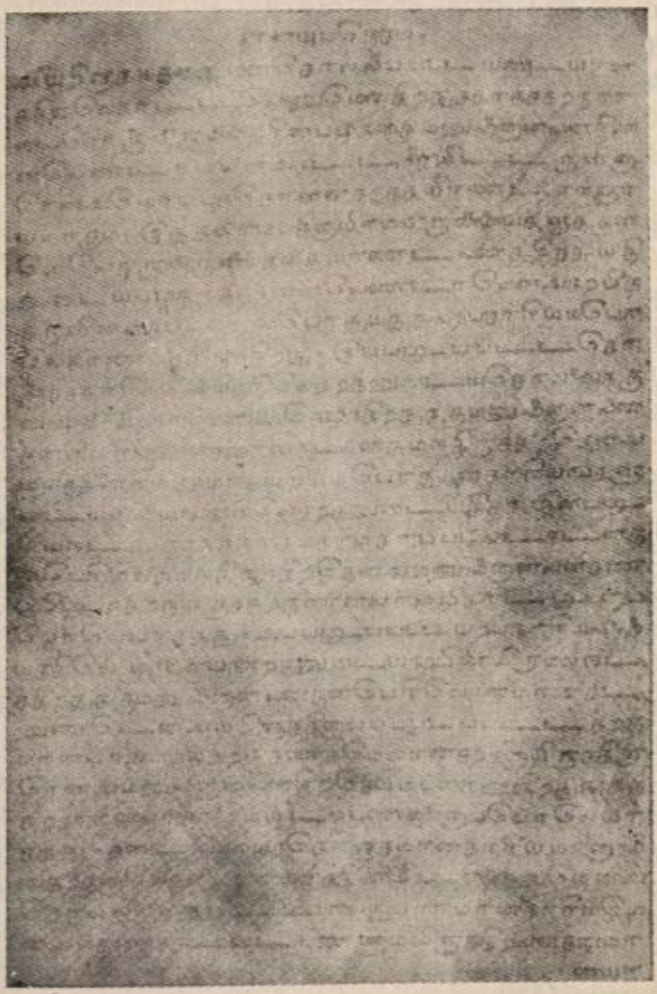


Fig 4. Page of an early Tamil book

square in appearance. The characteristic slope and more rounded appearance seems to have been introduced by the Dutch East India Company's Press at Colombo. There is a fine quarto volume produced there in 1748, now in the possession of the Diocesan Press in Madras; this shows a very high standard of workmanship. Another excellent piece of printing is in Arndt's *True Christianity*; this was printed at Halle in 1751.

32 Printing in Madras

321 *Diocesan Press*

Printing in Madras started in rather a curious way. In 1761, Sir Eyre Coote captured Pondicherry from the French. He found a printing press and some types in the Governor's house. These were brought to Madras as part of the loot; but the Fort St George Authorities were unable to make use of them as they had no printer. Fabricius, the great Tamil scholar, was then living at Vepery; and the equipment was handed over to him on condition that if at any future time the Company should require any printing done, he would do it for them. This was the commencement of the SPCK Press at Vepery, now known as the Diocesan Press. It can thus claim to be, by many years, the oldest existing press in India. It was at Vepery that Fabricius printed his hymn book, and also his Tamil–English dictionary in 1779. The original wooden press was replaced by an iron lever press in 1826. It is uncertain when Tamil types were first cast in Madras; it must have been somewhere about the beginning of the nineteenth century. A new typeface was cut; it was a great improvement on the typeface cut in Halle. This was used by the SPCK Press upto 1870.

322 *Indian Owned Presses*

Upto 1835, there were few presses in the country owing to the severe restrictions imposed on printing by the East India Company. In that year Sir Charles Metcalfe removed these restrictions; and Indian-owned presses began to be established. By 1863, there were ten such presses in Madras City, printing in Tamil on a small scale. Most of them were set up in family houses and owned in common. Some members of the family worked as printers and the others attended to sales. In 1872, three or four printers had iron presses and some even hot-pressed their sheets. Some books printed by them were of very good workmanship.

323 *Peak Period*

We now come to what may be termed the peak of Tamil printing under the old conditions of hand-cast type and hand presses. The American Mission had set up a press in Broadway; for many years it was under the management of a very fine printer, P R Hunt. About 1850, the question arose of the printing of a new and large Tamil–English dictionary, being prepared by Miron Winslow. It was the biggest venture so far attempted by any press in South India. Hunt was dissatisfied with the existing Tamil typefaces. He taught some of his workmen the difficult art of cutting type-punches by hand, and himself designed a new face. To some extent it followed the lines of that produced at the SPCK Press at Vepery at the beginning of the century. But owing to the reasons given in the preface of the *Dictionary*, it was not completed till 1862. Both composing and printing were of a very high standard and will, even today, stand in comparison with the work of any press in the world. In the middle of the nineteenth century there can have been few productions to equal it.

324 *Type Design Used in Linotype*

A close examination of the Tamil type reveals the fact that, if anything, it is superior to the Roman characters, which were the best imported type of the period. A few years ago, when an expert from the American Linotype Company visited Madras to make enquiries about the most suitable Tamil typeface for reproduction on the linotype machine, it was the unanimous wish of leading Indian printers and scholars that Hunt's designs should be used, a striking tribute to the affection in which they are held a hundred years later. The original punches were therefore sent to America, and in making new matrices the characteristics of the faces were carefully preserved, experts declaring that they could not be improved upon.

325 *Superiority of Tamil Workman*

Today, when people talk about the inferiority of printing done in India, and in their minds attribute it to a lack of ability on the part of the Indian workman to rise to the excellence of his brother craftsmen in Western countries, we can recall with pride that 100 years ago a Madras press was the equal of any press in the world. In the difficult art of cutting punches by hand, Madras workmen were probably superior.

4 First Printing in Bombay

In 1670, the first attempt to establish a printing press in Bombay appears to have been made. In that year the Council of Bombay wrote to the Directors of the East India Company: "Pimgee (Bhimji) Parrack (Parakh) makes his humble request to you that you would please to send out an able printer to Bombay, for that he notes a curiosity and

earnest inclination to have some of the Brahminy writings in print, and for the said printer's encouragement he is willing to allow him £ 50 sterling a year for three years and also to be at the charge of tools and instruments necessary for him. And in case that will not be sufficient, he humbly refers it to your prudence to agree with the said printer according as you shall see good, and promises to allow what you shall order. It is not improbable that this curiosity of his may tend to a common good, and by the industry of some searching spirits produce discoveries out of those or other ancient manuscripts of these parts which may be useful or at least grateful to posterity." The Court of Directors thereupon engaged Henry as "Printer for the Island of Bombay and despatched him from London in one of their ships" with a printing press, type, and a considerable quantity of paper. On his arrival in 1674, Bhimji was disappointed to find that Hill, albeit an expert printer, was not a founder and was quite unable "to cut the Banian letters"; and he therefore wrote once again to the Court of Directors, who replied by sending out a type-founder in 1678.

Apart from this, there is no other record about the press, which is believed to have been established in 1674. In 1780, a calendar is said to have been published. In 1793, a book of 164 pages was published with the following title:

"Remarks and Occurrences of Mr Henry Becher, during his imprisonment of two years and a half in the Dominions of Tippoo Sultan, from whence he made his escape."

The author of this book claimed in his introduction that this was the first regular book printed in Bombay. A copy of it is available in St Xavier's College. It was picked up from a second hand book shop.

5 Printing in Devanagari

The first attempt to cut punches for Devanagari types in India was made in 1785 by Charles Wilkins, Librarian of the East India Company. When he returned to England he prepared types, punches, and matrices. With them he printed his Sanskrit Grammar in 1808, to teach Oriental languages at the East India College at Hertford. A copy of this book is in the Royal Asiatic Society Library in Bombay. In his introduction to this book, Wilkins writes: "I cut letters in steel, made matrices and moulds, and cast from them a fount of types of Devanagari characters, all with my own hands, and with the assistance of such mechanics as a country villager could afford, I very speedily prepared all the other implements of printing in my own dwelling house; for by the 2 of the May of the same year, I had taken proofs of sixteen pages, differing little from those now exhibited in the first two sheets. Till 2 o'clock on that everything I had succeeded to my expectations; when, alas! the premises were discovered to be in flames, which spreading too rapidly to be extinguished, the whole building was presently burnt to the ground. Greatest part of punches and matrices was saved but types were ruined."

Colebrook's *Sanskrit grammar* was printed in Calcutta in 1805 at the East India Office, to teach Indian languages to servants of the East India Company

6 Printing in Marathi

The first book in Marathi was printed in 1807. It was a grammar book. Then followed the *Bible* in 1807. Next to that came a Marathi-English dictionary printed in 1810. All these are in Modi characters. Nana Phadnis of Poona printed the *Gita* in 1805 for presenting to learned Brahmins. The American machine press founded in Bombay in 1816 had

only a single fount on Marathi type. Early in the nineteenth century, Sarfoji Raja of Tanjore established a printing press to publish Marathi books on various subjects. A Marathi translation of Aesop's *Fables* entitled *Balabodha muktavali* was printed in this press in 1805.

7 Printing in Gujarati

Byramjee Jeejeebhai Chapgar produced Gujarathi type in Bombay in 1797. Drummond's *Illustrations of the grammatical parts of the Guzerattea Mahratta and English languages* was the first book to be printed in Bombay in 1808 in Gujarathi characters. The first Gujarathi press was set up in Bombay in 1812 by Mobed Fardunji. He himself cast letters. This later became the Mumbay Samachar Press. The first Gujarathi Panchang (= Almanac) was issued from this press in 1814. In 1815, a Gujarathi translation of *Dahistan* was printed by Fardunji.

8 Printing in Other Indian Languages

81 Printing in Bengali

A few Bengali books were printed in Roman script at Lisbon in 1743. Charles Wilkins of the East India Company was the pioneer in casting types in Bengali alphabet. About the end of the eighteenth century a number of printing presses were established at Calcutta. The first book to be printed in Bengali was a grammar by N B Halhed. It was printed at Hoogly in 1778. The East India Company itself established a press in Calcutta in 1792. In 1800, William Carey established his printing press at Serampore.

82 Carey's Contribution

In 1801, Carey was appointed as Professor at Fort William College in Calcutta. This new appointment induced him

to print books in several Indian languages apart from Bengali — Assamese, Gujarathi, Hindi, Kannada, Marathi, Nepalese, and Telugu. He is also said to have printed books in Burmese and Persian. It is also claimed that the Serampore Mission prepared the first movable metal types of Chinese character.

83 Printing in Kannada

The first book in Kannada is said to have been printed in a press in Madras in 1820. Some were later printed also in Serampore Press. However, Christian Missionaries of Bangalore, Bellary, and Mangalore established the press in Karnataka itself. The Kannada type is said to have been designed by one Ananthacharya belonging to the blacksmith community in Mangalore.

CHAPTER GL

PRESENT AND FUTURE OF PRINTING IN INDIA

1 Number of Printing Presses

Today there are nearly 1,500 printing presses in India. But this is too small a number to meet the printing requirements of the India of today. For, a book has now to wait in queue for nearly two or three years to get its chance to be printed. It is so in spite of literacy being only about 30 per cent. The difficulty will increase at a rapid rate as illiteracy is liquidated. Here is a measure of this rapid rate. In the Madras State, as against less than 500,000 books being used by the people annually before Independence, 20,000,000 books are being used annually today. It is in the interest of our social well-being that the book-hungry people should be fed adequately. The number of printing presses needed in India about a generation from now may have to run to a few thousands. For, if India is to benefit by its political independence, it must be able to produce plenty of books on current thought in all the Indian languages in an attractive form.

2 Machinery for Printing Trade

We are now depending entirely on imported composing machines, printing machines, and even printer's ink. Our foreign exchange will not allow increasing import of all these commodities. Further, imported materials would increase the cost of production. We should, therefore, make our own machinery and other commodities needed in printing.

3 Design of Letters for Printing

To attract people to the use of books — particularly the lower half in the intellectual scale — books must be made

attractive. The attractiveness of an open double page of a book depends upon the proportion of white and black. This is a matter for the printer in charge of the imposition. What is equally important is the beauty of the individual letters, which would naturally depend upon its basic design. For the same basic design, we should also have types of different sizes, and of styles, such as light, medium, and bold, depending on the weight or the blackness of the typeface, and on the width, such as condensed, medium, and expanded, depending on the width of the typeface, and of different shapes such as italics. There is much to improve in the basic design of the letters in each of the Indian scripts. Improvement in these matters no doubt comes often from the enterprise and imagination of a gifted individual. But this is casual. It does not always have a direct positive correlation to the needs of the day. India is now in the midst of an outburst of renascence after a few centuries of cultural exhaustion. It is, therefore, in an expanding phase. To meet the present situation, we cannot totally depend on the off-chance of a man of genius appearing spontaneously. On the other hand, we should base the improvement of our typefaces on deliberate research. For this purpose, there should be a Printing Research Institute for each script of India, for the design of typeface, and the adaptation of the script to machine setting. The barrier to machine setting is set by the number of channels that the machine can provide — one for the matrixes of each letter. In the Indian scripts we have consonant-vowel combination and conjunct consonants. This increases the number of channels required to more than what is convenient. Therefore, the Linguists and the Type Designers in the Research Institute should work in collaboration to reduce the number of channels in the type-setting machine. In the initial stages, the Government should give financial assistance to these Printing Research Institutes. In 1960, a Committee on this subject

was appointed by the Secretary of the Union Ministry for Works. In that Committee, I stressed the need for research along these lines. But I have not yet heard that any action has been taken at all in the matter.

4 Uniform Script

In this connection, the Printing Research Institutes for the different scripts should also work together and endeavour to arrive at an agreed single script for all the Indian languages. The sentimental forces set by tradition and the political forces emanating from them should be got over, in a statesman-like way, in the interest of reducing the cost of making matrixes for typefaces and also for removing one removable hurdle in the way of the people of one language learning to read other languages. Western countries have benefited a good deal in this way, as a result of the Roman script being used by several languages. The present generation of adults should not over-emphasise the inconvenience likely to be felt by them by change in script, forgetting that the new generation will have no such inconvenience as they will learn only the single new script. If it is found absolutely necessary, as a transitory measure, books may be printed with the text in the two scripts inter-lineared. There will be extra cost only in the transitory period; and we cannot have any useful reform without paying for it.

5 Leap Ahead

The message of Law 2 of Library Science to India in respect of Physical Bibliography is: "Leap ahead. Be quick. Do not make renascent India, which has come back to life very late in the day, foot through every stage in printing through which the already developed countries had gone. Your population is vast enough to make the latest large-scale-producing printing machinery economical. For illustrations pool

together the resources of all the constituent States, make the same blocks go round to books in the diverse Indian languages, skip through the laborious hand composition, and even machine composition. Adopt straightaway the versatile photo composition. Do not go after the printing machines, rapidly getting outmoded. Go in for the latest double offset machine, eliminating the impression cylinder. This may mean training your young men in the latest phase of printing technique. This will also mean that the National Planning Commission should show greater awareness than it does at present to the important work of book production to the full satisfaction of all the Laws of Library Science. Then only, India can derive the greatest possible benefit from the hard-won Independence. Then only, will its human resources be cultivated at the right speed. And then only will her natural resources be cultivated with an intensity, necessary to maintain its teeming millions in a happy, healthy, and enlightened condition."

6 Matrix for Photo Composition

We should straightway begin to use Photo Composition. The versatility of computers will allow the formation of consonant-vowel combinations and even conjunct consonants to be straightaway put on the film, without a separate matrix for each of them. The matrix for each basic letter and for each of the attachments to it would prove sufficient. A team of linguists, artists, and engineers should work together in arriving at the minimum number of different matrixes to be designed and produced. Again, there is no need for matrixes of different sizes for one and the same letter. For, the photo composing machine can produce letters of different sizes — say from 5 point to 16 point or even more — with one and the same matrix.

PART H

TYPE FOR PRINTING

CHAPTER HA

TYPE-CASTING

1 Type

Type (for printing) is a piece of metal or other substance cast in relief for use in the composition of printed matter. It is made of "Type Metal" — an alloy of lead, antimony, tin, and some little copper. It is the end-product of a series of operations.

2 Pantograph

Pantograph is a machine used in making a type. By adjusting it, any motion made at its lower end can be reproduced at the upper end in an identical manner, but on a vastly reduced scale to any proportion. The artist draws the letter on a large scale — nine or ten inches in depth. A reduced negative of it is made photographically. The photograph is printed down on a brass plate. This is placed on the pantograph.

3 Punch

The 'Punch' is a steel piece at the upper end of the pantograph. The letter cut on it in relief in the reverse; it is 'Negative'. It is then hardened, justified, and trimmed.

4 Matrix

The punch used to stamp the matrix is a piece of copper. The matrix is then fixed in a type-body. The matrix is Positive.

5 Casting

The matrix forms the mould from which the type is cast. The type is cast from the matrix. The type is Negative. Of course, the print will be Positive.

CHAPTER HB

ANATOMY OF THE TYPE

1 Parts of Type

The body height of all types is the same — about nine-tenths of an inch — so that the face will stand up in relief and take the ink, make an even surface, and give a consistent impression on paper. The accompanying diagram shows the parts of a type.

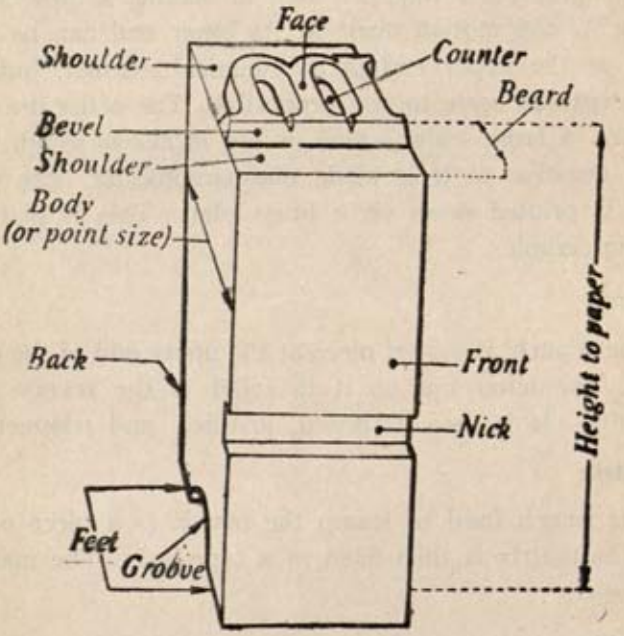


Fig 5. Type : Parts

The following five main parts may be recognised:

1 Type-Face. — The entire printing surface in the design of a unit-sybol — letter, numeral, or any other — used in combination for printing;

2 Shoulder. — Blank space on the top surface of a type, around the type-face;

3 Beard. — The space from the bottom of the letter to the front of the Body;

4 Body. — The stem forming the pedestal for the faces; and

5 Feet. — The two projections at the base of the body giving rise to a groove in between them.

2 Features of the Body

The Body is precisely rectangular in section. This admits of types being set side by side and tied together rigidly. The following features of the Body may be recognised:

1 Belly. — The front surface of the Body;

2 Back. — The back surface of the Body, parallel to the Belly;

3 Sides. — The other two vertical sides of the Body; and

4 Nick. — The groove or a set of grooves across the Body. Each size in a type-series has a distinctive form of nick. This is of vital importance to the compositor.

CHAPTER HC

TYPE-SIZE AND MEASUREMENT

1 Type-Size

Type-Size is the distance between the belly and the back of the Body.

2 Point as Unit of Measurement

The unit used to measure type-size is 1/72 of an inch. It is called a 'Point'. Formerly different type-sizes had different conventional names. The following table indicates the common sizes of types with their conventional names and type-size in points.

Modern name	Old name	Modern name	Old name
5 points	Pearl	12 points	Pica
6 points	Non-pareil	14 points	English
7 points	Minion	18 points	Great Primer
8 points	Brevier	22 points	Double Pica
9 points	Bourgeois	24 points	Two-line Pica
10 points	Long-Primer	28 points	Two-line English
11 points	Small Pica	48 points	Canon

3 Set-Measure

Set-Measure is the distance between the sides of the Body. It will vary with the letter. It will be least in the letter "i."

It will be greatest in the letter "M"; here it is equal to type-size.

4 Em

Therefore, 'Em' is the term used to denote type-size when it is used as the unit to measure the length of a composed line.

5 Height

The heights of the types differ from country to country. The American and British standards are 0.918 inch. Several countries in Europe use the standard 0.928 inch. What is called on the Median standard used in Belgium is 0.934 inch.

CHAPTER HD

ANATOMY OF TYPEFACE

1 Structural Elements

The individuality of the typeface of a letter is no doubt unanalysable. And yet there are many structural elements in the form of a letter — that is, in the form of its typeface. Some of these are Serif, Hook, Loop, Ascender, Descender, Cross Strike, Hair Line, and Curve.

2 Schematic Diagram of Structure

The following schematic diagram shows the chief structural elements in a typeface:



Fig 6. Type face: Structural elements

The above diagram and the glossary of terms given in the next section are taken from the British Standard 2961: 1958.

3 Glossary of Terms

31 Serif. — A light line or stroke crossing or projecting from the end of a main line or stroke of a letter.

32 Base Line. — That line on which the bottom serifs of the capitals and of such lower case letters as x, m, etc seem to rest. The position of the line is reckoned in terms of its

distance from the top of the ascenders or, in the case of metal type, by its distance from the back of the type.

33 Ascender. — That part of the vertical stroke of a lower case letter which rises above the x-line (that is, the line indicated by the top of the lower case x).

34 Descender. — That part of the vertical stroke of a lower case letter which descends below the base line.

35 Extruder. — A generic term denoting both ascender and descender.

36 Logotype. — This term refers to the physical type and indicates a group of letters on one body.

eg. dh gh kh Th

37 Ligature. — This term refers to the image and indicates a joining stroke which connects any two letters.

eg. ff fi fl ffi ffl æ œ

CHAPTER HE

STYLE AND OTHER QUALITIES OF TYPEFACE

1 Grace of Typeface

The grace of a letter is determined not only by the grace of each of its structural elements, but with even more emphasis, by the manner of combination of their variants to form a letter.

2 Glossary of Terms

This glossary of terms is taken from the British Standard 2961: 1958.

21 Weight. — The degree of blackness of a typeface. The relative weights should be known as:

Extra-light	Semi-bold
Light	Bold
Semi-light	Extra-bold
Medium	Ultra-bold

By 'Medium' weight is meant the weight which the manufacturer puts forward under the titular name of the family as representing the design in that normal weight from which variants in the family have been or may be derived. The term is used here only to distinguish the 'Medium' from the variant series.

22 Width. — The relative widths of typefaces should be known as:

Ultra-condensed	Semi-expanded
Extra-condensed	Expanded
Condensed	Extra-expanded
Semi-condensed	Ultra-expanded
Medium	

By 'Medium' width is meant the width which the manufacturer puts forward under the titular name of the family as

representing the design in that normal width from which variants in the family have been or may be derived. The term is used here only to distinguish the 'Medium' from the variant series.

Note. — Weight and width. — The terms recommended for use in describing the weight and width of a typeface have been selected to provide a logical scheme. They do not represent any absolute concept but are solely relative to the weight or width of the 'Medium' typeface.

In practice it is unlikely that all the weights or widths listed will be applicable to any single typeface family; but it is recommended that any manufacturer introducing new typefaces should give careful consideration to the term he selects to describe weight or width. It is strongly recommended that the words 'heavy' and 'Clarendon' should not be used in relation to the weight of typefaces.

23 Height. — The relative height allowed for that part of the lower case fount from the base line to the top of the lower case x. This affects the relative legibility of the fount size for size. This term is recommended in preference to 'appearing size'. The terms 'small x', 'large x', and 'medium x' are acceptable for the purposes of comparison.

24 Titling. — A fount of capitals with little or no space below the base line (*See* Fig 1 in Sec HD2).

25 Inline. — A typeface with a white line drawn on its strokes.

26 Outline. — A typeface in which continuous line of more or less consistent width encloses the shape of the character.

27 Shadow.—A typeface creating a three-dimensional effect.

28 Engraved. — A typeface, with or without an outline, cross-hatching, ruling, or any other pattern as an essential feature.

291 Latin. — The use of this word for a kind of display letter characterized by wedge-shaped serifs is deprecated and the term should be used to distinguish the letter-forms used in Western Europe from others, such as Cyrillic and Arabic. These others are referred to in the industry as 'exotics' but would be more conveniently referred to as 'non-Latin'.

292 Roman. — The group of alphabets in the printers' fount distinguished from italics by verticality and the shape of certain lower case letters.

293 Italic. — The lower case and its accompanying capitals which is used as subsidiary in the printers' fount and is distinguished by the slope and, in the case of lower case letters, by the shape of certain letters.

294 Monoline. — Any typeface in which all parts of the letter are apparently of equal thickness. Most sans-serifs and Egyptians are monoline.

295 Sans-serif. — A typeface, generally but not necessarily monoline, designed without serifs (*See* Fig 1 in Sec HD2).

296 Egyptian. — A typeface, generally, but not necessarily monoline, in which the serifs (*See* Fig 1 Sec HD2) are abnormally thick and squared off.

CHAPTER HF

DESIGN OF TYPEFACE

1 Introduction

It will take us beyond the province of Physical Bibliography for Librarians, if we go into further details. The creation of a letter for use in typeface is a matter of art. Geometry of shape and structure can only help us to appreciate the way in which these have been handled by the artist to produce the total effect on the reader. A knowledge of these elements will be of help in designing experiments to study the effect of typeface on men of the lower quartiles, who have to be attracted and retained as habitual readers. The librarian has unusual opportunities to observe and report to the type-design artists. He should observe and report intelligently. This defines the role of the library profession in Physical Bibliography.

2 Original Ancestor

We say that all men had descended from the same ancestors — Adam and Eve, as the Bible puts it — and yet no two faces are alike. So also it is true, though not to the same extent, that all typefaces have descended from the same ancestors although they all differ from one another. The original ancestor was the written letter of pre-printing days. When Gutenberg cut his first punches, he faithfully copied the written letter of his day. It was of the ornamental Gothic variety. This did not stand in the way of the select intellectuals who alone were literates and whose attraction to a book depended on their attraction to its subject and did not lean, for its continuance, on the aesthetics of the printed word.

3 Variation from Ancestor

But as Law 2 began to draw readers from lower intellectual strata, Law 3 persuaded Physical Bibliography towards a plain but inviting kind of typeface which will retain the custom of every reader, without inducing undue strain on him in pouring through dozens of printed lines. The social pressure of Law 2 and Law 3 has been ever active. Many typefaces came to be designed decade after decade. And now that universal literacy is extending the potential region of readers even to the lowest intellectual levels, new typefaces are being designed almost every year. This has become literally true in our own days. This is being done by subtle variations in the anatomical details of the letter.

4 Illustrative Table of Design

Year	Name	Country	Year	Name	Country
1470	Cloister	Italy	1931	Baton (More for display)	Germany
1540	Garamond	France	1932	Weiss	Germany
1734	Caslon	Great Britain		Perpetua	America
1757	Basker ville	Great Britain	1934	Deepdene	America
1768	Bodoni	Italy	1935	Electra	America
1810	Scotch	Great Britain	1936	Egmont	Holland
	Walbaum	Germany	1937	Electra	America
1852	Bookman	Great Britain	1938	Stradi-varius	Hungary
1900	Century expanded	(Children's books)	1939	Caladonia	America
8911	Kennerly	America	1141	Farefield	America
1912	Medieval	Holland	1942	Cornell	America
1916	Goudy	America	1946	Studio	Holland
			1952	De Roos	Holland

5 Glossary of Terms

This glossary is taken from the British Standard 2961: 1958.

51 Family. — A group of series all derived from one basic design and emanating from the same manufacturer. Such a group is classified under one family name. But its members may vary by weight, width, or other special treatment.

52 Series. — A typeface exemplified by one or more sizes, which can be identified by name and/or number as emanating from a specific manufacturer.

53 Fount. — An adequate collection of matrices or types of the same family, series, size, and alignment.

CHAPTER HG

AUXILIARIES

1 Kinds of Auxiliaries

Auxiliaries, which go with types, are

1 Punctuation marks;

2 Spaces or materials of less than type-height used for providing space between words; and

3 Leads or materials of less than type-height used for providing space between lines.

2 Sizes of Spaces

The Unit of Measurement for the thickness of spaces is an 'Em', which is equal to the size of the type.

1 Hair space is 8 to 12 to the em;

2 Thin space is 5 to the em;

3 Medium space is 4 to the em;

4 Thick space is 3 to the em;

5 Quad is a piece of metal similar to spaces, but much broader so that about half a dozen will fill an ordinary line; and

6 Em-quad or square space is a space whose thickness is an em.

3 Sizes of Lead

Leads are chiefly made in four thicknesses: 1, $1\frac{1}{2}$, 2 and 3 points respectively. Leads are available in lengths of 18 or 24 inches.

CHAPTER HH

CASE

1 Two Trays

Types are contained in two large trays resting at an angle, one behind and above the other mounted on a frame. Each of these trays is called a Case.

2 Lower Case

The trays are divided into numerous small receptacles. Each of these receptacles contains a different letter. Every small letter of the alphabet, spaces, and lines are contained in the lower case. That is why the small letter is caled Lower Case. The small letters are arranged in a manner similar to that employed in the typewriter key board, that is, letters required most often are placed close to one another, in a position from where they can be easily picked out.

3 Upper Case

The capitals and figures of numbers are contained in the upper cases. The capitals are arranged in the alphabetical sequence.

PART J

TECHNOLOGY OF PRINTING SURFACE

CHAPTER JA

PRINTING SURFACE

1 Four Kinds of Printing Surface

The term 'Printing Surface' is used to denote the surface from which impression is to be taken on paper. There are four possible kinds of printing surface.

2 Surface for Relief Printing

The surface for Relief Printing is made of metallic typefaces standing out in relief above the surrounding parts. Ink covers only the typefaces. This surface has been used for a long time and is even now largely used.

3 Surface for Gravure Printing

In the surface for Gravure Printing, the matter to be printed is in the form of shallow recess in a plate. Ink of low viscosity is flowed into the recess and the surface of the plate is wiped free of ink. This is used for very fine printing in small quantities (*See* Chap LG).

4 Surface for Litho Printing

For Litho Printing, the matter to be printed is written on a certain calcareous stone or specially prepared metal surface. This has been used largely for printing in Semetic scripts (*See also* Chap LD).

5 Surface for Offset Printing

In Offset Printing, the ink is not taken by the paper directly from the letter press or the gravure plate or the litho stone, but only through an intermediate surface. The surface for Offset Printing is also prepared nowadays by Photo Composition (*See also* Chap LE).

CHAPTER JB

HAND COMPOSITION

1 Composition

'Composition' is the setting up or the assembling of the types as for the text. The publisher and the printer settle the types to be used, the number of lines in a page, whether leaded or solid, the length of the lines, and so forth. 'Compositor' is one who composes types. He does the composition in a small shallow tray called the 'Stick'. It has a handle. It can hold about 11 or 12 lines of 12 point types. It is provided with a Cross Strip screwed to the required length of line before composition begins. The compositor holds the stick in his left hand, picks out the types one at a time with his right hand, and inserts them in the Stick beginning from the left side. He does not use his eyes in picking out the types nor in putting the type in the right way. By feeling with his fingers, he puts the type with the nick away from him. He composes over 1,000 types per hour — too fast to follow the movements of his hand.

2 Justification

As setting proceeds, the compositor so puts thick spaces between words that the printed matter of a line ends evenly. For this, he has invariably to decide when approaching the end of the line whether to

1 Increase the spacing between the words or decrease it in order to get the last word in; or

2 Divide the last word.

Real skill is needed to space the line so that the spacing shall appear — but need not really be — equal between the

printed words. This is called 'Justification'. Ends of paragraphs are filled up by long spaces.

3 Leading

Leads of approved thickness are inserted between lines. When lines are not separated by leads, the matter is said to be 'Set Solid'. Types are also specially cast on a larger body — such as 10 point type in 12 point body. This produces the effect of leading without the insertion of leads.

CHAPTER JC

LINOTYPE COMPOSITION

1 Machine Composition 1

Linotype is one of the machines for composition. This machine consists of two parts. One part is the composing machine; it composes matrixes by keyboard operation. The second part is the casting machine; the caster is at the end of the machine. It consists of equipment for melting lead for pumping the molten metal into the matrixes. Linotype composition is thus 'Hot-Metal Composition'.

2 Slug

The Linotype Machine composes one line at a time. There are twenty (or more for some letters) matrixes of every letter, contained one behind another, each in its own narrow channel. The set of channels is called 'Magazine'. By pressing a key in the keyboard, one of the corresponding matrixes is lifted up and brought into position in the Line. When the Line is finished, the line of matrixes is brought in front of a Mould, by pressing a lever. Then molten type-metal is pumped into the Mould. This gives a cast of the whole line. Thereafter, each matrix in the line is put back automatically into its channel in the magazine. The finished line of type is called 'Slug'. It is delivered into a brass tray and passed on from it into the galley. Further stages of work are as in hand-composition.

3 Advantage

With the aid of about twenty matrixes for each letter, it is now possible to set up a book requiring thousands of types in hand-composition. Line-composition is about ten times as

fast as hand-composition. A one-piece line is easier to handle than a line composed of twenty or more pieces. The typeface is always new. There is no re-distribution of types and therefore no Foul will arise. Since the same type is not used over and over again, no broken type will arise. After the printing is over, the Slug is melted and cleaned. The type-metal is again ready for casting.

4 Disadvantage

If any correction is to be made in a line, the whole line will have to be re-composed. If the correction shortens or lengthens a line, not only that line but also several of the neighbouring lines will have to be recomposed in order to secure justification. The matrixes should be replaced as and when they get worn out.

5 Field of Use

The Linotype machine is now universally used for printing newspapers, though it is now being threatened by the Photo Composition machine. A Linotype machine is usually used only for types ranging from 4 to 14 points in size. It usually carries only two styles of type — Roman and either bold or italics. In other words, Linotype matrixes are two-letter matrixes. Extra trouble and expenses are involved in setting small capital letters by Linotype. In order to change from one family or size of typeface to another, the Magazine itself will have to be changed.

CHAPTER JD

MONOTYPE COMPOSITION

1 Composition

Monotype Composition involves two machines — the Keyboarding Machine and the Casting Machine. The first has a keyboard as in a typewriter. By pressing the keyboard the operator punches out on a spool of paper tape fed from the Paper-Tower. The combinations of holes represent the letters, punctuation marks, and spaces; they translate the press copy into a machine readable language. After the spool is finished, it is passed on to the casting room. The Die-Case of the appropriate font is selected. It is a small square of steel in which are sunk brass matrixes. The spool is fixed in a paper-tower. From there, it rolls itself over an air-pressure bar. The blast from it passes through the holes punched in the spool and sets the die-case in motion. This brings the appropriate matrix over the flow of molten typemetal. Thus, monotype composition is hot metal composition. In this system, single letters are cast. Therefore, this is called Monotype Composition. Each letter is arranged in its line in the galley one by one. The galley is moved up as soon as each line is completed. The entire process is automatic. Further stages of work are as in hand-composition.

2 Advantage

The method has all the advantages of line composition. There are also some additional advantages. Justification of line is mechanised. Proof correction does not involve resetting of entire lines. Spools can be preserved and used for further editions. Monotype composition is now largely used for books and periodicals.

CHAPTER JE

PHOTO COMPOSITION

1 Photronography

Here is the picture conjured by Daniel Melcher in his *New development in printing: A progress report (Publisher's weekly,* V161, 5; 2 Feb 1952). No metallic types, no composition, no plates, and no wet ink, but more than thrice the present speed of production. We shall call it 'Photronography'. This method was developed by William C Huebner and the Standard Register Company of US.

11 Ink Powder

In this method, ink is replaced by dry, finely divided, ink-powder. Pressure is not used in the traditional way to transfer ink from type to paper. There is no contact between plate and paper. In fact, there is a gap of about one thousandth of an inch between them.

12 Composition

The composing machine is a keyboard machine. Alphabets are arranged in the form of images on film. They can be simultaneously focussed through lenses on to a receiving surface. The appropriate letter is unmasked by keyboard action so as to project its image. Justification is automatic.

13 Printing

The plates are thus nothing more than photographic negatives or positives fixed to transparent cylinders. A light shines through a slot behind the film to drive ionized "smoke" particle into the paper and create the image. The image is in-

tensified by electronic means to the point where it will then smoke on to the paper in sharp outline.

14 Film-Belt

The film, from which a book is to be printed, will be made in the form of an endless belt of variable length. Whatever be the length of the book, the entire volume can be printed with one circuit of the belt. Reel of paper is used. Folding is done by a part of the printing machine. Gathering of sheets will thus be eliminated.

15 Self-Made Paper

It is even conjectured that the printing machine may be expected to make its own paper. The printer will have simply to dump a bale of fibre at one end of his machine, turn a few dials and feed his press with freshly made paper of any weight, thickness, finish or colour, and in any desired reel-width! It will take the smoke ejected by pressing the keyboard of the composing part of the machine.

2 Film Setting

Film Setting involves two machines — the Keyboarding Machine and the Filming Machine. As in monotype, the work on these two machines can be done independently at different places and time. It is advantageous to do so. For, the speed of work with the second machine is many times greater than that with the first machine. Work with the Keyboarding Machine in Film Setting is similar to that in Monotype setting.

3 Filming Machine

The Filming Machine in Photo Composition corresponds to the Casting Machine in Monotype Composition. The former by-passes the use of metal types. By photographic process, it gets on a film strip the image of each character of the press-

copy directly from its matrix. Here follows a description of one kind of Filming Machine.

4 Parts of Filming Machine

The Filming Machine consists essentially of five parts:

1 Memory unit;
2 Film matrix case;
3 Electrical control system;
4 Photographic unit; and
5 Stripping unit.

41 Memory Unit

The punched tape received from the Keyboarding Machine forms the Memory Unit. It has 21 channels of perforation. The tape carries also signals such as character-delete, character-fill, and justification.

42 Film Matrix Case

A Film Matrix is essentially a tiny photographic negative with the transparent character on a black opaque ground. It is held in a protective plastic carrier. Usually, there are 272 characters, superiors, and inferiors, for printing in Roman script. These are kept in a Matrix Case in 16 rows of 17 matrixes each. All of them are separate and any one of them can be changed independently.

43 Optical Unit

In the Optical Unit, the following are arranged in series:

1 Lamp;
2 Condenser lens;
3 Film matrix case;
4 Shutter;
5 Tilting optical flat;
6 Focussing lens, prisms, and mirrors; and
7 Film drum.

The punched tape and the air tower set the Optical Unit into operation. Accurate synchronisation of the various operations is of the very essence. The unit of time to be used is a

micro second. The synchronisation is therefore regulated by an electrical system. The optical system can produce the character image to any desired size from 6 to 72 points, with only a single 8 point size film matrix. It can also produce bold face with the film matrix in Roman.

5 Film Make-Up and Proof Correction

The film first undergoes darkroom processing. The processed film is then made up into pages. The processed films of illustrations are also inserted in their appropriate places at the make-up stage. Proof correction is rather expensive. Therefore, it is usual to send to the author galleys with the house-correction. After the author makes his own corrections, all the corrections are carried out in one process.

6 Offset Plate

From the corrected film make-up, offset plates are made for printing. From here on, Photo Composition does not require anything special.

7 Advantages

Some of the advantages of Photo Composition are: A variety of type sizes from a single fount, greater variety of characters within a fount, quicker change of founts, better fit between characters, no need to store large quantities of type metal, no risk of losing or running out of certain characters, and capacity to set wider lines and to place any superior over any character and of any inferior below it. The last-mentioned capacity will simplify composition in Indian scripts.

8 Disadvantages

Photo Composition introduces some new problems of its own — notably the problem of making corrections, for which entirely new techniques have to be worked out.

CHAPTER JF

GALLEY PROOF

1 Clean Proof

As soon as the Stick is nearly full, the compositor slides the lines from it, on to a larger tray called 'Galley'. A Galley is an iron tray normally of a size to hold three octavo pages. The standing type arranged in a galley is called 'Matter'. The Matter is secured on a hand-press kept for the purpose; and a proof is taken or "Pulled." The proofs are read by "Readers." After the corrections indicated by the Readers are carried out, a clean proof goes to the author. The author should make all his corrections at the Galley Stage.

2 Proof Correction

The table on pages 238-9 indicates the common symbols used in proof correction.

Detailed examples for proof correction are given in the *Indian standard: Proof corrections for printers and authors* (IS: 1250–1958), 21 pages.

The Documentation Sectional Committee of the Indian Standards Institution has also formulated a standard for the proof correction of illustrations.

Marginal mark	Meaning	Marks in the text
Read - See Copy	Insert omitted portion of copy	Caret mark in the required position
⊙/	Insert full point	" "
,/	Insert comma	" "
⊙/	Insert colon	" "
;/	Insert semicolon	" "
-/	Insert hyphen	" "
?/	Insert interrogation mark	" "
em/	Insert one-em rule	" "
!/	Insert exclamation mark	" "
'/	Insert apostrophe	" "
x/	Insert superior figure	" "
2/	Insert inferior figure	" "
"/	Insert quotation marks	" "
⊙/	Insert a three-dot leader	" "
/⊙	Insert a slant stroke	" "
[/]/	Insert square brackets	" "
(/)/	Insert circular brackets	" "
#/	Insert space	" "
Caps/	Change to capital letters	Three lines under the letters or the words to be altered
Sm Caps/	Change to small capitals	Two lines under the letters or the words to be altered
Cap & Sm Caps/	Use capital letters for initial letters and small capitals for remainder of words	Three lines under the initial letters and two lines under the remainder of the words
l.c./	Change to lower case	Encircling the letters to be changed

Marginal mark	Meaning	Marks in the text
b.f./	Change to black face	Wavy line under the letters or the words to be altered
itals/	Change to italics	Line under the letters or the words to be altered
Rom/	Change to roman type	Encircling the words to be altered
w.f./	Wrong fount—replace by letter of correct fount	Encircling the letter to be altered
⊙/	Inverted type	" "
×/	Broken letter—replace by undamaged character	" "
eq #/	Make spacing equal	between words
less #/	Reduce space	between words
trs	Transpose the order of letters or words	between letters or words (numbering when necessary)
□/	Indent one em	
‖/	Correct the vertical alignment	As marginal mark
=/	Straighten lines	As marginal mark, drawn through lines to be straightened
⌀/	Delete (take out)	Striking through words or letters to be taken out
⌀/	Delete and close up	Striking through and place above and below words or letters to be taken out
stet	Leave as printed	Dots under the letters or the words which are to remain

CHAPTER JG

IMPOSITION

1 Transfer of Matter to Stone

After the corrections are carried out in the galley, the matter is passed on to the stoneman for Imposition. The term 'Imposition' denotes putting "in position." The stoneman transfers the matter to the Stone. It is a table whose top is of smooth metal. While still in the Galley, the type is divided and arranged into page lengths. Each page length of type is tied up with a cord. This allows it to be moved about to a limited extent, without falling to pieces.

2 Make-Up of Forme

The pages are arranged on the Stone into Outer and Inner Formes. Outer Forme is the set of pages to be printed on the Recto of the open sheet of paper. The Inner Forme is the set of pages to be printed on the Verso of the open sheet of paper. The Outer and Inner formes taken together is called a Forme. The arrangement of the pages for a format, so that they will fall in the right sequence and in the right way up, can be worked out by folding the pages as for the format, numbering the pages serially, and then spreading the sheet out. The position as well as the orientation of the pages will then become obvious.

The blocks of any illustration to be printed with the text are inserted at the appropriate places. The pages are now provided with signatures, pagination, and head lines.

21 SIGNATURE

The "Signature" is a small capital letter or numeral placed alphabetically or numerically at the foot of the first page of each sheet (*See* at the foot of this page). The signature is of use in Collating. The term "Collating" denotes checking the correctness of the sequence of the pages of the book. The signature designates the various formes. It is a necessity to the binding department. It is also a convenience for the composing and machine departments. For the preliminary pages, lower case letters in italics are used as signatures.

22 BLACK STEP

A modern style of Signature is known as Black Step method. In this method, a rule about six points thick and 24 points long is placed in the Spine of each forme — that is, between the first and the last pages. In the first forme the rule is positioned opposite to the top line of text. For the next forme the rule is stepped down say 24 points and so on. The Signature in the Black Step method will be covered away at the stage of binding. That is why no signature digit is found in some modern books. The Signature in Black Step method will not therefore be of any use in collating a book after binding.

3 Lock-Up of Formes

After an inner forme or an outer forme is made up, the next process is to convert it, taken as a whole, into a rigid plate. This process is called 'Locking-Up'. The aids used in locking up are:

1 Chase;

2 Furniture; and

3 Quoin.

4 Chase

Chase is a metal frame surrounding the made-up inner or the outer forme. It is made of steel. It is heavy. In a Book-Chase the frame is fitted with two cross bars dividing it into four compartments. These bars give greater strength and accuracy when locking up a number of pages.

5 Furniture

Spacing material 24 points or more in width is called 'Furniture'. It is made of wood, cast iron, steel, or plastics. When making up large blanks, Furniture will add too much to the weight and it will undergo too much strain. It is therefore usual to use hollow Furniture. Hollow Furniture is called 'Quotations'. The Furniture is used to fill up the spaces between the pages and the chase and between the pages themselves.

6 Quoin

The Furniture employed to fill up the chase is Locked-Up by the insertion and Driving Home of Quoins. These are metal devices used to exert lateral pressure on the type within the chase. They are either wedge-shaped or of the expanding variety. After the driving home of the Quoins, the type is tightly jammed. The types and the Chases and the Furniture become one solid piece. The whole may be safely lifted without the types falling out or even being shaken.

7 Forme-Proof

A proof of the matter in locked forme is then pulled out. It is called Forme-Proof. Strike-order is usually taken on the Forme-Proof. The author should avoid introducing any author-correction at the forme-proof stage. For, this will involve a re-make up of the forme, unless the effect of the correction does not go beyond one page.

CHAPTER JH

PRINTING PLATE

1 Value of Printing Plates

Ordinarily and for small editions, printing is done from the locked-up formes. But for fine printing and for large editions, printing plates are made from locked-up formes. Printing plates are valuable in several ways:

1 To allow the same job to be printed in many different plants at the same time;

2 To save original photo-engravings and types from wearing out in press-runs;

3 To prevent accidental damage which use on the machine would involve.

The following four kinds of printing plates are in use:

1 Stereo-type;
2 Electro-type;
3 Plastic Plate; and
4 Rubber Plate.

2 Stereo-type

Preparing the printing plate for stereo-type is cheap. The moulding material used for stereo-type is called the Flong or Papier Mâché. The Flongs may be Wet or Dry. Flong is composed of alternate layers of tissue and blotting paper fixed together by a special non-inflammable paste. It must be free from air bubbles or other irregularities. The flong is laid tissue-side downwards on the forme and beaten in. The mould so made is light and lasting. It can be stored for any length of time. Type-metal-cast is made from it and mounted on wooden blocks to type-height for printing.

The stereo can also be made in a cylindrical forme. Then it is called 'Rotary Stereo-Type'. This is suitable for production by rotary printing machines. This is now used largely in the production of newspapers. It is easy and cheap to send paper matrixes to other places for printing.

3 Electro-Type

Electro-type is a long and expensive process. The oldest method of electro-type is by wax-moulding. The mould is black-leaded in order to give it a metallic face and increase its electrical conductivity, to assist the growth of the copper shell. It is then inserted into the electroplate bath of copper sulphate solution. The copper shell which is to become the surface of the finished electro-type is allowed to be in the mould until the desired thickness is reached. The thickness can vary according to the run required from the plate. The sheet is then brought to the standard thickness of a printing plate by the addition of suitable metal to the back. Lead moulding is frequently used in place of wax, particularly for electro-plating halftone. It is also adopted for hygienic reasons. For extra-ordinarily long printing runs, nickel shell is deposited or the copper shell is nickel-faced. For still longer runs chromium facing can be done.

4 Plastic Plate

Nowadays plastic plates are used. The trial issue of Unesco *Bulletin for libraries* produced in Delhi by me as the President of the Indian Library Association was printed in September 1951 from plastic plates flown from Paris.

5 Rubber Plate

In making rubber plates, a piece of unvulcanized rubber cut to size is brushed with French chalk and placed upon the

mould. It is then placed under hot hydraulic press for a few minutes to vulcanize the rubber. This is fitted to the flat bed or to the curved cylinder, as the case may be, of the printing machine by means of a special adhesive.

6 Direct Image Offset Plate

For eventual offset printing, the image of a locked forme containing the matter to be printed, both type and halftone areas, is transferred to an aluminium plate. The aluminium plate is about 0.012 inch thick. It is a thin grained plate laminated to an impregnated card stock. The image is transferred to the special aluminium plate by printing with a heat-set thermosetting ink from the locked forme using a typographic press. The inked plate is then put for about five minutes over an oven at about 500°F. The ink thus dried and hardened is the printing area. Halftones with more than 110 lines per inch are not suitable for printing from this kind of plate.

CHAPTER JJ

HIGH-SPEED COMPOSITION AND PRINTING

1 High Speed

In this age of electronics, speed is being measured in terms of milli-seconds, micro-seconds, and nano-seconds. In printing too, such fantastic speeds are being thought of through the elimination of mechanically moving parts of the composing and printing machines. The electronic and photo-optical character generating machines are among the first fruits of the researches in this field.

2 Method of Forming Characters

Broadly, the electronic and photo-optical methods of forming characters are of five kinds: These are:

1 The characters are formed by passing an electronic beam through a stencil-like cut-out in the shape of the character. The cut-out is positioned between an electronic gun and the face of a cathode ray tube.

2 An electronic beam is made to hit a metalised target within a cathode ray tube, on which the characters are printed. This causes a video signal corresponding to the desired character. The signal is amplified and displayed on a separate cathode ray tube face. This method of character-generation is called the monoscope method.

3 A digitised-matrix is generated in which the character selected is represented by a series of intersecting points. The lens of the matrix is displayed on the face of a cathode ray tube.

4 Using an optical tunnel cathode ray tube, a beam is made to scan the character mask placed outside the envelope

of the tube. The mask is larger than the face of the cathode ray tube. The resulting video signal is displayed on the face of a separate cathode ray tube.

5 A flash of light operating behind a rectangular matrix is used for optical generation of characters. The light passing through the matrix is directed on to a film by means of the parallel mirrors, travelling lens, and a suitable electronic timing circuit.

3 Electronic Character Generating Machine

An example of a successful commercial development of electronic character generation with the aid of a computer, is the SC 4020 Highspeed Microfilm Recorder. The machine displays data on the screen of a special cathode ray tube called the Charactron Tube. The data on the face of the tube are projected through an optical system on to a high speed 35 mm camera. Simultaneously, an optical unit records the image on a 24-cm wide photo-recording paper. The rate of composition is about 17,400 characters per second. The characters are formed when a beam from an electronic gun is projected on to a thin metal disk which may have 64 different characters arranged in a 20 × 20 cm matrix cut out as in a stencil. The horizontal and vertical deflection circuits deflect the selected character to the appropriate spot on the cathode ray tube.

4 Photo-Optical Character Generating Machine

The GRACE (= Graphic Arts Composing Equipment) is an example of the photo-optical character generating machine. It is used in the printing of the *Index medicus*. The principal moving parts of the equipment are:

1 A travelling lens system of low weight that traverses the page horizontally, composing the line with each sweep; and

2 The film advance mechanism.

The matrix plates containing the image of the characters are stationary. Each character has its own strobe-light. By means of an optical device, consisting of two parallel mirrors, the characters in a vertical column are directed to a single horizontal base-line. The film is also stationary during the composition of any given line. The flash tubes discharge at a precise time depending on the electronic circuitry, when the travelling lens is in the proper position with respect to the character matrix and optical device. The lens moves and in 0.4 second is in the correct position to project the character. The electronic system takes into account the appropriate escapement for each character, the value of word spaces, the location of each character on the matrix plate, the position of the travelling lens, etc.

5 Electrostatic Printing

51 Method

In electrostatic printing, a visible pattern is produced on paper or other media by the application of an electrical field. Materials, such as Selenium and Zinc Oxide, become photoconductive when exposed to light, but become insulators in the dark. This phenomenon is made use of in the Xerographic process. (*See* Sec QL5).

The Xerographic process can also be used to record characters generated by computers. The images of the characters formed on the screen of the Charactron can be focussed on to a photo-sensitive plate and copies made in the usual xerograph method. This combination gives a composition rate of about 16,600 characters per second.

52 SIGNIFICANCE

The factors of significance arising from electrostatic printing are:

1 The print and the surface to be printed on need not be brought into contact with each other.

2 The print can now be made on surfaces that were a problem heretofore.

3 Full colour copies or pictures can be made just as well and at lesser cost as could be done with the conventional machines and techniques.

6 Videograph

The Electron Beam Scanning method is used in the videograph system. This is particularly suited for application where the input is electrical rather than optical — for example, magnetic tape instead of manuscript. A particular tube can cover 9,290 sq cm of paper with typewriter size print in one second — that is, 50,000 characters per second. Modifications of the videograph are now in use for transmitting facsimile of documents over long distances and also in certain computer-aided printing work.

7 Use of Computer

The computer is now helping the human compositor in several tasks, such as Line justification, Hyphenation, and Change of fount. Further, the productivity in several of the operations has been appreciably increased. Examples are,

1 Re-keyboarding in those cases where the information already put on keyboard once, is to be reused in a different form;

2 Increased speed of composition. For instance, compositors averaging at best about 6,000 characters per hour working directly on a Linotype or Intertype or Fotosetter or

Photon, are able to turn about 10,000 characters with less effort when working on a keyboard that itself produces only tape;

3 There is an advantage if the same information is to be presented in a variety of ways, as for example, in cumulative directories, stock lists, etc;

4 If the basic data is at one stage or other maintained in a machine-readable form such as on punched card or punched tape, a repetition of the keyboard operation can be saved in the case of pricelists, mathematical tables, etc.;

5 Even if the input is to be specially done by keyboard operation — for example, either to produce punched tape or to produce a copy that is good enough for input in a character-recognition machine — the extent of keyboard work can be reduced by taking advantage of the ability of the computer to re-sequence the elements. Such a situation may arise in the printing of a library catalogue;

6 It is possible to up-date a record by putting on the keyboard just the new information, and the computer can interpolate in the appropriate place in the old record;

7 Variations in typeface such as capitals, lower case, and bold face is possible in typesetting by computer. But careful attention should be given to the choice of ribbon, indentation, etc, to get a legible printout;

8 A computer can be so programmed to produce an output suited to more than one kind of composing machine — Linotype, Intertype, Fotosetter, Photon, Monotype, Charactron, etc; and

9 It is possible to program a computer to convert tape from one configuration to another or to generate one kind of output for an original edition and another kind for a reprint. But the programming is expensive.

PART K

TECHNOLOGY OF PRINTING

CHAPTER KA

LETTER PRESS PRINTING

1 Machine-Minder

A Printing Press is essentially an appliance by means of which a sheet of paper is pressed against the inked printing surface, usually of the size of a forme, in order to transfer the ink from the type to the paper. The man in charge of the press-work is called the 'Machine Minder'. Of the processes involved in the production of a book, none is more important than the work of the machine-minder. It is in his hand that the finished product takes shape. His work is not merely mechanical. All inequalities or deficiencies in material, workmanship, or mechanical principle, which are inherent or have crept in before the job reaches him, must be set right by him. The forme or the printing surface is first 'Laid on the Bed of the Press'. In the case of a type-surface in relief, it is hammered down by beating on a board kept on it, in order to make the typefaces even. Then begin the processes of "Registering," "Make-Ready," and "Striking."

2 Registering

'Registering' means the adjustment of the printing surface — forme or plate — such that it will print in correct position over another forme or plate. This is absolutely necessary in colour-printing. Even in ordinary printing, it is desirable that the printed lines of one side of a leaf of paper fall exactly on the printed lines of its other side.

3 Make-Ready

'Make-Ready' means the setting up of the press to print on a particular quality of the paper supplied and making

sure of each element of the printing surface — small type, large type, and plates of illustration — printing in the best manner. For this, the plane of the whole printing surface should be absolutely even. Otherwise, there will be uneven impression with alternative patches of heavy black and grey. In relief-printing, the unavoidable margin of error in the heights of types etc, makes Make-Ready a necessary process. Make-Ready is done by pasting thin paper at appropriate points in the paper-packing of the impression platen or cylinder, against which the type presses. A layer of paper may also be pasted under the type in the forme.

4 Striking

When registering and make-ready are completed, the forme is said to be 'Put to Bed'. Then it is printed off: The type is inked; the paper is fed either by hand or by machine; and copies are taken by applying pressure with a machine. Letterpress printing machines are of three types:

1 Platen; 2 Cylinder; and 3 Rotary.

5 Platen Press

A platen press prints from flat formes of type. Hinged to the bed is the 'Tympen'. This is a frame holding a stretched canvass sheet on which the sheet of paper to be printed is fixed. Pressure is applied by a ponderous iron plate. The speed of printing is low.

6 Cylinder Press

Cylinder press also prints from flat formes or plates. Paper is fed automatically. And pressure is applied by a heavy cylinder. Speed is high. Two thousand impressions can be taken in an hour. There are now Perfecting Machines which

print both sides of the sheet in immediate succession. Printing the second side is called 'Perfecting'.

7 Rotary Press

Rotary press prints from plates which are cylindrical to fit the impression cylinders. It prints from a roll of paper called 'Web'. Speed is very great. About 60,000 copies per hour may be reached.

8 Faults

When the run commences and the sheets are going through, the pressman watches them to make sure that they are being printed correctly. He corrects any fault that may be detected. The chief defects met with in running are:

1 'Slurring' due to a springy forme going off the bed or by the recurring of blocks or due to buckling or other causes;

2 'Rising of Spaces' due to a springy forme, rocky block, untrue wooden mounts, or bottleneck slurs, or faulty furniture;

3 'Creasing' due to wave-edged paper over packed cylinder, the sheets not being held tight, or spongy packing;

4 'Plucking' which is experienced while printing on coated paper; and

5 'Set Off' due to bad ink or wrong impression or ink drying on machine.

We should not therefore think that all copies in an edition will be equally good.

CHAPTER KB

OFFSET PRINTING

1 Two Processes

In offset printing, the ink is not taken from the printing plate direct to the paper; but it is first taken on an intermediate surface and transferred from there to the paper. The usual method is to have a special cylinder on which is stretched an offset blanket. As the print is reversed on the offset blanket and again reversed when it is transferred on to paper it follows that the matter which is to be printed offset should be positive on the printing plate. High speed and close register are easily secured. There are two offset processes known as "Albumin Process" and "Deep Etch Process."

2 Albumin Process

In the Albumin Process, a photographic negative is formed from the proof of the type-matter. This proof is usually called Repro-Proof, because it is to be reproduced photographically. Transparent acetate or cellophane proofs are nowadays used.

3 Stripping Operation

After the negatives of illustrations and type-matter have been prepared, they are 'Stripped' on a lay-out so that the press plate can be made. This corresponds to the make-up and lock-up in relief-printing. The purpose of the lay-out is to get the work square to the edge of the sheet; also in correct position and square on the offset lithographic plate. The relief-printing make-up and lock-up work is done *under* a light. But the offset lithographic stripping is done *over* a light. This enables the stripper to see the negative in the best way. The

stripper places the negatives in reverse on a Golden-Red-Coloured paper cut to the size of the press plate. The golden-red paper gives support to the negative and also acts as a mask to the action of light when they are Burned-In the plate. The light from the arc lamps used to transfer the image from the negative to the plate cannot penetrate the golden-red paper.

4 Preparation of the Plate

Plates for offset printing are usually made of cold-rolled zinc or aluminium or stainless steel, or other alloys. The plates are first grained together with a slightly roughened surface to help the water and ink used on the press. After counter-etching — that is, cleaning chemically — the plate is sensitized with ammonium bichromate and albumin. Then the stripper's negative, affixed to the golden-red paper, is placed on the plate and pressed firmly together. After the plate has been exposed and printed, it is developed by rubbing developing ink over the grained side. The plate is then washed in running water. This removes the developing ink from the non-printing areas in the plate. The plate is then ground to prevent oxidation.

5 Physical Chemistry of Offset Printing

The fact of grease and water not mixing with each other is the basis of the process of offset printing. In the offset plate, the printing areas are greasy and the other areas are not. When the plate is moistened, water adheres only to the latter parts and not to the former. The ink does not adhere to the moistened part, but only to the unmoistened part. Therefore the offset plate prints in spite of its having a smooth plane surface.

PART L

TECHNOLOGY OF BOOK ILLUSTRATION

CHAPTER LA

PRINTING OF ILLUSTRATION

1 Three Processes

The following are the three main processes of printing illustrations — that is, pictures — in books:

1 Relief Process.—In this process, the surface taking the ink is raised above the rest of the surface not taking the ink;

2 Planography.—In this process, the surface taking the ink is at the same level as the rest of the surface not taking the ink; and

3 Intaglio Process.—In this process, the surface taking the ink is below the rest of the surface not taking the ink.

2 Medium of Expression

Whatever be the process used, the medium used to form the pictures is made of the elements, lines, dots, flat tints, and tones of varying intensity. By 'Tone' is meant the shade, hue, or degree of colour — as in the terms 'dark tone' and 'light tone'. All forms of light and shade are expressed by the arrangement in gradation of these elements.

CHAPTER LB

RELIEF PROCESS

1 Three Methods

Relief Process is the simplest of the three processes. There are three methods of Relief Process:—1 Wood-Cut; 2 Half-Tone Block; and 3 Line Block.

2 Wood-Cut

In the wood-cut method, the picture is transferred in reverse to a smooth level piece of wood. The wood is cut away in the places which are not to print. Being in relief as the letterpress, the two can be easily printed together. The dots and lines cannot be very fine, as they will get damaged by the pressure of printing. Relief block printing cannot therefore be used to reproduce satisfactorily a drawing with toning as an important feature of it.

3 Half-Tone Block

Half-tone comprises tones of varying depths brought about by lines or tints of varying intensity of tone. A photographic negative of the picture is made by interposing, between the lens and the negative, a screen. The screen consists of two plates of glass fixed together with transparent cement. Each plate contains black, opaque, parallel lines engraved on it very close to each other. The lines of the two plates cross at right angles. The number of lines to an inch varies from 50 to 200. The resulting screen is like trellis-work with tiny square windows. As a result of passing through this screen, the image of the original on the sensitized plate is broken up into dots and squares, instead of the continuous unbroken tone in an ordinary photograph taken without the screen.

After development, the negative is placed over a polished plate of copper on which a solution of potassium bichromate and fish glue has been evenly applied and dried. This is then exposed to light. The light decomposes the water-soluble bichromate, which is thereby turned into insoluble chromic oxide. The negative is then removed and the plate is washed. Then the image broken up into dots and squares remains on the surface; and the opaque parts of the negative and the rest get dissolved by water. The plate is then soaked in violet aniline dye. This colours each dot and makes the picture show clearly on the metal. The print is next Burned-In or heated and then cooled slowly. This turns the coating into a hard acid-proof enamel. The burnt-in plate is now cleaned with a mixture of acetic acid to remove all traces of coating from between the dots. The plate is then placed in a bath of ferric chloride. This eats away the unprotected copper between the dots leaving the dots themselves in relief. It is then mounted on a block of wood and brought to type-height. This is Half-Tone Block.

4 Line-Block

In making a line-block, no screen is used. The negative is printed on a zinc-plate, sensitized with bichromate and egg albumin. It is then rolled with a leather roller charged with stiff greasy ink. The print is then washed with water. Then the image alone, now covered with ink, remains; the rest of print is washed away. The zinc print is now slightly warmed and then dusted over with a resinous powder which sticks to the inked portion of the plate. It is then heated till the resin melts and incorporates with the ink. This causes an acid-proof coating over all the lines of the picture. The plate is next placed in an etching bath containing dilute nitric acid. The acid eats away the unprotected zinc between the lines, leaving the lines themselves in relief. It is then mounted on a block of wood and brought to type-height. This is Line-Block.

CHAPTER LC

PLANOGRAPHY OR LITHOGRAPHY

1 Chemical Printing

Lithography is the common name of the planographic process. The printing surface is not raised in this process as in relief process. But it is quite flat. Planography is often referred to as chemical printing; because the principle is based on the physico-chemical property of certain calcareous stones and such metals as zinc and aluminium in a chemically clean condition. They undergo certain peculiar changes, when brought into contact with an organic fatty acid. The fatty acid is absorbed by the stone or metal. Unless forcibly removed, it becomes a part of the stone or metal. Such parts of the stone or metal have the property of all fatty acids. They are greasy and attract any greasy substance applied over them. But they repel water or watery substance applied over them. The process depends upon the reaction of gelatin to light and water.

2 Three Methods

There are three methods of planography: 1 Auto-lithography; 2 Offset-lithography; and 3 Collotype.

3 Uses of Planography

The chief uses for lithography are pictorial work of large size, work requiring the use of many colours, prints on tin and other metals and all pictorial posters.

CHAPTER LD

AUTO-LITHOGRAPHY

1 Writing in the Reverse Way

The lithographic stone is quarried in Germany. It is calcareous — that is, it is composed largely of calcium carbonate; and it is porous. A thick slab of this stone is levelled on both sides. The side, used for printing, is ground with sand for purposes of cleaning and giving a grain to the surface. This is the Face of the stone. There should be no scratches on it. The stone is dried. On this, the artist draws the picture in the reverse way, with a special crayon, the grain giving the necessary tooth for the crayon. It is like the crayon used by artists for drawing on paper; but it contains a greasy fatty acid.

2 Chemistry of Auto-Lithography

When the artist has finished his drawing, the stone is coated over with a mixture of gum arabic and dilute nitric acid. The acid attacks the bare parts of the stone. But it is not strong enough to etch it to any depth. The purpose of the acid is not to produce any depression in the non-printing parts. It is not necessary in planography to produce any difference in level between the printing and non-printing parts. The acid has merely to produce a granulated surface in the non-printing parts, so that water can collect in small quantities in their hollows. The gum arabic makes the non-printing parts insensitive to grease. The arabic acid in the gum arabic acts on the stone in the same manner as a greasy fatty acid. After absorbing arabic acid, the stone behaves in the opposite way to that of the greasy parts; that is, it repels grease and attracts water. The behaviour of any part of the face of the

stone will depend on whether a fatty acid or gum arabic comes into contact with it first, while in a chemically clean condition. Once this change has occurred, nothing can alter the behaviour of the stone or metal till the removal of that layer by mechanical or chemical means. This is due to the basic substance of the clean stone, calcium carbonate. Metals such as zinc and aluminium, used in the place of stone, contain zinc oxide and alumina. A few molecules on the surface undergo chemical or physical change when these basic substances come into contact with acidic substances. The change is permanent, until the molecules are bodily removed or are acted upon by strong acids.

3 Printing

When the gum is dry, the stone is washed with water. This removes all the gum on the surface. The picture drawn in crayon is still there on the stone. This is washed away with turpentine. Now the picture has disappeared, as turpentine has dissolved away all the grease with which the picture was drawn. The surface of the stone looks to all appearance as bare as it was soon after having been grained and polished. Yet, it is really bare. Invisible though it may be, the picture has been indelibly fixed on the stone. The stone is damped with a wet cloth. The granular surface produced by the nitric acid helps to retain the water on the surface. While still wet the stone is rolled with a roller charged with stiff greasy ink ground in linseed oil containing the fatty linoleic acid. Gradually, the picture comes back to sight; for, the stone in those parts is grease-attracting, and therefore, the greasy ink particles collect on those parts, making the picture visible. The parts which have absorbed gum are grease-resisting and therefore ink particles are unable to adhere to those parts so long as such parts continue to hold water. That is why the stone will have to be frequently damped while being rolled.

If the water evaporates leaving the stone dry, then ink particles will stick to the stone. But this will not do any permanent damage. When damped again and rolled, the ink particles come away from those parts, as grease can never remain there in the presence of water. When the picture has been fully charged with ink, the stone is dried by fanning it. A sheet of paper is placed over the stone and pulled through under pressure in a lithographic press. Thus, a print of the picture is obtained on it. The stone is damped again, rolled with ink, and used for further printing.

4 Inexpensive Printing

This is a very interesting way of printing. It is also a quick and comparatively inexpensive way of obtaining prints of pictures or any other kind of matter.

5 Advantage of Metal Face

What has been described regarding stone applies equally well to zinc and aluminium. For they possess similar properties. Nowadays these metals have superseded stone. Because metal sheets are easier to handle, they can be wound round a cylinder and printed on the rotary principle. They are not liable to get broken as stones are. They are cheaper. Large sizes can be used, which will be impossible with the stones on account of their weight.

6 Transfer Paper

There is not much direct drawing on metal or stone done these days. The drawings are made on grained Transfer Paper (like "transfer" pictures used by boys to affix pictures to books). These Transfer Papers have a coating. They can therefore be transferred to other surfaces and to metal ones in particular.

7 Photographic Negative

Most lithographic work today is done from prints obtained from photographic negatives. The metal sheet is coated with egg albumin and ammonium bichromate and allowed to dry. A photographic negative is made of the original. This is placed in contact with the sensitized metal and exposed to powerful arc lamps or bright sunlight for about three or four minutes. The negative is taken out, and a cloth soaked in printing ink diluted with turpentine is passed over the plate. It is then washed with cold water. This dissolves away all parts not affected by light. In the parts rendered insoluble by the action of light, the image remains in the plate. The non-printing parts are desensitized with gum. The printing can be done from this plate, as if the image were directly drawn on the plate with greasy ink.

8 Pictures with Tones

Pictures containing tones such as paintings, photographs, wash and pencil drawings can all be produced by lithography. Screens like those used in relief process for making half-tone blocks have to be used for this purpose. But when the picture is drawn direct on stone or transferred from paper, the grain is obtained by rough-graining the stone or paper.

9 Defects of Auto-Lithography

There are certain defects in printing direct from stone or metal on to paper. As the printing surface is on the same level as the non-printing parts, very considerable pressure is required for the transference of ink, unlike relief process or intaglio in which a difference of level makes it necessary to use but little pressure in printing. Another difficulty is that fine screen half-tone images require a smooth coated paper for printing. Coated paper is affected by moisture as the

coating is fixed by a water-soluble adhesive, and it comes away on being wetted. As the printing plate is damp, coated paper is ruled out for printing direct from metal. Hence only half-tones of fairly rough screen not requiring coated paper should be used.

CHAPTER LE

OFFSET LITHOGRAPHY

1 Advantages of Offset Lithography

The difficulties of auto-lithography are overcome by offset printing. This process is known as "Offset Lithography." As rubber adapts itself as readily to the irregularities in the metal plate as to those in the paper, comparatively little pressure is required, and there is a full transference of ink. Also half-tone images and even fine line work can be printed on paper of however rough a surface, if printed by offset.

2 Defects of Offset Lithography

Obviously there are two transferences in the course of printing. Therefore, the image of the picture on the plate should be in the same way as it should appear in print and not in reverse as in direct lithography. Most lithographic work is done by offset at the present time. The chief defect is that on account of the double transference, there is a certain lack of depth of colour. By the use of highly concentrated inks, this defect is largely got over.

3 Offset Deep

A new development combining offset lithography with intaglio called Offset Deep promises to make up for all the disadvantages of lithography in comparison with intaglio printing, while retaining the qualities which are peculiarly its own.

CHAPTER LF

COLLOTYPE

1 Plate Glass

Collotype is also called Photo-Gelatin Process. It is more nearly photographic than any other printing process. The printing surface is a photographic positive in glass. A negative containing no screen is made from the copy. A large piece of plate glass, about 0.9 cm thick and having ground sides, is cleaned and coated with water-glass. The glass then receives a coating of gelatin. This is then dried by heating. The negative and glass are placed in contact before a strong arc light. The still-soluble sensitizer is then washed off. The plate is then dried and immersed in a bath of water and glycerine. The most soluble (least light-hardened) portions of the copy are dampened most; the least soluble (most light-hardened) portions least. In printing, the various portions of the plate accept the greasy ink in inverse proportion to their dampness.

2 Aluminium Plate

Later methods employ an aluminium plate, from which impressions are made in a manner similar to that used in offset-lithography.

3 Disadvantages

The presswork is quite costly and slow. It is moreover a short-run process. It is difficult to print more than 2,000 copies.

CHAPTER LG

INTAGLIO PROCESS

1 Manual Method

If a smooth plate of copper is taken and a line scored on the surface with a sharp instrument so that every part of the line is below the surface of the plate, then the line is said to be engraved Intaglio. Suppose we take some thick and stiff ink and apply it to the surface of such a plate, the ink will fill inside the engraved line and the surplus ink will remain on the surface. This surplus ink is removed with a piece of cloth, taking care not to remove the ink contained inside the line. A sheet of moistened paper is placed over the plate and pressure is applied. The ink is drawn out of the line through the adhesion brought about by the heavy pressure and the suction of the wet sheet. The line thus printed on the paper will be of the same width as the engraved line, and the intensity of the colour of the line will depend upon the depth to which the line is engraved.

2 Advantage

The most complicated design in fine line can be engraved in this manner. All degrees of width of lines (with the limitation that no line be so wide that the ink will wipe out of it) and a great variety of depth of printing lines can be made on the copper. The finest line that the human hand can engrave is the only limit to the degree of fineness of intaglio line engraving. For, if the ink is of the proper quality it will fill in the merest scratch on the copper. Furthermore, the finest line will stand up under the pressure of the press and a series of such fine lines, however near together, may be printed so that each one is sharp and firm on the impression.

The thick dense body of ink gives richness to the impression. It gains an additional soft mellow quality from the shadows cast by the printed lines standing in perceptible relief on the paper. The lines in the shadows may be engraved very close together, sufficiently as almost to touch one another and yet their separation can be preserved on the impression.

3 Comparison with Relief Process

The engraver can obtain a luminous quality in large masses of shadows, which would appear dull and lacking in richness in relief printing. While in relief printing it is necessary to maintain the same quantity of ink all over the surface, and only the thinnest film is possible in order to prevent its being squeezed out into the depressed parts, in intaglio the quantity of ink carried can be made to vary by varying the depth of the lines. The ink carried by the printed lines in the shadows is not a thin film as in the case of relief printing; on the other hand, it is a thick layer. This gives the shadows a depth and velvety richness unequalled in any other process. Great smoothness of silken texture is obtained in the high lights by the tiniest scratch on the surface. This smoothness also is unobtainable by the relief process. One can see, therefore, that intaglio line engraving is superior to relief-block engraving for obtaining the depth of colour, the delicacy and the smoothness of the lighter tones.

4 Photogravure

The engraving of the plate is not nowadays done directly. It is done by photo-mechanical means. This has resulted in photogravure. As in the half-tone form of relief process, a screen is used. This breaks up the design into tiny squares. Unlike in the screen for half-tone, in this screen the lines are transparent and the intervening squares are opaque. When the negative of the original picture is photographed on to

zinc plate, the darker parts of the original are reproduced on the zinc plate in the form of fatter dots than the lighter parts. The plate is given a coating which protects it from acid (except where the dots occur). It is then etched in a bath of acid. The darkest parts are eaten away most by the etching process, and the lightest parts least. The parts immediately under the cross-lines of the screen have not been affected at all by light, and therefore during the etching process they remain untouched by the acid. Thus, after etching, the plate consists of a series of tiny ridges and of countless tiny hollows between the ridges. Before printing, an ink scraper on the printing-machine wipes the ridges clear of ink. The deep etched hollows (the darks of the original) hold much ink and the shallow ones (the lights of the original) hold little or none. Therefore, when the plate is pressed against paper, the dark and light tones of the picture are printed exactly as they were in the original.

5 Contrast Between Photogravure and Half-Tone Block

In etching for half-tone block, it is the unwanted or white portion that is etched away and the wanted or the print-portion is protected. In etching for photogravure, it is just the reverse.

6 Advantage to the Artist

As in modern methods for cutting punches for types, in both half-tone block and photogravure the artist is saved from the task of working with hard materials. He has all the ease of working on paper or canvas with ink or colour to produce the original. He can leave the rest to photography and the succeeding processes.

CHAPTER LH

COLOURED ILLUSTRATIONS

1 Three-Coloured Process

For reproducing coloured paintings in oil colours or water colours, half-tone blocks are made by the trichromatic process. It is possible because every conceivable colour can be produced by a suitable intermixture of the three primary colours — yellow, red, and blue. The original is photographed three times one to record all the yellows contained in the picture, the second for the reds, and the third for the blues. This recording is made by interposing in front of the lens Colour Filters made of celluloid or glass — violet filter for the yellow plate, green for the red plate, and red for the blue plate.

2 Printing Process

Blocks are made from the three negatives. The yellow block is printed in yellow ink; the red block is then printed on top of the print already obtained in yellow; and finally the blue is printed on top of both the other colours. If the blocks are made properly, the correct colours of inks are used, and the printing is done in such a fashion that the three printings fall exactly on top of one another, then the final result will be a more or less exact reproduction of the original.

3 Colour Printing in Lithography

While the three-colour process gives excellent results in relief printing and fairly good ones in photogravure, it is unsatisfactory by lithography. This is mainly because the correct colour-values of yellow, red, and blue cannot be obtained each time as the prints lack in depth and brilliance.

PART M

LAW 3 AND ASETHETICS OF THE BOOK

CHAPTER MA

LAW 3 OF LIBRARY SCIENCE

1 Enunciation and Appeal

Law 3 of Library Science is "Every book its reader." Its appeal to Physical Bibliography is somewhat as follows: "According to Law 1, it is the soul (= idea-content) that is intended for consumption. But intellectual hunger is either absent or feeble and fleeting in many; none but a few intellectuals will seek books voluntarily. Books cannot find consumers without aid, as food can do. Even in the case of food, it is specially flavoured, coloured, and dressed artistically so as to appeal even to senses other than taste. Therefore, make the body of the book attractive; increase its aesthetic appeal. In response to Law 1, you have already made it convenient to handle. I ask you to make its subtler physical features inviting."

2 Factors for Attention of Physical Bibliography

Law 3 really depends on the principle that the probability of finding its reader for a book will increase with the number of people who will be attracted to it by the very aesthetic appearance of its exterior and interior. It also wishes that the strain of reading a book should not be so severe as to make a reader throw it away. For this purpose, Physical Bibliography should attend to the following:

1 Jacket;
2 Binding;
3 Lay-Out of the Page;
4 Space between Lines;
5 Length of Line; and
6 Type-face.

CHAPTER MB

JACKET AND AESTHETICS

1 Latest Part of the Book

It is the Jacket of the book that first catches the eye of a potential reader. It covers the binding of the book. It should therefore be made as colourful and attractive as possible. In this, we should imitate nature. Nature uses an effective use of colour to attract insects which help in polination in the plant-kingdom and to attract the mate in the animal-kingdom. Further, when the book is taken on hand, the "blurbs" should be fully appetising. The artistic skill, dowered on the design of the Jacket nowadays, makes one sad that the Jacket wears out quickly. To avert the early dropping out of the Jacket and to retain it permanently at the service of Law 3 of Library Science, it should be possible to fix a transparent plastic cover over the Jacket. The march of Physical Bibliography in regard to Jacket is indeed a demonstration of what a purposeful alliance of art and science can achieve. It is easy to follow this march in detail. For, no part of the book is as young in history as the Jacket.

2 History of the Jacket

Till some date early in the nineteenth century, books were issued in paper-covers or boards. It was left to the purchaser to have them bound to his taste. But Law 2, democracy, and industrial revolution brought about mass production of books and also began to draw book-buyers from the masses too poor to afford individual binding. Thus, books came to be bound in quality and sold as finished products, thereby reducing the cost of binding. Further, while still on the book-seller's shelf, a copy of the book is handled by many persons

before it is sold out. It soon became obvious that if the binding was to be fresh when the book is passed on to the purchaser, some kind of protection from soiling was necessary. A temporary wrapper of some sort was the obvious answer. Paper suggested itself as the most convenient material. It was easy to cut a piece of paper so as to cover the boards and spine, and to turn it over the fore-edges — exactly, as we did in our school days to cover with brown paper our fresh textbooks at the beginning of the year.

3 Window-Wrapper

This first attempt at wrapping in this manner was offensive to Law 3. For, it made the book an anonymous block. It had to be unwrapped and opened if its identity was to be known. To minimise this offence to Law 3, a rectangular hole was made near the head of the spine to make the name of the author and the title of the book visible. The hole was also later replaced by celluloid window.

4 Printed Jacket

It was not long before it was realised that the simplest thing to do where large numbers of books had to be wrapped was to print the title on the wrapper. Once this freedom was taken, Law 3 egged Physical Bibliography on to exploit this freedom more fully. The first mode of exploitation was to print a few extra words, as an inducement to the reluctant but potential readers — saying, for example, that the author's previous book had been received with rapture by the public and the critics are praising the quality of the present one. It was but a natural next step to fill up the remaining space in the wrapper with the names of other interesting books which the publisher had for sale or to describe some of them. It was not long before the wrapper was seized upon for the

play of all the cunning and skill of the art of publicity. The result was the conversion of the wrapper into the modern Jacket. An artist is now employed to design the Jacket. He has to read the book and express its "soul" on the Jacket in revealing, attractive symbolic pictures. The artist's fee and the cost of colour-printing for the Jacket of a book now reaches even upto a thousand rupees.

5 Plastic Cover

Thus, the Jacket reached the stage when the original purpose of being a protection against dirt was lost sight of. The Jacket itself now needed protection against dirt when the customers browse round the book-seller's shelf. It is here that modern science has been invoked to protect a work of art which the Jacket has become. During the last few years, plastic chemistry has produced smooth, transparent, pleasant, plastic covers to protect the Jackets permanently. Many brands of plastic cover are now available.

6 A Blind Practice

When Physical Bibliography had taken the Jacket to this stage under the stimulus of Law 3, the vandalism of some unthinking librarians removes the Jacket before placing the book on the shelf. This is due to the blind persistence of the tradition, but a few decades old, of throwing away the unprinted paper-wrapper when it was hiding the attractive publisher's case. Another class of librarians show equal blindness in depriving the book of the self-advertisement which the Jacket would give it and put the Jacket on the display board. There is no doubt that there is some publicity value in this. If librarians want to have the best of both the worlds, the proper course is to ask the publisher to clothe the book with

two copies of the Jacket. Then one can be left on the book and the other transferred to the publicity board.

7 The Next Stage

When I was in Paris in 1950, I happened to visit one of its public libraries. That library violated the Laws of Library Science in several ways. Its location was on the top-floor which was the fourth or the fifth deck; and there was no lift. As I was ascending the steps, I found several people bringing their books all wrapped in ugly brown paper — all made anonymous! I was puzzled. As I was being shown round the library, I found a stock of brown paper on the issue counter. On enquiry, I learnt that no reader was lent a book unless he bought one of these brown paper sheets and wrapped the library book. Poor readers, whose intellectual hunger was a little more intensive than in others, saved the brown paper bought for the first book and used it repeatedly for the later books until it was worn out. I thanked God and thanked the library that it did not collect the toll from such a persistent poor reader on purchasing a new brown sheet, on every occasion he borrowed a book from the library. The instinct of this French library to keep the exterior of the book clean and beautiful is quite in keeping with the sense of elegance with which the French genius is associated. But the practice of this library demonstrated the possibility that one can suffocate a child in the process of keeping it clean. Law 2 and Law 3 of Library science make a joint appeal to Physical Bibliography to make the provision of the plastic cover as much a part of the routine of book production as publisher's casing. This I regard as the next stage expected in the Physical Bibliography of Jackets.

CHAPTER MC

ANATOMY OF THE JACKET

1 Material

Let us next take up the anatomy of the Jacket. Its substance is paper. It should be substantial and yet not so stout that it cracks when folded. It should be tolerably stiff. It should not be so thin as to tear easily. The side of the paper that comes next to the book should not have a slippery surface. This will cause the Jacket to slip. Avoidance of double-sided art paper is therefore indicated. Otherwise the reader is irritated by the Jacket slipping out while reading without the exhausting nuisance of holding the book tightly.

2 Parts

The folded Jacket has five surfaces — the spine, the front and the back which are on the outside, and the two flaps by means of which the Jacket is held on to the book and which are therefore on the inside. The flaps should be adequate. They should extend at least to half the width of the board. The sheets for making Jackets have therefore to be of a size larger than the sheets on which the book is printed.

3 Art

The colour of the Jacket may be anything, single or multiple varying according to the artist's skill. Artists have a scale of colours to match the degree of seriousness of the thought-content of the book. The texture of the paper also has often to be left to the requirements of the artist. Jacket-Design is a work of art. What words should be used on it, what pictures, and in what proportion — there can be no rigid standards for these. In a work of art, we can only ask for the

end result. The details and the measures should be left to the intuition of the artist. Indeed we want an artist of great intuition to be employed on Jacket-Design.

4 Lettering

The Jacket may be printed by the relief process using the usual printing type or freedom can be given to the artist to provide his own lettering. Invention has given birth to some fine lettering. We have only to ask for legibility. Everything else we must leave to the artist.

5 Psychology

The artist's creation and public taste have an inscrutable correlation between themselves. The psychology of design is best left to the artist himself. The best artist will bring out on the Jacket the true soul of the book so as to engage the attention of every potential reader. Intuition is self-born and spontaneous. Some years ago, I was conducting what was called "Reading Habit Competition" for school students. One of the conditions of competition was that the notebook containing the essay should be provided with a cover which had a suitable design. I was amazed at the creative capacity of the young boys in making the cover-design bring out the soul of their essay with an economy and an exactitude which are the true traits of all works of art.

6 Duplication

The printing processes used for making copies of Jackets are the same as those used in the printing of books. The majority are printed letter-press from type or blocks. Occasionally collotype is used. Planography has led to the most interesting developments. Photo-lithography is often used.

Auto-lithography will give even better results. These terms are explained in Part L.

7 External Parts of Jacket

71 Spine

The Jacket-Spine must be designed in relation to the front board. It may have a picture or a pattern. It may be so designed that the picture spreads from the side over the spine, provided the portions on the spine and the side are capable of being viewed separately without any sense of incompleteness. A difficulty was experienced during World War II with regard to the printing on the spine. The spine of the book had become too narrow to admit of words to be run across it. They have to run up or to run down. This has given rise to the perennial controversy between "runners up" and "runners down". To make the words on the spine — the name of the author, the title, the call number, and the name of the publisher — run parallel to the way in which they do if they are printed across the spine, we should support runners down. The opponents say that one naturally bends his head to read the back of the spines of such a book and he begins with the bottom. But this is true only for those who bend their heads on the left. It should be equally easy for readers to acquire the habit of bending their heads on the right in which case they will read from the top to the bottom of the spine.

A spine of normal thickness usually carries a short title within one inch from the top, the name of the author below it, and the publisher's device or name near the bottom. In case prenatal classification is done, the call number will have to be above the publisher's device.

72 THE FRONT

The front of the Jacket usually contains the title and the name of the author and perhaps also the publisher's imprint. As already stated in Sec MC3, it contains a decoration or an illustration calculated to enhance the book's appeal and suggest its contents.

73 THE BACK

Generally the back of the Jacket is used for the advertisement of other books in the publisher's stock — particularly those in the same subject or related ones. Thus a volume on Library Classification may have on the back of the Jacket a list of other books on Library Science. As an alternative, this side of the Jacket is used for a list of the other books by the same author with or without annotation. It is offensive to let the back of the Jacket for advertisement on totally unconnected matter.

8 Flap

81 FRONT FLAP

The front flap is usually utilised for "selling" the book. Either a preview or a review or a special write-up on the value of the book is usually printed upto three-fourths of the way down. The price of the book is sometimes printed at the foot.

82 BACK FLAP

Either the matter in the front flap is carried forward to the back flap, or it is used to print a short account of the author so as to enhance the authoritativeness of the book.

CHAPTER MD

BINDING AND AESTHETICS

1 Introduction

When one comes across a new book, one generally opens out the Jacket and examines the binding. Physical Bibliography should exploit this in favour of Law 3. Law 3 would like to have the binding as attractive as possible. Here comes a conflict between durability, strength, and cost on the one hand and artistic appeal on the other. An account of durable, strong, reinforced, library binding is given in Chap RB. It will have to be done by hand. It cannot be made on a mass scale. Its cost will therefore be high. To make it artistic would mean increasing the cost still more. This kind of individual binding for each copy would take the book beyond the financial capacity of most readers and even libraries. It has therefore become the practice to provide a cheaper and less strong binding but with good artistic effect. To make it cheap, it has to be machine-made. A machine-made binding of this kind usually involves the preparation of the cover quite independently of the book. Such a cover is called Publisher's Case.

2 History

21 Manuscript Days

If the Jacket is the youngest part of the physical book, binding is one of the oldest. Binding — attractive binding — had come into vogue long before printing was invented. The binding of some of the medieval manuscripts is magnificent. Rich owners lavished some part of their wealth in decorating the binding of their manuscripts in the most gorgeous and

costly manner. Excellent leather was used as covering material. It was inlaid with silver or gold and set with jewels. The artists, jewellers, and goldsmiths worked together on the binding. In the Incunabula period, the tradition of manuscript binding was continued. In those days, the basic material for the cover was wood or cardboard; the covering material was leather, silk, or velvet; and the tooling material was gold. Sometimes the wooden boards were not covered. They were polished to reveal the decorative qualities of the natural grain, or they were inlaid with gold or silver, or carved in low relief or intaglio. Each book was bound separately. Each tool was impressed separately on the covering material. Each impression was gilded individually. It was a slow process. It took sometimes weeks and months to bind a book. There was no doubt that such a gorgeous binding was very attractive. Perhaps it was too attractive. It was so attractive that people began to own books for the sheer richness of the binding rather than of the idea-content — for the enjoyment of the exterior rather than the interior.

22 Effect of Printing

However, as the number of copies of a book was increased by the invention of printing the munificence lavished on binding a single copy had to be spread over several copies. As the number of books themselves increased, the embellishment began to decrease more and more. Therefore, the tradition of good binding and the need for cheap binding were reconciled by leaving binding to the individual owner and the publisher himself issuing the book in paper covers or boards.

23 Mass Binding

The industrial revolution of the early nineteenth century made mass-production popular. Mass-binding was attempted.

The machine usurped the field. Cloth was used. Cloth as a covering material lent itself to be "blocked" in one piece. The machine and the "blocking" dispensed at one stroke with the days and weeks that had to be spent formerly on each book. At first the blocking was done with lavish gold. Urge for cheapness often replaced gold blocks by plain blocks. At first the all-over blocking of cloth served the incidental purpose of covering the unpleasant cloth surface. But in due course colourful cloth was designed. Cloth came to be had in dozens of different kinds and qualities and in as many surfaces and colours. The machine made it necessary to prepare the cover independently.

24 Weak Attachment of Cover

While this gave opportunity to make the cover really attractive, the attachment of the book to the cover had to be weak. The binding with weak attachment with which the publisher releases the book nowadays results in "Publisher's Case" or simply "Casing."

3 Covering Material

The publisher's case consists of the board and the covering material. It is usually straw-board and cloth that are used. Choice of cloth is a matter of taste. Sometimes each publisher prefers a particular colour and sticks to it. The colour of the covering material used by the Cambridge University Press is different from that of the colour used by the Oxford University Press. In texture too, they differ. There is also a conventional correlation between the colour of the cloth and the nature of the idea-content of the book. Very attractive plastic coated cloth is coming into vogue. Law 3 would ask for an inviting colour and a pleasant surface in the covering material used.

4 Spine

In the days of binding by hand, the cords on which the sheets were sewn, showed themselves as raised bands on the covering material on the spine. In machine-binding the cover of the spine does not touch it. There can therefore be no raised bands. However, the traditional desire for them is satisfied by parallel block rules in approximately the position where the bands would have appeared. The panels formed by these rules were once decorated very elaborately.

41 Artificial Panels Made Functional

It is now felt that Law 3 would be better satisfied if the panels are made functional. The uppermost panel takes the names of the book and the author. The lowermost panel takes the name of the publisher. The upper one is usually larger than the lower one. Sometimes recommended books like those of the National Book Club put on a separately made panel. It is usually made of leather with a distinctive colour and glued on to the binding. This is one of the ways in which Physical Bibliography propitiates Law 3. But, of late, the artificial formation of panels and their functional use are losing ground.

5 Art

It is true that a cloth-bound book is not blocked quite as luxuriantly or as elaborately as a leather-bound book. The appeal of simplicity is not however less powerful than that of gorgeousness. The majority of modern books bear nothing more than the names of the author of the book and the publisher. Still the harmony of such virtual bareness can be made sufficiently attractive and dignified.

6 The Front and the Back

Nowadays the front and the back of the binding are left empty. This is rational. The books are usually displayed in shelves — closely packed. In this situation, the front and the back are not visible. It is only the spine that is visible. Therefore it is but proper that all the attention should be diverted to the spine, and the front and the back be left empty. Another factor that is responsible for it is the advent of the Jacket. When the front cover is displayed, it is the Jacket that is on view and not the front of the cover. If a plastic is put on the Jacket, this becomes a permanent display.

7 The Boards

Though the boards are covered and are not visible, they do play some part in the aesthetics of the book. The boards contribute a great deal towards the satisfaction of the sense of touch. Their weight and hardness do matter. Children's books can be made very attractive, with very thick boards as the core and coloured paper printed over artistically with pictures as covering material. The charm thrown on the children by such a binding is unmistakable. Law 3 is immensely pleased.

The treatment of the edges of the pages can add to the dignity and attractiveness of the binding of the book. A clean, smooth edge on all the three sides is now becoming common. This treatment is always necessary to the top edge as dust is apt to settle on it. Before World War II, the top edge was sometimes gilded. As gold does not absorb dust, it is easier to keep such an edge clean; but more than that the aesthetic advantage was the prepotent one. The Bible is sometimes glided on all the three edges in order to give it an air of richness and distinction. Where gold is too costly, the top edge is washed in some suitable colour.

CHAPTER ME

LAY-OUT OF THE PAGE

1 Open Double Page

The Jacket attracts the reader. The binding makes the feel of the book pleasant. This is all what happens before the book is opened. Law 3 would like Physical Bibliography to ask aesthetics to give help even after the book is opened. The lay-out of the open double page also needs its attention.

2 Margin

The print differs in colour-tone from the surrounding paper. Therefore, the print should be set on the background of paper in the same manner as setting a photograph on a mount. One does not feel happy to see a large photograph mounted with narrow margins all round; nor does one like to have the photograph centred on the mount. The same thing applies to a printed page. Firstly, the shape of the print should harmonize with the shape of the page, and more or less in the same proportion, though not necessarily exactly so. The margins all round should be ample in the case of large sizes such as quartos, and in like proportion in the case of octavos. In all cases, these should be large enough to allow the print to stand out in a pleasing manner against the white paper as the background. Secondly, these margins should not be equal all round. This rule is not often observed, with the result the printed page is unpleasing to the eye. It is not sufficiently well realised that the margins form one of the most important factors that go to beautify print. A page crowded with printed letters is like a room too much filled with furniture. Furniture can be a source of great beauty to the room, provided the pieces are chosen tastefully and

arranged neatly, and if their size and number are made to suit the size of the room. Empty space is an integral part of the design, and should be given its due place in any artistic arrangement. The margins on the different sides should be unequal. The margin close to the stitching is the Back margin; the top margin is the Head margin; the margin on the sides of the page away from the stitching is the Fore-edge margin; and the bottom margin is the Tail margin.

3 Proportion of Margins

The margins should be so allocated that there is least in the back, more at the head, still more at the fore-edge, and most at the tail. The proportion in which these are allocated is a matter on which all are not agreed. Tastes differ considerably in this respect. Some of the proportions, commonly advocated between the Back, Head, Fore-edge, and Tail Margins, are as follows: 4:4:6:7; 4:5:6:8; and 4:5:6:10. William Morris, the famous artist, poet, and printer, used for some of the famous books printed by him at the Kelmscott Press, rather narrow back and head margins, fairly broad fore-edge margins, and a very considerable tail margin. Between this extreme and the modest practice in which the margins are but 1/6 inch more, progressively, as one proceeds from the back margin to the tail margin, there is room for considerable freedom to choose the extent of the margins and the proportion in which they are arranged.

4 Space Between Lines

William Morris preferred to have lines following each other closely with little or no space between successive lines. This is "Solid" Setting. But in this, he had few supporters even in his time. Though every one acknowledges Morris as the greatest modern aesthete of printed books, one finds it

impossible to share his liking for lines closely packed together. The general feeling in this matter is that the lines should be spaced whenever the margins are large. The larger the margins, the greater should be the space between lines; but it should not ordinarily exceed 1/18 inch; 1/36 inch, however, is the most pleasing for a large octavo or crown quarto. Too much line-spacing will produce a certain lack of set solid. Also, the larger the type used, the greater the space cohesiveness, which is as unpleasing if not more so, as lines required between the lines. The space between lines is usually secured by the insertion of leads. Nowadays types are produced in which the body is 2 points bigger than the type-face itself. Many monotype faces are of this kind. No lead is necessary in their case; for, spacing is automatic and very pleasing to the eye. Solid setting is preferable in indexes and certain reference books where it is helpful to enable a single sweep of the eye to pick up as many lines as possible.

5 Length of the Line

The length of the line is another element which can either retain a reader or repel him. In the old palm-leaf books of India, the lines were often 18 to 24 inches long. A reader often fumbled in passing on from the end of one line to the beginning of the next. This was most irritating. The optimum length of the line is determined by the size of the type. The larger the type, the longer can be the line. For 12 point type, anything more than 3 inches will be inconvenient. For 6 point types, which are used in reference books, 2 inches should be the maximum. These considerations will determine the number of columns which a page should have in order that a printed page may satisfy Law 3 from the angle of aesthetics as well as convenience. What can be taken in one sweep of the eye is the most convenient length.

CHAPTER MF

TYPEFACE AND AESTHETICS

1 Typeface and Human Face

In the aesthetics of the printed page, the typeface plays a prepotent part. Its potency is as great as that of the human face. The aesthetics of human personality is largely determined by the face of the person. So also typeface determines the aesthetics of a printed page. It is determined by the individual letters. Ultimately, this depends on the typeface. The character of the human face is elusive, indescribable, and intangible. All persons sense its general effect. But very few perceive the innumerable elements collectively producing that effect. So it is with typeface. A reader may not be able to distinguish one typeface from another when a single typeface is seen. But when the prints of the typefaces are strung together into lines and arranged in a page, the reaction of most readers is imminent and often alike. Law 3 of Library Science would therefore ask Physical Bibliography to pay as much attention to this basic factor of typeface as to any other. Indeed, all the other factors centre round typeface. Mixing up in the line of a book typefaces of different families (*See* Chap HF) does not help the aesthetics of the printed page. In selecting the typeface family, qualities such as the anatomy and the style of the typeface (*See* Chap HD and HE) should be taken into consideration.

2 Paper

Whatever be the intrinsic quality of the typeface, it is the nature of its impression made on paper that has true value to Law 3. It is this that produces its ultimate artistic effect. The texture of paper has a decided effect on the print

of the typeface. Soft paper has a tendency to "Thicken." That is to say, it makes the letter appear as bolder when compared to the same letter printed on smooth hard paper. The following is a table showing the graduation of the effect of paper on the impression of the typeface — of course, within its own narrow limits.

Paper surface	Degree of boldness
Newsprint	Boldest effect
Antique	Next boldest
Super-calendered	Light
Coated	Lightest

When seen on a whole page, the varying weight of the same type printed on various types of paper is indeed easily recognisable.

3 Ink

Ink also may make some slight modification in the quality of the impression of the typeface. It should have sufficient tack to withstand the impression without being subject to undue lateral displacement as a result of the applied pressure, if the true quality of the typeface is not to be altered. It is also necessary that the ink must not chemically react with paper. In fact, the resulting quality of the impression is determined jointly by the quality of the typeface, the nature of the paper, and the nature of the ink with which it is printed.

CHAPTER MG

INDIA AND THE AESTHETICS OF THE BOOK

1 Situation in Independent India

Modern India has yet to look upon the physical book as a work of art. It has not yet learnt that the Physical Bibliography of a book will be to the satisfaction of Law 3, only if the artist is invited to play his part. He will have to play his part in the design of the Jacket, the binding, the title page, the overall printed page, and the typeface. The value of a work of art cannot be measured in physical terms. It is something ineffable. It is not measurable as materials. An artist's skill cannot be bought by length or weight. Unfortunately, modern India has not yet recovered from the stage of fixing the value of the physical book by size quite oblivious of the aesthetics of the typeface used, the printed page produced, or the external finish of the book. This retardation in the scale of values is proving to be inimical to the progress towards the fulfilment of Laws 2 and 3. Before Independence, it was only 10 per cent of the people that could read a book. These were all drawn naturally from the first intellectual quartile. No hurdle was insuperable for such people. There was therefore no incentive for Physical Bibliography to pay attention to the aesthetics of the book production. Now that India has become independent and, what is more, it has adopted the most democratic form of constitution possible, the State is hampered at every turn by the absence, in the masses, of the capacity to inform themselves, educate themselves, and inspire themselves with the aid of the printed word. And yet, every enterprise, be it transport or industry or management, has to depend for its success on the information and enlightenment which the workers in the

lowest rung can pick up for themselves. During the last twenty years we have been experiencing the pestering, frustrating, and heartbreaking phenomenon of several enterprises being started with fanfares and soon fizzling out to such a level that everybody concerned is ashamed to speak about it. In the modern set-up, no method of making the lower quartiles put forth their best efforts and participative and intelligent cooperation can escape the feeding of the intellect of the workers with printed words.

2 Cost of Aesthetic of the Book

In 1953, there was occasion to discuss at the national level the production of Social Education Literature. The moment the aesthetic qualities necessary to attract and retain the interest of neo-literates in books was mentioned, there came forward the prompt monetorial voice of finance: "You are talking of the ideal. How can our poor people afford the cost of such luxuriously produced books?" This is a symptom of the deplorable sense of values, prevailing in the country at most levels. The proper approach should be, not to take the vote of treasury bench as the first step. Unfortunately it is this wrong course that is adopted in almost every project. The proper course is something else.

1 Step 1.—Decide the ultimate objective of the project;

2 Step 2.—Decide the number of years in which the ultimate objective could be achieved;

3 Step 3.—Work out the time table for the development of the project;

4 Step 4.—Prognose the possible dangers and risks which the project is likely to be exposed to and to provide for their prevention;

5 Step 5.—Decide the necessary and sufficient funds and other means to realise the objective of the project within the prescribed time table and to overcome all possible dangers;

6 Step 6.—Bring in finance for consultation; and

7 Step 7.—After the Treasury Bench has taken the stereotyped attitude, either come to a compromise with it or overrule its objection.

Let us remember that it is taken to be a Dharma of Finance to present to any organising body the copy book maxim "Finance won't allow it."

3 Statesmanship

It is here that statesmanship comes into play. It is for statesmanship to find out methods of maximal efficiency. Maximal efficiency can be secured in diverse ways. It is best secured for all the problems of the day viewed as a whole, evaluated globally, and developed integrally.

31 Mass Production

In several projects and particularly in the project for Social Education Literature, mass production is one of the methods which statesmanship should adopt. In mass production the irreducible overhead cost is distributed thinly over a vast area of consumption. In India today books of the order of Social Education Literature are wanted in hundreds of thousands of copies. This want is potential. It is the duty of the statesman to make this actual. If he does it, books for the adults can be produced in a quantity which will simultaneously admit of the high aesthetic standard and the low cost.

4 Wrong Role

The Government in our country today is not sure of what role it should play for maximal efficiency in the development of the country. It is not able to make up its mind whether it should play the role of the policy maker, the capitalist, or the entrepreneur. It attempts everything by itself. It plays thereby into the hands of a short-sighted inexperienced political group or of a bureaucracy, the rigidity of whose outlook is proverbial. The successive failures or under-performance of many of our ambitious and well-meant projects during the last twenty years are partly traceable to this wrong role of the Government. The Government, for example — amazingly enough, even the Central Government of Federated India — begins to run schools directly. It seeks to write books through its officers whose daily life is spent in the routine of unwinding red-tape. It wants to spot out the best authorial capacity in the country through committees composed largely of bureaucrats and politicians. It seeks to run a local public library. It seeks to play the role of the publisher, printer, and distributor. All this is wrong.

5 Right Role

The right role of the Government is to take a whole view of book production, to establish the objective to be realised, to plan, and to facilitate the working of the plan so as to secure maximal efficiency. It should pool together the authorial, the publishing, the paper-making, the printing, the binding, and the library personnel of the country and enable each party to understand its own role in relation to the roles of the others. Actual execution, it should leave to the appropriate parties. The most difficult part is to bring to the surface the really competent artists with vision both for creating the soul and the subtle body of the book — the thought-content

and the language of the book — and to create the physical body of the book. This is the business for entrepreneurs in the publishing trade. They should be entrusted with this task. The production of the right paper, the right typeface, the right printed page, and the right cover and Jacket should be left to the care of the concerned subgroup in that trade.

6 Financial Backing

The great headway which Physical Bibliography has to make in the country will be brought within what is practicable, only if the State organisations help in finding market for the books. As stated in Sec MG 31, unless this market is vast, correct standard of book-production would become impossible. The State should provide, during the first twenty or thirty years, for the bulk-purchase of books of proper standard by the various education and library authorities. This it should do without making it a ritual which kills at once the initiative of the supplier as well as of the consumer.

7 Message of Physical Bibliography

The book has now taken an important place in modern community. Communication is of the very essence of community life — be it a small local one, or a big national one, or even the vast community of the whole world. It is co-operative living alone that can bring concordance and happiness. Cooperative living will be impossible without communication. There are three modes of communication:

1 Communication in the immediate presence of one another;

2 Communication of the voice alone, that is, communication through radio; and

3 Communication through writing — that is, through books.

71 Personal Communication

Of the three modes of communication, personal communication is the most effective. For, here not only the words, but also the movement of the eye-balls, the modulation of voice, the change of expression, the gestures, in fact, the total personality is pressed into service to effect communication. This global mode of communication was available only when the community was a small local one. When its size increased to that of a nation occupying a vast territory, this form of efficient communication ceased to be available. A great personality like Mahatma Gandhi might move round the country and communicate through the whole charm of his personality once in a while. This personal mode of communication can only act as an appetiser. It can only stimulate a way of looking at things. It can only lift people to a new level of life. But to maintain that view and to continue in that level, it is necessary to feed continuously by other means of communication.

72 Communication through Voice on the Air

Communication by radio no doubt abstracts the voice of the personality and produces a valuable tone-effect in the communication. This again can only appetise and stimulate. Further, the voice on the air is ephemeral. It dies out. It is not a form of communication to which a person can come back again and again for checking up, or for absorbing more of it in the measure of his own advancement.

73 Communication through the Book

The importance of the written book as a means of communication lies in supplementing the above two forms of communication. But, the written book is ideas transformed first into phonetic symbols — which are an abstraction — and

again the transformation of these phonetic symbols into a physical something — the book. This physical something must be made acceptable to the common man. For this, every part of it must be made handsome. All the features of the book — from the intangible ideas to the most external Jacket — should be blended into a balanced whole. It is the ideas of the author and his style which form the starting point. This creates the atmosphere of the book. These fix its character. Every element in its physical clothing should be in keeping with this character. The choice of typeface, the design of the page, the binding, and the Jacket should all express and enhance the character of the book. The author and his printer are collaborators. The business of the printer is to present the author's ideas as attractively as possible, to captivate the reader by the very appearance of the book, and when he picks it up, to make his reading easy, irresistible, and delightful. This is the message of Law 3 of Library Science — Every Book its Reader — to Physical Bibliography.

PART N

LAW 4 AND LAY-OUT OF THE BOOK

CHAPTER NA

LAW 4 OF LIBRARY SCIENCE

1 Enunciation

Law 4 of Library Science is "Save the Time of the Reader." It is not only the objective time, but also the subjective time, which should be saved. Saving the subjective time is equivalent to saving the tempo of the reader. To save the tempo of the reader, it is not sufficient if all the physical characteristics of the book and its aesthetics are to the satisfaction of Laws 2 and 3. It is also necessary that the book should be divided into parts, chapters, sections of chapters, their subsections, and so on, in order to save the time of the reader in skipping through the book for the first time and in locating any needed specific information on any later occasion. A book should also have several auxiliaries, such as

1 The title of the book, the name of the author, and preferably also the call number being displayed on the spine of the book;

2 Prels or preliminary pages; and

3 End matter.

2 Preliminary Pages

The Prels or the Preliminary Pages are, as the very epithet shows, pages to be prefixed to the text of the book. These usually consist of

1 A half title leaf giving a brief title of the book on its recto;

2 A title page leaf giving on its recto the title of the book, the name of the author, the name of the publisher, and

any other relevant details such as names of collaborators, and also preferably giving on its verso the call number of the book — thus giving a quick preview of the subject of the book;

3 Contents page giving a more detailed but only a bird's eye view of the subject of the book;

4 Pages containing conspectus or introduction giving a brief descriptive account of the special features in the development of the subject in the book; and

5 A few other pages giving other items such as, dedication.

3 End Matter

The end matter, as the very epithet shows, is suffixed to the text of the book. The end matter usually gives

1 Bibliography;

2 Index; and

3 Other odds and ends such as, appendices, annexures, and glossaries.

4 Oddments

A generic name for the prels and the end matter is 'Oddments'. Of the oddments, the preliminary pages are intended to save the time of the reader as he approaches the book before he dives into it. The end matter is intended to save the time of the reader when he comes to the book on a later occasion to verify a statement, or to look up a fact, or to check his memory, or to pick out some specific information. It also takes away from the text the other end matter so as not to distract the attention and therefore the time of the reader while reading through the book.

CHAPTER NB

ANATOMY OF THE LAY-OUT OF THE BOOK

1 Long Chain of Letters

In the early ages of writing, words and sentences had to be sensed only by following the thought. They were not separated out so as to help the eye to recognise them at sight. It was not unusual to make the entire matter in a manuscript to run on as a single chain of letters without separation of words or of phrases, clauses and sentences by punctuation marks, or into paragraphs, or chapters or parts.

11 Fantastic Manuscript

In 1951, a fantastic book was brought to my notice by Pandit Yellappa Shastri, a Jain scholar of Bangalore. The script was in Kannada. But it was really polyglot. By varying the sequence of the letters in different prescribed ways, one gets out of it different books in different languages. Again by following certain other prescriptions in combining the letters, one gets different books on different subjects. Say, for example, if the second letters of each line were taken together, it was in Sanskrit. If the third letters were taken together, it was in Tamil. If every fifth letter was read out, we got astronomy. If every twelfth letter was read out, we got medicine, and so on. A more tantalizing factor was that even the lines had not been marked out. The owner of the manuscript said that after several years of struggle he had been able to mark out the lines and that he also obtained some clue regarding the combination of letters which gave certain languages and certain subjects. He said that he also found instructions to arrange the letters in geometrical patterns or in the form of the figure of a bird, a snake, an elephant, and

so on. When the letters were thrown into any such prescribed pattern an account of a subject symbolised by the pattern was got. Surely such a disposition of the letters in a printed book will be repugnant to all the Laws of Library Science and particularly to Law 4.

2 Spacing and Punctuation

It is not known when space came to be left between words. Perhaps punctuation marks were inserted even later. We now have a convention about different kinds of space — word space, comma space, semicolon space, and full stop space.

3 Chapter Formation

Division into chapters is said to have begun in the printed books by the end of the sixteenth century. A common practice today is not to begin a chapter at the top of the page, but to begin some lines lower down. The chapter heading is said to be "Dropped." The space between the top of a page and the first line of a chapter is called "Chapter Drop." The practice of writing the first letter of a chapter in a huge hand and and illuminating it in manuscript books was continued after printing was invented. It is even now being continued by some printers though in a much reduced size.

4 Section Formation

Separation into sections should have come into practice still later. It has now become almost universal practice to begin each paragraph in a new line and to indent it by a few ems or indicate its beginning in some other way. There is a tendency now to separate sections into subsections of remove 1, 2, and so on, so that no section is too long. The aim is to make it short enough to ensure the observance of the Principle of Unity of Idea appropriate to the level of the sections and the subsections.

CHAPTER NC

HEADINGS AND AID TO THE EYE

1 Variation of Typeface

The latest practice in printing books is to provide headings of various kinds — such as, page heading, chapter heading, and section heading. These headings are a great help in browsing through or consulting a book. It has now become a general practice to indicate the status of these headings by a suitable variation in typeface. One such variation is as follows:

1 Small capitals for page heading;

2 Roman capitals for the first line of the chapter heading if it mentions only the number of the chapter, in a form such as "CHAPTER 8";

3 Bold face capitals for the name of the chapter;

4 Bold face capitals and lower case for the headings of primary sections;

5 Capital and small capitals for headings of subsections of remove 1;

6 Capital and lower case Italics for headings of subsections of remove 2;

7 Small capitals for subsections of still higher removes; and so on.

2 Page Heading

A simple and helpful rule for page heading is: "Use the short title of the book as the heading for every verso page and the heading of the chapter as the heading for each recto page."

3 Chapter Heading

Some books merely number the chapters. Some give fanciful chapter headings. Law 4 will be better served if the chapter heading is an expressive one.

4 Section Heading

Few books give section headings. In my books, I have been giving section headings, almost to the point of every paragraph getting an expressive heading of its own.

5 Section Number

My practice has also been to number the section headings by a decimal fraction notation, bringing out the modulation in every chain of heading and subheadings. I go even a step further and make the number mnemonic. This is helpful in developing the theme of a book. Some of the mathematical books published by the Cambridge University Press and some of Otto Jesperson's works on linguistics were fore-runners in this. This is new; and the usual resistance to anything new is met with. It took me some effort to persuade one of my publishers to provide section headings and much against their wish to accept also my numbering of sections. My belief is that this practice will add considerably to eliminate fogginess in thinking on the part of the author. It will also be of help to readers in slow reading and assimilation and in looking up the book again for consultation. But, if publishers and authors bring this into practice, the reading public will get accustomed to it and ultimately have the benefit of it. This is a direction in which Law 4 would like Physical Bibliography to develop.

CHAPTER ND

TEXT WITH COMMENTARIES OR TRANSLATION

1 Classic

For classification and cataloguing purposes a work is said to be a classic if

1 It has elements of permanent value;

2 It is saturated with the personality of the author — itself very powerful and highly organised;

3 It is a seminal work cutting new ground, blazing new trail, and stimulating new thought;

4 It is usually republished over long periods; and

5 It attracts other works on itself by way of either evaluation or commentary.

In this chapter we are concerned only with commentaries.

2 Commentary

A commentary on a classic develops further and extends the ideas found in the latter. The practice of developing a subject through commentaries on a classic has been much in vogue in India. The development made in a commentary of Order 1 may be further developed in a commentary of Order 2, developed still in a commentary of Order 3, and so on. Part 3 of my *Colon classification* (Ed 6; 1963) gives many examples of classics with their respective families of commentaries. In a family of Sanskrit classics, the classic as well as each of its commentaries has a distinctive title of its own amounting to a proper noun.

3 Text with Commentaries

It is helpful to print, immediately below each passage or verse of a classic, the commentary of Order 1 on it, imme-

diately below the latter the commentary of Order 2, and so on. Thus while printing, the text of the classic is cut into helpful pieces and the appropriate commentaries on each piece are inserted along with it before the next piece is started. This is usually done in the case of Sanskrit classics.

4 Typographical Distinction

In this way of printing a classic and its family of commentaries, different sizes of types are used to distinguish each member of the hierarchy of the text and its successive commentaries. Such a lay-out of a classic and its family of commentaries saves the time and preserves the tempo of the reader to a great extent. Here is an example:

SANKARA. Brahmasutra-Bhashya with Bhamati of Vachaspati Misra, Kalpataru of Amalananda, and Parimala of Appayya Dikshita (Vani vilas sastra series. 2).

5 Text with Translation

Occasionally we have books containing the original text and its translation into some other language. These are two ways of printing such a book. These are described in the next two sections.

6 Passage by Passage Translation

Each passage or verse of the original text may be immediately followed by its translation. Such an alternation of text and translation is continued down each page. Here is an example:

BRAHMOPANISAT-SARA-SANGRAHA, tr by Vidyatilaka (Sacred books of the Hindus. 18, Part 2). The translation of each passage follows it immediately).

7 Page by Page Translation

The translation of each page of the original text may be printed on the opposite page. Here are some examples:

1 OVID. Heroides and Amores with an English translation by Grant Showerman. (Loeb classical library. Latin series).

In this book the Latin text is on the verso pages and the English translation is on the recto pages.

2 BHAGAVAD-GITA (With Tamil translation) by S Subramanya Bharati.

In this book the Sanskrit text is on the verso pages and the Tamil translation is on the recto pages.

3 S R RANGANATHAN and MUTHUKUMARASWAMY. Commemoration bibliography of the first 1008 books published by the South India Saiva-Siddhanta Works Publishing Society. 1961.

In this book the English text is on the verso pages and the Tamil translation is on the recto pages.

CHAPTER NE

EVOLUTION OF PRELIMINARY PAGES

1 Pre-Natal Stage

Among oddments, the first to evolve was preliminary pages. They began with the ancestor of the title-page. To get an idea of it, we should examine the ancestor of the book itself, namely, the manuscript.

11 Colophon

The printed books of the incunabula period closely imitated the manuscripts in the form to which they had evolved at the time of Gutenberg. These manuscripts did not possess a title-page — still less preliminary pages. The barest information, now found in a title-page and the neighbouring pages, was given at the end of the manuscript. It was called 'Colophon'. The term 'Colophon' is defined in the *New English dictionary* as "The inscription or device, sometimes pictorial or emblematic, formerly placed at the end of the book or manuscript, and containing the title, the scribe's or printer's name, date and place of printing, etc. In early times the colophon gave information now given on the title-page."

12 Example of Colophon

For instance, Jacob de Voraigne's *Golden legend* printed by William Caxton has the undermentioned colophon:

"1 Black. 2^a [wood cut] 448^b. Col. 2: Thus endeth the legende named/in lateyn legenda aurea/that is to saye/in englysshe the golden legende/For/lyke as globe passeth in valewe alle/other metals/so thys legende excedeth/alle other books/wherein bencontey=/ned alle the hygh and grete

festys of/our lord/the festys of/our blessyd lady the lyues passyons and myracles/of many other sayntes/and other hys/toryes and actes/asal alonge here/afore is made mencyon/whyche weke/I haue accomplished at the comman=/demente and requeste of the noble and/puyssaunte erle/and my specyal good/lord wyllyam erle of arondel]and[haue/fynyshed it at westmestre the twenty/day of nouember/the yere of our lord/M/CCCC/xxxiij/and/the fyrst yere/of the reygne of kyng Rychard the/ thyrd//// by me Wylyam Caxton." This is the pre-natal stage of the title-page and the preliminary pages. For, under the imitative influence of the manuscripts some of the earliest printed books did thus give a fully worked-out colophon and featured it prominently. This resisted the appearance of the title-page.

2 New-Born State

After labouring in this pre-natal stage for about a quarter of a century, the title-page in the front had its small beginning. It was indeed as puny as a new-born. Though a separate page was devoted to it, it was rendered similar to the half title-page of our days. It did not however remain long in this puny form. For, even the third quarter of the fifteenth century witnessed the printing of a book which had the title-page expanded to a more respectable dimension, almost suggestive of the modern title-page.

Example 1.—In 1470, Arnold Hoernen at Cologne printed a long paragraph, on an otherwise blank page, giving the title of the book *Sermo ad populum predicabilus in festo presentacionis Beatissime Marin Semper Virginis*. Besides such a long title, the title-page contained also some eulogistic remarks regarding the book. The year of publication was also given. As a matter of fact, this book is probably the first to transfer bodily the information contained in the colophon, to a page at the beginning of the book.

Example 2.—Another improvement was made in the display of the legends in the title-page in the Italian edition of the *Calendar* of Regimontanus printed in 1576 by Erhardt Ratdolt. Here the title-page was elaborated further by the insertion of the imprint near its tail margin. Thus, even in the sixteenth century we have the prototype of the modern title-page.

3 Printer Dominates

In those days it was the printer rather than the author that was the godfather of the title-page. This led naturally to the dominance of his interests in the legends that were allowed to appear in it and the way in which they were rendered. For instance, the title appended to an edition of the *Life of Sir Phillip Sidney* by Sir Fulke Greville published in 1652 is transcribed below:

"The life/of the Renowned/Sr Phillip Sidney with/The true interest of England/as it then stood in relation to all For-/rain Princes: And particularly for sup/pressing the power of Spain Stated by Him./His principall Actions, counsel,/Designes, and Death./Together with a short account of/the Maximes and Policies used by Queen/*Elizabeth*, in her Government./Written by Sir Fulke Grevil Knight, Lord Brook, a servant to Queen/*Elizabeth*, and his companion and friend./London, printed for Henry Seile over/against st./Dunstants Church in Fleet Street./MDCLII."

It is observed by an editor of a later edition of this work that it was first published in 1652, twenty-four years after its author's death and the title 'The life of the renowned Sir Phillip Sidney' (with other matters) was given to it presumably by the unknown P.B., the editor, certainly not by Greville himself. In a manuscript copy of the work, the title is simply 'a Dedication'.

Here is the opinion of an Elizabethan critic on the matter of godfathership of the title-page: "On the title-pages of the old editions of the separate plays designations are used which appear to have been chosen at random by someone other than the author." This justifies the heading of this Section.

4 Publisher Dominates

We may well guess that the title-page was the creation, not of the author but of someone else connected with the book. Taking advantage of this fact, the publishers tried to make use of the title-page for advertisement. As a natural consequence of this, much of the contents of the book began to appear on the title-page itself. Here are transcripts of the title-page of such a work and of the title-page and the contents pages of the same work printed at a later date:

"The/Rare and most wonderful/thinges which Edward Webbe/an Englishman borne, hath seene and passed/in his troublesome trauales, in the cities of Jerusalem, Dammasko, Bethelem and Galley:/and in the Landes of Jewrie, Egipt, Grecia,/Russia, and in the land of Prestor John,/Wherein is set forth his extreme flauerie sust/ained many years together, in the Gallies and wars/of the Great Turk against the Landes of Persia,/Tartaria, Spaine, and Portugall, with the/manner of his releasement and coming into Englande in May last/. London,/printed by Ralph Bolwer for Thomas Passier, and/are to be solde at his shop in Cornhill, at the signe of the Cat and Parrats over against Popeshed alley, near the Royal Exchange."

This is the title-page of the work printed in 1590. Here is the transcript of the title-page of the 1902 edition of the same work included in the Arber's English Reprints.

"English reprints/Edward Webbe/Chiefe Master Gunner/ "His trauailes/1509/edited by Edward Arber/F.S.A., etc., late

examiner in English/Language and literature/to the university of/London/Westminster/A. Constable & Co., Ltd., 1902. The verso of this title-page is made use of as the contents page. Here is the transcript of a portion of the same:

"Edward Webbe's Travels

1	Epistle to the Reader,	13
2	Dictation to Queen Elizabeth,	14
3	Acrostic on the Queen's Name,	16
4	Places, etc., referred to—	
	Russia, etc., Moscow, Kaffa,	17, 18
	in Crimea, Narfa, in the	18
	Baltic,	19
Italy		
	Leghorn,	19
	Trybusas,	23
	Venice, Padua, Ferrara, Bologna, Florence,	30
	Rome,	30, 31, 32
	Naples,	31, 32
	Palermo,	32
Egypt, etc.,		
	Alexandria,	21, 22, 23, 26, 33
	Cairo,	21, 22, 23
	The Nile,	33
	Crocodiles,	26
	The Red Sea,	32, 33
	The pyramids,	33
	Tunis,	35
Turkey, etc.,		
	Constantinopel,	20, 25, 29
	Persia,	20, 21

Syria,
Dymascus, 23, 33
Jerusalem, 22, 26, 34
East Indies,
Goa, 22
Armous 23
The land of Prestor John, (Tartarica) 23, 24, 25, 35
France
Dreux, 34, 35
Notes, 36

Much of the contents of the 1590 title-page find a place here.

5 Patron Dominates

The widespread patronage of authors by Royalties and nobleman in the Elizabethan days led to the inclusion of this fact in the title-page. But, later the dedicatory part of the legend on the title-page was transferred to a separate preliminary sheet. At about the same time, the author was given a share of the preliminary pages, to introduce the work briefly to the reader. In fact what we now call the preface was then entitled "To the reader." Thus by the middle of the eighteenth century, the title-page became simpler as a result of its having shared its original contents with a family of preliminary pages.

6 Author Dominates

Besides the title, the title-page contained only the name of the author, publisher, the imprint, and sometimes the publisher's device. Now the author was given the privilege of occupying more of the title-page. This was used to indicate his qualifications, profession, and status in life. About the beginning of the nineteenth century, it became common for

the author to use his region of the title-page for mentioning his other works. Naturally this was not objected to by the publisher if he himself had published these works; even otherwise the description of the author as having brought out many books was not without its advertisement value for the publisher.

61 Works

This again naturally crowded the title-page too much. This additional matter on the title-page was slowly transferred to an additional preliminary sheet — the half leaf which began to appear in the latter half of the nineteenth century. Similar to the present practice, the list of the other works of the author found a place on the back of the half title-page. This page is in the alternative used to mention the different books of the series, if any, to which the book in question may belong.

62 Estimate

In our own days some further developments are taking place. These are not without relation to some peculiarities found in the early forms of the title-pages. The transcript of the title-page of Edward Webb's *Travels* given in Sec NE 4 shows that it contained an evaluation of the book. During the years when the title-page was progressively simplified by the transfer of some of its contents to different preliminary pages, the evaluation part of its contents was left out. It was not only ejected from the title-page but was first denied a place even in the family of preliminary pages. This wrong done to it is nowadays sought to be redressed by allowing it a place at least outside the family of preliminary pages. That place is the flap of the Jacket or the dust cover of a book, which came into vogue just at the beginning of this century. No doubt the dust Jacket is not an organic part of

the book and hence shortlived. Even a transient something is better than nothing; and a compensation is that when a book is fresh, it is the habit of the modern reader first to peruse the flap of the Jacket. With the insertion of a strong transparent plastic cover over the Jacket, even the wrong of transience is removed.

7 Other Additions

One of the early members of the preliminary pages to establish itself was the contents-page. This is a necessary member. A preface or an introduction or a conspectus is also now regarded as necessary. Generally the preface contains also the acknowledgement of the author. But in some publications as in those of the Madras Library Association's publication series, acknowledgement is separated from the preface and is given an independent status and an exclusive page. This is not the only possible addition to the preliminary pages. Foreword by a distinguished personage and the general preface to the series, if any, to which a book may belong, often get some pages in the preliminary forme.

8 Arrangement

The arrangement of the preliminary pages is getting more or less conventionalised. It is now definitely the practice to have the first few of them in the following sequence:

1 Leaf containing the half-title
2 Leaf containing the title; and
3 Leaf containing dedication.

With regard to the rest of the preliminary pages, there is some variation in practice. They should be arranged in the increasing sequence of their help to Law 4. The title-page is of greater help than the half title-page. Of course, dedication

does not come into this line of thinking. Nor does acknowledgement do. I should therefore prefer to put acknowledgement on a late leaf. Next to the title-page, should come the contents-page which gives a fuller view of the book. Law 4 would therefore recommend to Physical Bibliography giving the contents on the fourth leaf, that is on the first substantive leaf after the leaf containing the title. The preface or the introduction gives the author's own estimate of the value of his contribution. It may also function as the author's brief guide to the book. It is therefore desirable to make it follow the contents-page and indeed to be the last element of the prels. If there is a foreword by a person other than the author, perhaps its very name will be justified if it is inserted just after the contents page.

CHAPTER NF

TITLE-PAGE

1 Contents of Title-Page

The present formula for the make-up of the title-page is basically as follows:

1 Title or name of the book;

2 Name(s) of author(s);

3 Names(s) of collaborator(s) such as translator(s), illustrator(s) and so on, if any, with appropriate words indicating their respective role;

4 The publisher's device, if any; and

5 The imprint.

The imprint consists of the name(s) of the publisher(s), the name(s) of the place(s) of publication, and the year of publication. The edition also may be given in the title-page, unless one prefers to give it on the back of the title-page. The back of the title-page may give also the call number of the book. The title is the prepotent element on the title-page. It is therefore the practice to compose it in types of the greatest weight and size and insert it in the upper part of the title-page. The name of the author, normally the next in importance, is usually composed in a type of slightly smaller weight and size and inserted below the title but above the centre. This position approximates to the optical centre of the page which is higher than the physical centre. The imprint is usually given in subordinated typeface at the bottom of the title-page.

2 Decoration

If we take the main purpose of the title-page to be that of helping Law 4, it is desirable that it has physical simplicity without any attempt at decoration, illustration, colouring, bordering, or any other addition. These would have been welcome to Law 3. But the Jacket meets all such requirements of Law 3. If the modern practice of protecting the Jacket permanently by transparent plastic cover is followed, Law 3 should be satisfied with the Jacket and leave the title-page entirely at the service of Law 4. There can be a division of function between the Jacket and the title-page. Aesthetics should be the main motif in the design of the Jacket. But the design of the title-page should be functional. Aesthetics should not override functional purpose.

3 Double Title-Page

In Germany and other countries of continental Europe, the unit of design of title-page has been taken to be "an opening" or an open double page. To my mind this appears to have been based on a faulty psychology. In the first place, there is not enough matter to be distributed over two pages. Secondly, for the mere aesthetic appearance the opening may be the unit; but, for purpose of absorbing the information given, the fold and the sewing between the two pages form too great a partition to regard the two pages together as a unit. If this view is upheld, it will follow that the back of the half title-page can very well be relegated to the function already described in Sec NE 61.

CHAPTER NG

EVOLUTION OF TITLE-PAGE

1 Protective Purpose

There has been a continuous change in the very purpose of the title-page. In the early years of printing, books were sent out to booksellers folded but unbound. They remained unbound for a long time before they were bound and sold. In this case, the first page was liable to be damaged. To protect the text from damage, the printer adopted the practice of leaving the first page blank, so that it could be cut away by the binder leaving the book whole and in good condition. This is evidenced by the transcript of the colophon given in Sec NE 12. But as in the case of the first stage in the evolution of the Jacket, such a blank page in the front of a page made it an anonymous blank to the inconvenience of the bookseller as well as the customer. Again as it was often turned over to see what the book was, the first page of the book was exposed to damage even as before.

2 Identification Purpose

To avoid this contingency, the title or some identifying phrase came to be printed on the face of the blank. It did not take long for other information to be added after the title. This led to the development of a full-blown title-page. As soon as the title-page was thus made to carry more information than the mere name of the book, it gained in value and it too required protection. A blank sheet was added before it. The same process of evolution was gone through until the face of this blank sheet was converted into the half title-page. To protect this half title-page again, the printer is nowadays adding a blank "End Paper."

3 Opportunity for Art

Originally, the title-page was printed in the same type as the text. But the need for diversity was soon felt and types of larger size and of ornamental face were introduced. For a long time, Gothic face was used for the title-page though the text was printed in Roman face. The Gothic-faced title-page was often cut in wood with very elaborate and intricate ornamentation almost to the point of hiding away or suffocating the title. Decoration became the motif instead of the satisfaction of Law 4. The protest of Law 4 was soon heard. The decoration was made to recede to the border, and the centre of the title-page was made readable.

4 Effect of Puritanism

The sixteenth century puritanism had its effect on the design of the title-page. It hounded out all distracting ornaments from the face of the book, which the title-page was. Indeed Law 4 found a good ally in puritanism.

5 Additional Engraved Title-Page

During the seventeenth century, engraved title-pages became popular. This led to a revival of decoration of title-page. There was a tug of war between puritanism and Law 4 on the one side and decoration on the other. It was finally decided as a compromise to retain the ornamentally engraved title-page and add another title-page of simple letterpress, after the engraved one.

6 Words in the Title-Page

Originally, the words scrambled over the entire title-page — cramped and crowded. This defeated the purpose of Law 4. In the eighteenth century some simplification came. Indeed in keeping with the general spirit of that age, the title-page

assumed classical simplicity. But the romanticism of the early nineteenth century brought back both profusion of words and ornaments. New-born lithography freed the typeface from the limitation of the rectangular type body and letters were designed for the title-page along sentimental lines. It was not unusual for the title-page of a Christmas story of early Victorian period to be made of letters contrived out of icicles or twigs crowned with snow or robins. About 1870, William Morris brought this tendency to a climax much to the chagrin of Law 4.

7 Current Practice

The simple functional design described in Sec NF1 has now slowly established itself. The present generation is getting accustomed to this functional kind of title-page. This movement to make the design of the title-page functional is not an isolated phenomenon. This principle is now being widely adopted. In architecture, for example, old conceptions are brushed aside and new experiments are made to make the design functional in all utility spheres. Title-page belongs to the utility sphere. There is ample scope for art to express itself in such a way that the utility function is enhanced rather than suppressed. It can endow the space of the title-page with a forcefully subtle quality by a proper distribution of space and words. Thereby, art as well as utility can be equally satisfied. There is ample scope for the further evolution of the title-page in keeping with this symbiosis between art and utility. It is the business of Physical Bibliography to exploit it.

PART P

LAW 4 AND INDEX

CHAPTER PA

INDEX

1 Author of Index

Among end-matter, the Index is the compulsory element. To get into a book without an index is like getting into a forest without a trained guide. The index has no doubt to be provided by the author. It cannot be made by the printer. It is now the practice to get it done as a piece of back work or by an obliging near relative or by a premature junior. I regard the index as too vital to the purposes of Law 4 to be treated in that indifferent way. My experience is that the author alone is the most competent indexer. Even he loses the fulness of his competence, unless he indexes the book the moment he finishes creating it. A profession of indexers is now emerging.

2 Definition

According to classical usage, the Latin word *index* denoted a discoverer; a catalogue or list; the title of a book; and the fore or index finger. Cicero (106 – 43 B C) used the word to denote the table of contents, or "*Syllabus*." Shakespeare too did so. In the present English usage, the term 'Table' is used for the term 'Contents'. *The new English dictionary* affords an interesting study of the many meanings with which the word 'Index' is associated — in mathematics, mechanics, anatomy, and music. But the definition with which we are concerned, is "An alphabetical list placed (usually) at the end of a book, of the names, subjects, etc, occurring in it, with indication of the places in which they occur." Its equivalent is "Table" in French and Italian, and "Register" in German.

CHAPTER PB

HISTORY OF INDEX

1 Introduction

In sending certain volumes to his friend Lucilius, Seneca (4 B C – 65 A. D.) sent along with them notes of particular passages, in order that "he who only aimed at the useful might be spared the trouble of examining them entire." Thomas Fuller (1608–1661) said, "An index is a necessary implement, without which a large author is but a labyrinth without a clue to direct the readers within." According to E B Osborn, "There is no greater literary sin than the omission of an index."

2 Eighteenth Century

In 1750, Dr Johnson wrote to Richardson entreating him to add an index of subjects to the work of Clarissa Harlowe. He says, "When the reader recollects any incident, he may easily find it, with the aid of an index." In 1778, a sum of £12,900 was voted for indexes to the *Journals of the House of Commons*. Issac Disraeli (1776–1848) wrote, "I for my part venerate the inventor of indexes; and I know not to whom to yield the preference, either to Hippocrates, who was the great anatomizer of the human body, or to that unknown labourer in literature who first laid open the nerves and arteries of a book."

3 Nineteenth Century

While the eighteenth century was an age of advocacy, the nineteenth was one of agitation. It was said that the "omission of an index, when essential, should be an indictable offence." Both British and American lawyers proposed that

an author, publishing a book without an index, should be deprived of the benefits of the Copyright Acts. Lord Campbell (1799–1861) proposed legislative sanction for this.

31 Low Literacy

The great delay in the practice of providing an index to a book is largely traceable to the late appearance of universal education. Though printing was invented in the fifteenth century and books were made comparatively cheap and plentiful, the conservatism of the educated few led to indifference, if not obstruction, to the spread of literacy among the masses. In England, elementary education was made compulsory only in 1870. We do not know when we shall have universal literacy in India. The percentage of literacy has not yet reached 50.

32 Upper Centiles

When only a select few use books, the probability is that they are persons belonging to the uppermost centiles in the intellectual scale. These have an unusual memory and a remarkable familiarity with books. Such people may not depend very much on indexes. No wonder the need for indexes was not felt for nearly three centuries after the invention of printing.

33 Lower Quartiles

But when the lower quartiles of the community began to use books and books themselves became far more numerous overreaching even the memory of the uppermost quartile, the index naturally became a necessity. This social change began only about the end of the nineteenth century; and it accounts for the index tending to become a normal feature of the printed book more definitely thereafter. If we remember this dependence of the evolution of the index-consciousness on the spread of literacy and couple with it the fact that more than half of our countrymen are still illiterate, is

it a wonder that even the few worthwhile books produced in India often go without an index? It is all a matter of social pressure.

4 Meagre Index

The index is often very meagre. Here are examples:

SN	Author	Title	No. of pages of	
			Text	Index
1	Davy (Humphry)	Elements of agric chem (1813)	388	4
2	Bleck (A V)	Aveste (1854)	211	13⅓
3	Maspens (G)	Struggle of the nation (1896)	788	6
4	Largerguist (Walter E)	Public utility finance (1927)	671	4½
5	Mackenzie (Findlay)	Planned society (1937)	978	11
6	Jackmen (Wl)	Economic principle of transportation (1935)	881	8¼

5 Sumptuous Index

At the other extreme, T T Sharma's *Kannada poets* mentioned in inscriptions 1924 (Memoirs of the Archaeological Survey of India, 13), has an index of two pages to a text of two pages. Verily it has virtually repermuted the words of the text in an alphabetical sequence to form the index.

6 Optimum Index

The correct length of index should surely be between these two extremes. In my books, the question of determining the most helpful length of index had been borne in mind. Indeed in several senses their indexes constitute experiments in indexing. They would indicate a proportion of 1:30 as the optimum proportion of the length of index to that of the text.

CHAPTER PC

PLACE FOR INDEX

1 Index in Book

Usually the index occurs at the end of a book. The only cause of occasional confusion is due to appendices, annexures, and supplements either preceding or following the index without conformity to any accepted convention.

2 Index in Periodical

But in periodicals the index may occur either at the end or at the beginning of the text. At present the former is more often the case. But, the latter is more helpful. Here are seven periodicals to illustrate the occurrence of the index in the preliminary pages:

1 Nature;
2 Annals of botany;
3 Annals of applied biology;
4 Lancet;
5 British medical journal;
6 Annals of library science; and
7 Library science with a slant to documentation.

3 Index in Abstracting Periodical

My *Classified catalogue code,* Ed 5, 1964, specifies that the Alphabetical Index of Authors and Series, the Alphabetical Index of Classes, and the Classified Index of Entries should all precede the Text in an abstracting periodical. This is believed to be more helpful to the fulfilment of Law 4.

4 Index in Law Book

Law books present another deviation from normality. They often present an index of cases in addition to the general

index. A rigid convention has not been established in regard to the position of the index of cases. Earl of Birkenhead's *International law* (1827) gives the index of cases at the end of the book just before the general index. On the other hand, K V Krishnaswamy Ayyar's *Professional conduct and advocacy* (1939) gives the index of cases before the text of the book.

5 Index in Multi-Volumed Book

Multi-volumed books give rise to another kind of variation in the occurrence of indexes. Here are some examples:

SN	Book	Index	
		Each V	Cumulative
1	Yeaxlee (B A), Spiritual values in adult education, 2 V. 1925	Yes	No
2	Hooker (J D). Himalayan journals. 2 V. 1854.	No	Yes
3	Vaddell (J A L). Bridge engineering. 2 V. 1916.		Yes in Each V
4	Mellor (J W). Comprehensive treatise on inorganic and theoretical chemistry. 16 V. 1922–1937.	Yes all but V 16	Yes in V 16
5	Lord Acton. Cambridge modern history. 13 V. 1907–1911	Yes	Yes in V13
6	Frazer (G). Golden bough 12V. 1911–1915	Yes for V 3, 4, 9	Yes in V 12, and for each of V1–2; V 5–6; V 7–8; V 10–11;
7	Guizot (M). History of France, 8 V. 1882.	No	In V 6 for V 1–5; and in V 8 for V 6–8.

CHAPTER PD

CUMULATIVE INDEX OF PERIODICAL

1 Separate Volume

Usually each volume of a periodical has its own index. The ideal is to provide also cumulative index at stated intervals, say, once in five or ten years. Such cumulative indexes occur as extra set of volumes not counted as a volume of the periodical itself. In actual location on the shelves, they are best kept at the head of the volumes of the periodical. The *Chemical abstracts* of the American Chemical Society has a volume of cumulative index every ten years. So is the case with the *Annalen der Chemie*, and the *Berichte der Chemie*.

2 Unhelpful Practice

Some periodicals give a cumulative index of a number of consecutive volumes at the end of the last of them. For example, the *American journal of science and arts*, includes a cumulative index for ten volumes at the end of every tenth volume. This practice is a source of irritation. Another deceptive practice is to have one of the regular volumes of the periodical as a cumulative index, as V 21 of the *Journal* of the American Chemical Society. A worse practice is giving the cumulative index as part of a much later, regular volume of the periodical. Example: In the *Journal* of the American Chemical Society, the cumulative index to V 1–20 is given in the first half of V 21 and that to V 21–40 is given in P 313–348 of V 44. Here, the shelving of the cumulative index at the head of the set is impossible and it is destined to lie hidden in the shelves somewhere amidst the regular volumes of the periodical.

CHAPTER PE

CLASSIFIED INDEX

1 Rare Kind

A rare kind of index is the classified one. Paul Monroe's *Cyclopedia of education* provides such an index. It will be of much use in an index to a work in the class "Literature." P B Roy has experimented on this, in respect of some of the works of Rabindranath Tagore.

2 Unnecessary in Expository Book

A classified index may be rather out of place in the index to an expository book. For, the exposition of the text itself is systematic in such a book.

3 Reader's Convenience

The index to an expository book is in actuality to be used by every reader of the book, whereas a bibliography or a library catalogue has only a much smaller number of users. A select small class of people can with ease acquire the special skill for using a classified arrangement but not everybody. Further, even in the case of such a select and small class of readers their tempo at the moment of turning to the index of an expository book, while reading or consulting it, will seldom tolerate anything other than a simple alphabetical arrangement. No doubt, an alphabetical arrangement is not after all so simple. In spite of it, one has the belief or illusion that it is something very simple. And this is what counts for the tempo.

CHAPTER PF

MULTIPARTITE INDEX

1 Irritating Kind

Another kind of index is the multipartite alphabetical index. Here the entries are broken into a number of sequences. It is often irritating if not deceptive. The greater the number of such sequences the more ineffective the index becomes.

2 Bipartite Index

Bipartite form is the more common one. Examples:

SN	Book	Index
1	H N Russell's *Astronomy*	Name and Subject
2	S R Daniel's *Case for electoral reform*	Personal and Subject
3	L H Haney's *History of economic thought*	Name and General

3 Tripartite Index

If bipartite index is bad, a tripartite one is worse. The editor of the 1939 edition of Leonardo da Vinci's *Literary works* would have helped the reader better if he had coalesced the following three indexes into a single one: Names and Bibliography; Topographical Index; and General Index. Watkin Williams' *Saint Bernard of Clarivaux* gives the index in three sequences for persons, places, and manuscripts cited respectively. G C Wheeler's *Mono alu folklore* gives the index in four sequences for motives, flora, fauna, and places, respectively.

PART Q

LAW 5 AND REPROGRAPHY

CHAPTER QA

LAW 5 OF LIBRARY SCIENCE

1 Enunciation

Law 5 of Library Science is "Library is a growing organism." Growth can be phylogenetic as well as ontogenetic. In nature, continued experiment in ontogeny through thousands of generations leads to further stages calculated to be more suitable to the change in the environment. This is true of all growing organisms. It is true also of the library. In physical bibliography we are primarily concerned with the increase in the number of documents.

2 Social Pressure and Growth of Library

21 Social Pressure 1

Man's insatiable thirst for knowledge supported by social pressure for the creation of new commodities and services or for improvements in such existing ones to meet the growing demands of a growing population have resulted in a universe of subjects that is ever-growing. Consequently, the number of documents is also ever-growing.

22 Social Pressure 2

Democracy of learning requires that a nation should provide documents on any given subject in different standards in order to satisfy the intellectual-scatter among its people. Again, a nation has to provide such a variety of documents on an ever-growing variety of subjects in order to satisfy the subject-interest-scatter among its people. Law 2 of Library Science also demands such provision.

23 Social Pressure 3

Democracy in education is another force. Now, many more number of people are writing books, articles, and other documents than ever before. This tendency is on the increase.

3 Impact on Library

The result of the various social forces mentioned above, is a dowpour of a variety of documents on all kinds of subjects and in a variety of intellectual standards. Fifty years ago, under normal conditions, the number of documents in a library was said to double every sixteen years. Today it is doubling in half that number of years.

4 Pressure on Space

41 Threat of Law 5

A library can grow in the number of readers, staff and documents. Social pressure and democratisation of library service result in a continuing increase in the number of readers. The increase in the number of staff too has to keep pace with it. But there appears to be a certain limit to the number of the readers and of the staff, because human beings are mortal. On the other hand, there appears to be no limit to the increase in the number of documents in a library. This calls for an unending growth in shelf-space and therefore in library building. If every library retains all its documents for ever, the whole of the earth's surface will have one day to be given up entirely to libraries.

42 Two Kinds of Growth

This threat of Law 5 has led to the recognition that growth can be of two kinds: Adult Growth and Child Growth. Adult growth does not involve overall increase in size, but only

periodical replacing of the worn-out and less useful cells. In child growth, on the other hand, there is a continuous overall growth in size. The growth in the number of documents in a library is probably a logistic one.

5 Solution

51 Supplanting the Periodical Publication

To thwart the threat of Law 5, several solutions have been put forward. Some of them relate to what can be done at the level of libraries. Others relate to the very mode of production and distribution of documents. A number of the solutions relate to periodical publications. The reason for this special attention to periodicals may be the following.

The rate of production of micro documents is much greater than that of macro documents. The rate of obsolescence of micro documents is usually greater than that of macro documents. For reasons of economy, the micro documents are not published separately but each issue of a periodical contains a few articles. All of these may not be of interest to the clientele of a library. Thus, in general, the proportion of the bulk of the text of interest to the readers of a library is likely to be less in the case of the total volume of periodicals as compared to that of books. Further, the production of periodicals is becoming increasingly costlier.

One suggestion, for example, was to publish each article as a separate document. Through an abstracting or indexing periodical, readers and/or libraries are to be informed about the subjects of the articles. Sufficient number of copies of the articles of specific interest to readers and/or libraries alone need to be produced by the centre holding the originals. This solution to meet the pressure on space nullifies the opportunity for the young minds to browse widely among the arti-

cles in periodicals before they discover their field of specialisation.

In spite of the variety of propositions of this kind (Phelps (R H). Alternatives to the scientific periodical. Unesco bul lib. 14; 1960; 62–89), the periodical continues to thrive as a medium of dissemination of nascent micro subjects. Other newer media are used as supplementary channels.

52 Co-ordination of Acquisition

There is another difficulty brought in by finance. No one library can afford the finance to acquire every document that its clientele may require at one time or another. Efficient library management suggests each library acquiring comprehensively the documents on the subjects of the greatest interest to the majority of its clientele — that is, the umbral subjects only. A document falling in the penumbral or alien regions of interest may be required occasionally. It can be obtained on inter-library loan. Thus, co-ordination of document acquisition in libraries in a country or region is practised with advantage, helping the limited financial resource of each library go a long way.

53 Central Depository

Systematic and judicious periodical weeding out of the obsolete and less-used documents from a library can provide relief to the pressure on its shelf space. There may be an occasional demand for a document withdrawn from the library. To ensure that at least one copy of each of such documents withdrawn from the different libraries would be available in a country or region, a depository library for such publications is established for the country or region. Such a Dormitory Library may be attached to the National Central Library of a small country or each State Central Library in a large

country. This implies that the status of child growth is given only to the Dormitory Library and all the other libraries are given the status of adult growth, with a ceiling on the number of books they can have on their respective shelves.

However, with the present rate of increase in the number of documents, such a Dormitory Library will find it necessary to devise means to check its own growth. Further, reasons of convenience of access to documents and of security during national and international disaster, suggest the establishment of more than one Dormitory Library in different parts of the country, to share the burden.

54 Stack Tower

There is a premium on space in the cities where the large libraries are usually located. The problem has become acute in all the metropolises. In the past, it has been faced by extending the stack room vertically rather than horizontally. A stack tower, which begins perhaps 5 m below ground-level and goes up about 30 m above it, was considered a good solution. But, it is only a small relief in the face of the tremendous rate of increase in the number of documents to be housed.

6 New Species of Documents

To escape the pressure of Law 5, it became necessary to examine whether something could not be done with the embodiment of the document itself. Expressed thought has passed through several kinds of embodiments — from the massive stone form to the current compact paper form. We have now to look for truly tiny forms of documents to meet the problem of space. Can a document change its size from its present macro one to a micro one, even as Hanuman did as described by Valmiki in the *Ramayana*? Yes, it can. Microphotography

gives the answer. For example, standard microfiche cards occupying a 30 cm of shelf length, 7.5 cm height and 12.5 cm depth, can contain micro copies of 125,000 pages. In a micro microfilm the 22 mm micro image on a conventional 35 mm microfilm is reduced further by 2,000 times!

7 Other Benefits

71 PRESERVATION

An appreciable proportion of modern print, particularly in newspapers and popular periodicals, reduces considerably the readable life of documents to a few years. Microcopies are being made to maintain a more permanent record of such documents. The British Museum, for example, is microfilming the volumes of British newspapers.

72 SECURITY

Vital and valuable records exposed to the risk of loss or irreparable damage by fire, flood or other hazards can be safeguarded by making a duplicate copy on microfilm and depositing it in safe-vaults. The new methods of printing from microfilm makes the provision of permanent facsimile copies, when need arises, easy.

73 INTER-LIBRARY LOAN

The microfilm is substantially lighter than the original document. This is of importance when documents are to be transported on inter-library loan. It is estimated that the average cost of searching, packing, and mailing a book on inter-library loan is about Rs 10 or more in England and about Rs 5 in India. When the document required is only one chapter of a book or an article in a periodical, it is cheaper to supply a photo-copy or a micro-copy of the required part.

74 COMMERCIAL DISTRIBUTION OF PERIODICALS

Periodicals such as the *Wild life* are distributed on micro card at a considerably low cost. The Pandex subject and author indexes to articles in scientific periodicals are available in microfiche. One has to watch the extent to which the distribution of periodicals in micro-copy will establish itself.

75 ADVANCE DOCUMENTATION LIST

From 1954 to 1965 the Insdoc (= Indian National Scientific Documentation Centre, New Delhi) was distributing its fortnightly *Insdoc list*. It was a classified documentation list of articles appearing in the current issues of over 1,000 periodicals. The Technical Sub-Committee of the Insdoc of which I was the Chairman, decided to get by air-mail microfilm copies of the contents pages of the foreign periodicals as soon as they were printed. At our end these microfilms were blown up to readable size; the articles were classified and incorporated in the *Insdoc list*. This list used to reach the research workers in the different parts of the country simultaneously when, if not a few days earlier than, the regular printed issues of the periodicals reached them. This advance classified list acted as an appetiser and also saved the time of the research worker in picking up the articles of interest to him appearing in the current issues of the periodicals. As time was of the very essence in this case and as there are international abstracting services covering the subjects covered by the *Insdoc list*, abstracts were not included in the list. Thus there was no need for the compiler of the *Insdoc list* to read the original article. This meant an enormous saving in the acquisition of the microfilm copies of the contents pages alone. By way of contrast, mention may be made of the Japanese practice. They prepare documentation lists with abstracts in the Japanese language. They, therefore, get the cur-

rent issues of periodicals by air mail. The cost of their transport is far greater than it was experienced in India getting the microfilm copies of contents pages alone.

76 Availability for Research Purpose

Documents which have gone out of print or are otherwise not obtainable for study or research, can now be got as reprograph copy. For example, in USA, ninety institutions are cooperating to make the dissertations submitted for higher degrees available for use. About 6,500 of such dissertations are published yearly and 300 to 600 copies are made available each week.

77 Faithful Reproduction of Original

A reprograph copy can give an exact reproduction of the original in all its details. Any error that is likely to occur in copying from the original by other means, such as typing and copying with hand, can be minimised. This is of particular importance in the case of engineering drawings, data, etc.

78 Better Library Service

The successful production of good, fast photocopying equipment and also economical reading and reader-printer devices, has facilitated quicker access to documents.

8 Looking Forward

The punched tape, magnetic tape, and magnetic drum are newer forms of graphic storage. Experiments are in progress to reduce the size of documents to such a fantastic extent that the entire contents of a large library such as the Library of Congress, containing some fifteen million documents, could be contained in a crystal of about one cubic cm size. Video

tube systems such as the Dacom and the tele-transmission of documents with the aid of communication satellites herald an age when there may be need to have only one world store of micro-copies of documents and a reader, wherever he may be situated, can order and get the image of a particular document flashed on to the screen placed in front of him in a matter of seconds and if necessary, a copy of it made with equal facility.

91 PRINCIPAL DOCUMENTS USED

The succeeding chapters of this part deal with different kinds of reprograph copies and copying methods from the point of view of Physical Bibliography. The descriptions and discussions are based mainly on the following documents:

1 FREEDMAN (S B). Micro-photography of source documents for the proposed national science library system. 1964. (Lecture delivered at the University of Pittsburgh).

2 HAWKEN (W R). Copying methods manual. 1966. American Library Association. (Library Technology Program, publications. 11).

3 MARKUSEN (B E), *Ed.* Libraries and automation. 1964. Library of Congress.

4 MELCHER (D) and LARRICK (N). Printing and promotion handbook. Ed 3. 1966. McGraw-Hill.

5 VERRY (H R). Micro-copying methods. Rev ed by G H Wright 1967. Focal Press.

The documents mentioned at serial numbers 2, 3 and 5 give valuable information on the different aspects of reprography. Each of them contains also extensive bibliographies on the subject.

For information on current developments in reprography, the following periodicals may be consulted:

1 *FID news bulletin* (International Federation for Documentation). Monthly.

2 *Library resources and technical services* (American Library Association, Resources and Technical Services Division). Quarterly.

3 *Microdoc,* Journal, Microfilm Association of Great Britain. Quarterly.

4 *National micro-news* (National Micro-film Association). Bi-monthly.

5 *Reproductions review* (Wolf Business Publications). Monthly.

CHAPTER QB

KINDS OF REPROGRAPHY

1 Definition

The term 'Reprography' denotes all the processes and methods used for both copying and for duplicating documents, whether printed, typed or manuscript. But it excludes methods in which type composition, or photo-composition of the text forms a necessary stage — the traditional method of printing or its recent substitutes.

2 Two Kinds

The two main kinds of reproduction of documents are:

1 Micro-copy; and 2 Eye-legible copy.

21 Micro-copy

In a micro-copy, the image of the text is of such a reduced size that some optical apparatus, in the form of a magnifier or projecting device, is required to read it.

22 Eye-legible copy

In an eye-legible copy, the image of the text is either the same size as, larger than, or smaller than the original document, but is fit to be read without magnification.

3 Development of Methods

31 Photography

For over a century, document copying was done largely by a few different methods of photography — that is, based on the fact that certain substances are sensitive to the action of light. Even here, the action of light was confined to that of the region of blue light. With the gradual improvements in the techniques of photography, the entire range of the visible

spectrum of light and also the invisible spectrum — ultra-violet at one end and infra-red at the other — could be made use of.

32 Use of Heat Energy

A major advance was the use of heat energy from infra-red rays in document-copying process. Dr Carl S Miller's 'Thermo-Fax' was the first successful example of the thermal processes. It was followed by the Eichner process, the Ekta-fax process, and the Imagic process, and the fixation of image by heat in Xerography and Electrofax. Further, heat is used for the development of the latent image formed photographically in such processes as the Dual Spectrum, Dry Silver, thermal-diazo and Kalvar. These dry processes facilitate fast reprography service.

33 Electrostatic Process

The development of electrophotography methods, using the principles of photo-conductivity and electrostatics, is another landmark. Xerography and Electrofax are examples.

4 Economy and Ease of Use

Till about 1950, eye-legible copies were made largely by the Silver Halide process or its variations such as photostating and autopositive printing. The non-silver processes that became common included blue-printing and diazo printing. Mimeography, spirit duplication, and offset, involving the preparation of a master, use still other processes and methods. Most of these methods require costly and cumbersome equipment. Their handling and operation require appreciable skill. As a result, the cost of a copy made by these processes is comparatively high.

Some of the reprography equipment of today are of the push-button type requiring little skill on the part of the

operator. Comparatively inexpensive copies can be made in a matter of seconds. The equipment is compact and can be placed on an office desk top. The initial capital outlay on the equipment and installation is relatively small. Further, some of the equipment produce different kinds of copies usable for various purposes — such as, masters for spirit duplication, offset printing, and diazo printing; transparent copy for use in projectors; colour-coated copy; and copy on various kinds of paper ranging from tissue to card.

5 List of Processes

The following is a list of the reprograph processes in use:

Silver halide process (Photography)
- Contact copying (lensless)
  - Stabilization
  - Autopositive
- Optical copying (using lens)
  - Photostat
  - Microphotography

Transfer process
- Diffusion Transfer Reversal (D T R)
  - Diaversal
  - Polaroid
- Gelatin Transfer Reversal (G T R)
  - Verifax
    - Ektalight
  - Readyprint

Thermography
- Thermo-Fax
- Eichner process
- Ektafax
- Dry solver
- Imagic

Electrostatic process
- Xerography
- Electrofax

Diazo

Kalvar

Dual Spectrum process

Electrolytic process

Photochromic process
- Photochromic Micro Image
- Copy-Chrome process

Thermoplastic recording

Note. — 1 A brief description of these processes is given in Chaper QL.

2 The special characteristics of the processes are given in Tables 1 and 2 in Chapter QM.

CHAPTER QC/QG

MICRO-COPY

CHAPTER QC

HISTORY OF MICRO-COPYING

1 Micro-photograph

John Benjamin Dancer, an English optical instruments maker, is usually credited with making the first micro-copy of a document by photography, in 1839. The document copied was 50 cm long. A 3 mm micro image of it was produced using a reduction ratio of 160:1. Dancer's work was based on the methods of making photographs developed by Louis J M Daguerre, and on the collodion method of Scott Archer.

2 First Newspaper on Microfilm

In March 1853, A Rosling, Secretary of (now) the Royal Photographic Society, exhibited micro-copies of a page of the *London evening news*. The reduction was eight-hundredth part of the original.

3 Microfilm in Airmail Service

31 Franco-Prussian War

During the Franco-Prussian War of 1870, microfilm came into prominence. To enable the pigeons taking letters into besieged Paris to fly at heights beyond the gun-fire range of the Prussians, a means for reducing the letters to a light-weight form was needed. Rene Dagron, a Paris chemist, who was also a portrait- and micro-photographer, was commissioned by the French Government in November 1870, to organise

a "microscopic dispatch service." He succeeded in reducing photographically an abbreviated version of the document on to a film 30 x 30 mm dimension. A pigeon could carry 18 or more of these films, which weighed less than 0.5 grain and contained more than 80,000 words. At the receiving end, the films were placed between glass plates and projected on to the screen in a dark room. Later, the films were projected on to sensitised paper and then developed to make a copy of the original document.

4 Commercial Availability

By the 1920's, microfilm had become available commercially. At first, the major use was in banks for copying records, to conserve space and to protect the records.

5 Microfilming of Periodical Publications

In the 1930's, some newspaper publishers began programmes for microfilming newspapers. Some periodicals were also microfilmed for library use.

6 More Experience Gained

World War II gave a fillip to the use of microfilm. Experience was gained in its use for protecting and preserving files of engineering drawings and archival material in danger of destruction by bombs. The use of the microfilm in the V-Mail service established its value in transporting documents to distant places and their reproduction in hard copy form.

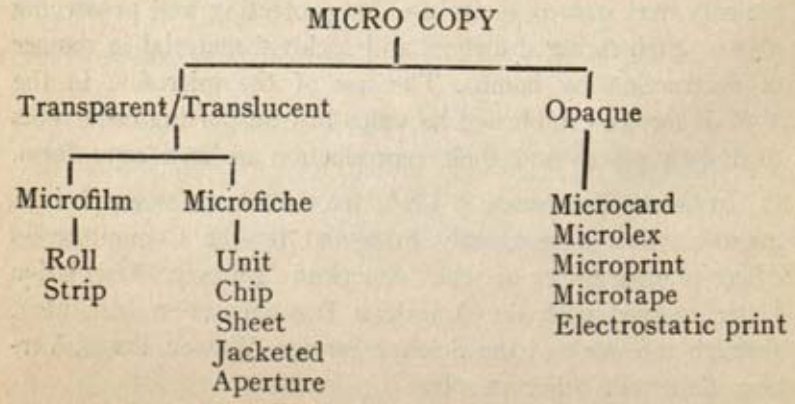
In the earlier years, in USA, the use of and research into, micro-copying were greatly promoted by the Committee on Micro-photography of the American Library Association (later merged with the American Documentation Institute), through the work of the Science Service, Watson Davis, Vernon Tate and other people.

7 Post-War Development

During the post-war period, the use of micro-copy was further promoted by the development of combined reader-printing apparatus. With such an apparatus, the reader can read the document on a screen and also get a hard copy of it within seconds. The development of the Electrolytic process led the way to the first of such push-button reader-printing apparatus. Later, such apparatus using the Stabilisation, Xerography, Electrofax, and Dry-Silver processes were developed. The production of eye-legible copies from micro-transparencies in roll form at a very low cost, was made possible by the development of the Xero Copyflo. New techniques using the Diazo process and the Kalvar process have made it possible to make duplicates of micro-transparencies without dark room facility. The incorporation of micro-copies in certain document finding systems has added a new use for them.

8 Chart of Micro-copy

Texts can be copied in a variety of micro-copies suitable for different purposes. Some of these are mentioned in the following chart.



CHAPTER QD

ROLL MICROFILM

1 What it is

A roll microfilm is the basic form of unitised micro-copy containing micro images of documents arranged in frames in linear array. A roll is usually 30.5 m or less in length.

2 Special Advantage

The roll form of microfilm is one of the most widely used. Some of its special advantages are:

1 The cameras used for making roll microfilm can be worked at comparatively higher speeds, as there is no step and repeat operation usually necessary with microfiche and micro card;

2 The output is greater;

3 The production cost is less;

4 It can be stored more economically; and

5 The new electrostatic reproduction methods such as xerography can quickly — about 5 m per minute — produce enlarged opaque copies from roll microfilm.

3 Size

31 Sixteen mm

The sub-standard 16 mm is the smallest width microfilm used in micro reprography. It is usually supplied in 30.5 m length, having single-, or double-perforation or without perforation. The width of the image between perforations is about 10 mm.

32 THIRTY-FIVE MM

The 35 mm microfilm is the standard size. It is usually supplied in 30.5 m length, with double-perforation or without perforation. The width of the image between perforations is 25 mm.

33 LARGER SIZES

Other large sizes used for special purposes include 70 mm, 105 mm, half plate (cut sheet 165 mm x 120 mm), and even larger sizes.

4 Film Capacity

41 INFLUENCING FACTORS

The number of records on a film varies mainly according to the size of the document copied, and the reduction ratio. Unperforated film provides a larger image area.

42 SIXTEEN MM

The number of documents, which can be photographed on a 16 mm film, will also depend on the length of the document. On an average, a 30.5 m roll can give about 18,000 images when filmed to produce an 8 mm frame. The approximate number of documents which can be photographed per 30.5 m roll is given in the following table:

Reduction	24—1	37—1	
Document length (cm)	One side 16 mm (full width exposure)	Both sides 16 mm (full width exposure)	One side 8 mm (half width exposure)
10.0	6,050	8,600	17,200
15.0	4,250	6,200	12,400
20.0	3,275	4,850	9,700
25.0	2,675	3,980	7,960
30.0	2,250	3,370	6,740

43 THIRTY-FIVE MM FILM

The 35 mm size gives about 800 full or 1,600 half frames per roll of 30.5 m. Each frame may contain one or more documents. In an aperture card, as the image may occupy a larger area of the film, the number of documents copied per 30.5 m of film may be less than 800.

44 LARGE SIZE FILM

441 *Seventy mm*

The unperforated 70 mm film gives an image of 66 mm x 89 mm — that is, intermediate between the 35 mm and 105 mm film. The reduction ratio used is usually 17:1. It is useful in photographing together materials usually kept separately, such as, newspaper cuttings, small drawings, and the contents of a file. It can be stored in roll form to facilitate quick enlargement; or as separate sheets to facilitate searching, filing, and replacing.

442 *Half Plate*

The half plate (165 mm x 120 mm) is used in photographing large drawings, and for several of the purposes for which the 70 mm microfilm is used. These films are usually kept as cut-sheets in separate envelopes, and can be viewed or enlarged individually.

5 Development of Unitised Microfilm

When a length shorter than 30.5 m is used for photographing, an inconvenient length of strip is left over in roll microfilm. When the roll contains a large number of documents, search and locating a particular one in it is not easy. Superseded documents cannot be easily replaced. Related documents are often in widely separated frames. These difficulties have led to the development of unitised microfilm, more efficient methods of indexing the contents of the roll, and the use of large size microfilms.

CHAPTER QE

UNITISED MICROFILM

1 What it is

A unitised microfilm is a strip or sheet of convenient length cut from a microfilm roll and used as such or inserted into a transparent jacket, or slits in an opaque card or mounted in an aperture cut in a card.

2 Special Advantage

21 Overall

1 Some of the inconveniences in handling the roll microfilm mentioned in Sec QD5 are avoided;

2 It is suitable for cumulative filing — that is, superseded documents can be replaced by new records, and new documents can be added to the unit, with greater facility and at less cost; and

3 Existing films can be converted to a more suitable form for a particular application.

22 In the Drawing Office

1 Drawings can be made on ordinary paper and photographed directly, thus making the service quick and eliminating the use of costly papers, translucent linen, and skilled staff for the tracing work;

2 The copies are superior to those produced by other drawing office reproduction methods;

3 The selection and refiling of the film in a large store is easier and quicker;

4 The storage space for the drawings is reduced by about 95%. There is also a considerable reduction in weight. For

example, the US Signal Corps has reported a saving of 158 tons in converting 220,000 drawings to aperture cards;

5 As the microfilm can be enlarged and directly read on the reading apparatus, fewer prints are necessary; and

6 There is a saving on paper cost up to about 70% compared to conventional methods.

3 Transparent and Translucent Units

31 Strip Film

A strip film is usually a 21.6 cm long strip of 35 mm perforated film containing 10 pages of text and the title page. In the case of film with single perforation, the title takes the position of the other perforation. For filing, usually the strip is inserted in a pouch with a suitable index of the contents. It is stored in the conventional catalogue card cabinet or on the shelves. Special reading apparatuses have been developed for these strips.

32 Transparent Envelopes or Jackets

Mircrofilm strips are inserted into sleeves or chambers of a jacket (acetate envelope). Each sleeve is sealed top and bottom and open at one or both ends for insertion of the film strip. Such jackets are available in various sizes, the standard catalogue card size — 75 x 25 mm — being the commonly used one. The sleeves can hold 16 mm or 35 mm film, or in some cases both. The 127 x 203 mm size jacket can take up to 100 pages of micro-copy. The jacket protects the film from abrasion during search and during projection in the reading apparatus. The jacketed micro-film is particularly useful for micro-copying reports, newspaper clippings, hospital case records, etc.

33 Opaque Frame

Strips of microfilm are inserted in a stiff card holder having a number of long narrow apertures cut out in it. The

cards are available in various sizes. The cards, placed in jackets, can be filed and indexed in the usual way.

34 Aperture Card or Window Card

The aperture card was developed during World War II by John Langan and his associates. One or more strips or a single frame is mounted into an aperture cut out in a card. The latter may be a punched card suitable for mechanical sorting. The aperture card has been particularly useful for engineering drawings, plans and similar documents. Replacement of obsolete ones is easy.

35 Microrit

Microrit is a transparent positive copy printed from roll microfilm in strip form. There is an adhesive layer for attaching it to a transparent plastic sheet. Individual frames can be attached to a master sheet. It obviates the need for jackets; but it is liable to wear and tear.

36 Diazo-sensitised film

361 *Film foil*

This diazo-sensitised film, available in sheet form of standard card dimensions such as 75 x 125 mm, 102 x 152 mm, and 127 x 203 mm, is generally used in making composite sheet copy of strips of roll microfilm. The use of wet chemicals is eliminated in the process. The completed copy would be like a microfiche.

362 *Actifilm*

Actifilm is a diazo-coated microfilm with the weight and size of a catalogue card. Unit images from roll microfilm can be made on a selective basis and developed by a dry process. It is useful for micro-copying engineering drawings, architectural tracings, medical case histories and similar documents.

37 KALVAFILM

In the Kalfax process, a latent image is produced in a Kalvafilm from a microfilm by exposure to ultra-violet light via a photographic master. The film is heat-developed at about 120°C. Fixation takes place over a period of time in normal use without any special treatment. Cumulative records can be printed on the same film days or months or years after the original film has been made.

4 Micro-Print from Roll Film

41 METHOD OF PRODUCTION

Micro-print is usually an opaque strip contact-printed directly from a roll film. The back of the strip has an adhesive protected by a thin transparent layer. The roll is cut into convenient lengths or into single frames, the thin protective layer removed, and the strip fixed on to a support such as a card. Information about the content may be written or printed in eye-readable size as in a conventional catalogue card. The maximum reduction ratio recommended is 26:1, the ideal being 19:1. About 40 records, each 254 x 203 mm, can be reduced to 75 x 125 mm card size. The difference among micro-print tapes, such as Microstrip and Microtape, is in the adhesive used for fixing.

42 ADVANTAGES

The advantages of the micro-print include:

1 Being printed in one continuous operation from a roll film, tapes can be produced at reasonable cost;

2 Existing film negatives can be contact-printed to provide opaque copies;

3 It is economical on account of the avoidance of costly transparent jackets;

4 It can be read on any apparatus designed for reading opaque microcopy; and

5 Eye-readable copies can be easily made from it (see Sec QH4).

CHAPTER QF

MICROFICHE

1 What it is

Microfiche is a rectangular sheet of negative or positive film containing a number of micro images arranged in rows according to a set pattern, depending on the area of the film and reduction ratio of the image size to that of the original document. The two standard parts in a microfiche are:

1 The top strip, running the full width of the fiche and about a frame deep contains eye-readable cataloguing or bibliographical information about the document copied; and

2 The micro images of the pages of the text in sequence in rows running left to right.

2 History

Microfiche has long been known, but was not used much until recently. Prior to the World War II, Dr J Goebel in Germany had been doing research on it and after the war he continued his researches in Netherlands. By 1959, a few publishers were issuing microfiche publications of articles etc. In USA the decision of the National Aeronautical and Space Administration to use microfiche in its programme for distribution of reports and the success of the Thomas Micro Catalogue System, gave a tremendous fillip to the use of microfiche. The Microfiche Foundation established in 1959 at the Delft Technological University has done considerable research on microfiche and has promoted its use as a publishing medium.

3 Production

The microfiche negative is produced by using a step and repeat camera which permits the negative sheet of film to be

moved after each exposure. Because of this step and repeat operation, making of microfiche is more expensive than making roll microfilm. Some cameras use roll film of 70 mm width to produce microfiche negative. This gives a greater output. For copying text from books, articles and reports, the reduction ratios 18:1 and 20:1 are recommended.

4 Size

Some of the common sizes of microfiche are 75 x 125 mm, 90 x 120 mm, 105 x 148 mm, 127 x 203 mm, and standard 80-line data processing card size. In France, Netherland, UK, and USA the 105 x 148 mm format is generally used. It has a capacity of 60 single frames, exclusive of the title strip, and 72 single frames in a continuation microfiche.

5 Advantages

The general advantages of microfiche are:

1 It has good storage capacity. A 105 x 148 x 305 mm filing drawer, can hold about 800 microfiches in paper packets. If every image-space is used in each of the microfiche, then 48,000 pages of text would be available in the file.

2 It can be easily reproduced by the silver halide, diazo, and kalvar processes.

3 Card-to-card reproduction is easy.

4 It gives good image quality.

5 The kind of reading apparatus required is easier and cheaper to produce than that required for opaque cards. Some roll film reading apparatus can accommodate sheet film, and if a piece of white paper is placed behind the fiche it can also be read in an opaque card-reading apparatus.

6 When stored flat the risk of the gelatin layer cracking and thereby spoiling the film as may happen in the tropics, is avoided.

7 It is economical to transport because the fiche weighs less than $\frac{1}{8}$ of an ounce.

CHAPTER QG

MICRO-OPAQUE

1 What it is

A Micro-opaque is an opaque card with micro photographic images of documents arranged in rows as in the microfiche. The cataloguing information in eye-readable form is placed on the top part along the longer dimension as in a microfiche.

2 History

In his original conception of the microcard, Fremont Rider proposed to have a micro text on one side of the card and an abstract of its content on the other side. The microcard came into extensive use in the early 1950's, when articles and other scholarly material were made available in this form. In 1952, the US Atomic Energy Commission started a programme of making its reports available on microcards. The micro-opaque is now more a publication medium rather than a copying method. Micro editions of several important collections of documents such as the *British House of Commons Sessional Papers of the Eighteenth and Nineteenth Centuries,* containing more than 80,000 separate publications and the Lawyers Cooperative Publishing Company micro editions covering some thousand legal works, have been published.

3 Production

In the earlier years, the opaque cards were produced by contact printing from 16 mm or 35 mm film, cut into convenient lengths and fixed on to special frames. The step and repeat camera is now generally used as in the case of microfiche.

4 Kinds of Micro-Opaques

The three main kinds of micro-opaques are:

1 Microcard; 2 Microprint; and 3 Microlex.

They differ from each other in their size and the number of micro text they contain.

41 MICROCARD

The Microcard is usually available in 75 x 125 mm size and contains up to 80 records on one side. Cards printed on both sides are also available. It is produced photographically and printed directly from the negative. A laminated card which does not curl, carries the micro text on both sides. It is only slightly thicker than a single card. A magnetic strip incorporated in the lamination aids the rapid sorting and selection of the cards by electronic means.

42 MICROPRINT

The Microprint card is 152 x 229 mm in size. It is printed from 35 mm film and usually contains 100 images on each side. The printing is done by lithography. It has a lightly less storage capacity than the Microcard but is more suitable for viewing purposes. The cloth-bound case in which it is supplied, is about 7.6 cm thick and holds about 200 sheets. These can be shelved like books, or the cards can be individually filed in the filing cabinet without the case.

43 MICROLEX

The Microlex has been specially produced for the legal profession in USA. The card is 165 x 216 mm in size and contains 200 pages on each side. It is produced photographically. To provide immediate access to any page on the card, a decimal notation is given on the left hand top of each sheet.

Special reading apparatus and filing cabinets are available for use with the Microlex cards.

5 Advantages

The saving in space is estimated to be over 95 per cent. For example, a library containing 75,000 items can be stored in microcards contained in one catalogue card carbinet. Single-side printed cards can be filed 85 per 2.5 cm, and double-side printed cards, each containing up to 160 pages, can be filed 65 cards per 2.5 cm. This gives 125,000 pages per 30 cm of shelf length, 7.5 cm high and 12.5 cm deep. Duplicate copies can be made from the negative when a microcard is damaged or lost. A slight loss of the definition of the image may occur partly due to the opaqueness of the card and the reflected light, but modern viewing apparatuses are adequate to provide reading with ease and without eye-strain.

CHAPTER QH

EYE-LEGIBLE COPY

1 Method of Production

Eye-legible copy of a document can be made by the following methods:

1 Contact copying

11 Print-through or Direct method;

12 Reflex method; and

2 Optical copying

21 Projection printing.

2 Contact Copying

Contact copying involves the exposure of the original document in contact with a sheet of sensitised material in front of a light box and subsequent processing of the photo-copy by conventional methods. The exposure can be based on two methods: Print-through and Reflex Copying.

21 Print-through

For applying the Print-through technique, the document to be copied should be:

1 Sufficiently translucent to permit the light to pass through it to the light-sensitive coating; and

2 The text should be on one side only.

During the exposure, light passes through the translucent document and produces an image on the sensitive material. Four different types of copies can be obtained, depending up-

on the characteristics of the original document, the processing, and copying procedure used:

1 Right-reading, negative;

2 Reverse-reading, negative;

3 Right-reading, positive; and

4 Reverse-reading, positive.

22 Reflex Copying

In Reflex Copying the light passes through the back of the sensitive material and gets reflected by the document. The image formed is negative in tone and reverse in reading. A right-reading positive copy can be made from the negative by repeating the operation with another sensitive paper by using the Print-through technique. An advantage of the method is that a document printed on both sides can be used. However, there may be a slight loss in resolution due to the light scattering effect.

3 Optical Copying

31 Principle

In Optical Copying, an image of the page to be copied is formed within a camera on a plane. A sheet of light-sensitive paper is placed on this plane. The image of the page is formed on this paper due to the action of light.

32 Control of Size

An important advantage of Optical Copying is its facility in controlling the size of the image. Depending upon the camera used, the range may be less than, equal to, or greater than the size of the original.

33 Two Methods

There are two principal methods of making eye-legible copies, using the optical method. These are:

1 Indirect method; and 2 Direct method.

331 *Indirect Method*

In the Indirect Method, an intermediate image is formed first. From this, the final copies may be made. For example, in the conventional silver halide photographic method, an intermediate film negative is made, from which the final copies are subsequently made by contact or projection printing.

332 *Direct Method*

In the Direct Method, the image is formed directly on the surface of a sensitised paper. This is processed to get the final copy. Xerography is an example of this method.

332 Equipment

A variety of cameras are now available for producing eye-legible copies through an intermediate master. In all copying set-up, however, the basic requirements are

1 Rectilinearity, that is, freedom from rectilinear distortion of image;

2 Rigidity, that is, the equipment should be free from any vibration or movement; and

3 Evenness of illumination, that is, evenness of the intensity of light falling on the surface of the sensitised paper.

341 *Automated Apparatus*

An increasing variety of automated 'office copiers' using optical systems are being produced. They usually give a copy

of the same or slightly reduced size as the original. Control over exposure range is limited. The built-in-processing unit delivers the finished copy in about a minute's time. The 'up-side-down' copying arrangement works well with loose sheet, but special techniques are to be adopted for copying from a bound volume. Xerox 914, Electrofax process copier, and coin operated copier using stabilisation technique, are examples of automated copier.

4 Enlargement from Micro-Copy

Eye-legible copies from different kinds of micro-copies can be made by different methods and by using different kinds of equipment.

41 From Roll-form Micro-transparency

An enlarged copy (hard copy) on a sheet of film or paper can be made using

1 Enlargers, such as, Recordak MEB and Xerox Copy-flo; and

2 Reader-printer apparatus, in ordinary room light.

42 From Sheet-form Micro-transparency

An enlarged copy can be made with

1 A photographic enlarger which can take the sheet of micro-transparency. Specially designed step and repeat en-largers are available for making hard copies of the documents on a microfiche; and

2 The Reader-printer apparatus.

5 Process

The processes that can be used for making hard copy from a microcopy and making eye-legible copy by direct-contact or contact-reflex, and in some cases both, are mentioned below:

Process	Useful in	
	Contact printing	Hard copy preparation
Silver halide	x	x
Stabilisation	x	x
Autopositive	x	x
Gelatin-dye-transfer	x	
Diffusion-transfer-reversal	x	x
Diaversal	x	x
Thermofax	x	
Eichner	x	
Ektafax	x	
Dry silver		x
Dual spectrum	x	
Diazo	x	
Xerography		x
Electrofax		x
Imagic	x	
Copychrome	x	

CHAPTER QJ/QP

CHOICE OF COPYING METHOD

CHAPTER QJ

GUIDANCE IN THE CHOICE

1 Choice of Process

With the availability of a variety of document copying and duplicating processes, the decision on the choice of a suitable method has become complicated. The principal factors to be taken into consideration in the choice are:

1 Physical characteristics of the original document;

2 Characteristics of the copying processes available;

3 Factors affecting the characteristics of the copy; and

4 Characteristics of the duplicating methods available.

The succeeding five chapters discuss these factors.

2 Setting up Reprography Unit

In setting up a reprography unit, certain additional factors are to be taken into consideration. These include

1 Purpose of the copies—acquisition, preservation, dissemination, or class room use; 2 Quantity required of each kind of copy; 3 Anticipated load of work; 4 Kind of equipment needed; 5 Reprography facilities already available in the country; 6 Availability, at a reasonable cost, of the raw materials and equipment: 7 Facility for servicing and replacement of the parts of the equipment; and 8 Availability of personnel required in operating the equipment.

A detailed study of these factors, however, does not fall within the purview of this book.

CHAPTER QK

PHYSICAL CHARACTERISTICS OF ORIGINAL DOCUMENT

1 Kinds of Documents

In relation to reprography, documents fall into two main categories:

1 Printed document; and
2 Non-printed document.

Each of these groups may be further subdivided as follows:

1 Printed document
  11 Book and periodical publication;
  12 Newspaper;
  13 Map;
  14 Continuous-tone illustration;
  15 Card
2 Non-printed document
  21 Manuscript;
  22 Typescript;
  23 Original continuous-tone illustration;
  24 Handwritten and typewritten card;
  25 Microform; and
  26 Other reprograph copies.

2 Printed Document

The characteristics of the printed materials that affect reprography include:

1 Characteristics of the printed image
  11 Type design and size;
  12 Quality of print, such as evenness of impression, embossing, effect of worn type, offset, and showing-through;

13 Colour, including the presence of coloured plates, text on coloured paper stock, and stained or discoloured paper.

14 Maps present special problems because of their size, fine details, and the use of printing in several colours. Further the folding of a map may produce crease.

2 Physical characteristics

21 · Dimensions of the document, such as size, shape, thickness and weight;

22 Paper characteristics, such as kind of paper surface, thickness of the paper, brittleness of the paper, damaged page — creased, folded, wrinkled, warped, soiled, mended — and the presence of folded plates;

23 Kind of binding; and

24 Card-to-card copying may require special equipment and techniques depending upon the copying process used.

3 Non-printed Document

31 Common Factors

The various factors, including physical characteristics, discussed in connection with printed documents also apply to non-printed documents. A few special problems are mentioned below.

31 Manuscript

Manuscripts may be in various sizes of paper, leaves, papyrus, vellum, or cloth. The text may be in pencil or ink of varied quality or a combination of these. The physical condition of the document and its location as bound pages of notebooks, loose sheets and the state of deterioration of the paper — are to be taken into account.

33 TYPESCRIPT

With typescript the problems are similar to those with manuscripts. The unevenness of the impression, the quality of the ribbon used, the quality of the type, and corrections made in the typescript with pencil or ink, also present problems.

34 ORIGINAL CONTINUOUS-TONE ILLUSTRATION

An original continuous-tone illustration may present a great range and subtlety of tone variations. For making a good quality reproduction from it, would require the use of special materials, efficient control over each step in the process, and skill on the part of the technician.

35 MICRO-COPY

A micro-copy is itself a reprograph. It may be a micro-opaque or a micro-transparency. Various reduction ratios are used in micro-copying and there are different sizes of micro-copies (See Sec QD42). Some reprography processes are more suitable than others in making readable copies from different kinds of micro-copies.

4 Table

The table on P 383 summarises the suitability of copying processes for reprographing the various kinds of documents.

It must, however, be borne in mind that reprography technology is advancing rapidly; that a process which had limited or no use at all in making copies from a particular kind of document may be made suitable for the purpose.

Suitability of Copying Processes

NOTE: L = Limited; S = Suitable; and U = Unsuitable

To copy from \ Process	Silver Halide	Stabilization	Autopositive	Verifax	Ektalith	D T R	Diaversal	Polaroid	Dry Silver	Thermo-Fax	Eichner	Ektafax	Xerography	Electrofax	Diazo	Kalvar	Dual Spectrum	Electrolytic
1. Bound volume	S	S	L	L	L	L	S	U	U	U	U	U	S	S	U	U	L	S
2. Newspaper file	S	L	L	U	L	L	S	U	U	U	U	L	L	L	U	U	U	U
3. Typescript	S	S	L	S	L	S	S	U	U	S	L	S	S	S	L	U	S	U
4. Manuscript	S	S	L	S	L	S	L	U	U	L	L	L	S	S	L	U	L	U
5. Continuous-tone original	S	S	L	U	U	L	U	S	U	U	U	U	L	L	L	U	L	U
6. Map	S	L	L	L	L	L	L	U	U	L	L	L	L	L	L	U	L	U
7. Card file	L	L	U	L	S	L	U	U	U	L	L	S	S	L	L	U	L	U
8. Copies made by other processes	S	S	L	L	L	L	L	U	U	L	L	L	S	S	L	U	L	U
9. Microform :																		
1. Production	S	U	U	U	U	U	U	U	U	U	U	U	L	U	U	L	U	U
2. Duplication	S	U	U	U	U	U	U	U	U	U	U	U	U	U	S	S	U	U
3. Hard copy	S	S	S	U	U	L	L	U	S	U	U	U	S	S	L	U	U	S

CHAPTER QL

DESCRIPTION OF PROCESSES

1 Silver Halide Process

In the Silver Halide process, the light-sensitive properties and the remarkable resolving power of Silver Halide salts are used for making photographic images. The Silver Halide emulsion is coated on to a support, such as a transparent film or glass or opaque paper. The image is formed on the sensitised coating by means of light either by contact-printing or lens. The exposed film or paper is either wet-processed in dishes of chemicals or stabilised.

11 Stabilisation

In the Stabilisation process, the exposed surface is laid flat on a porous block, such as Plaster of Paris, and sponged successively with the developer and stabiliser. This process does not require the use of dark room, immersion of the exposed sensitive paper in liquids, chemical fixing and washing.

12 Autopositive Process

In the Autopositive process, the phenomenon of Herschel Effect is made use of. A positive copy of a translucent one-side-printed document is produced in one step by transmission printing by yellow light on a pre-exposed sensitive paper coated with special Silver Halides.

2 Diffusion Transfer Reversal

In the Diffusion Transfer Reversal process a special negative sensitive paper is exposed to the document by reflex printing and developed by immersion in an alkaline bath and pulled out, while wet, under pressure between a pair of

squeegee rollers along with a sheet of non-sensitive transfer paper. When the papers are peeled off after a few seconds, a positive image appears, by chemical transfer, on the receiving sheet.

21 DIAVERSAL

The Diaversal process is a variant form of the Diffusion Transfer Reversal, in which both the negative and positive image forming layers are coated on a single support. The composition of the negative layer coated on the top of the positive layer is such that an exposed sheet of Diaversal material can be developed to form both the negative and positive images. The negative layer can then be easily washed off to leave the positive on the support.

22 POLAROID

The Polaroid process is also a variant form of the Diffusion Transfer Reversal. In it a "package" system, consisting of negative and positive materials and a pod of a chemical reagent contained in specially designed camera, is used to produce negative and positive images. The process has extended the Diffusion Transfer Reversal method beyond the document copying field, including colour photography.

3 Gelatine Transfer Reversal

The Gelatine Transfer Reversal process is similar to the Diffusion Transfer Reversal process. But it is different in the principle of image formation. A special matrix paper is exposed to the document by reflex printing and immersed in an "Activator" solution for a few seconds. The paper is pulled out in contact with a transfer sheet between squeegee rollers. A thin layer of unexposed Silver Halide gets physically transferred and forms a dye image on the receiving sheet. Successive transfers following short dips in the Activator, can give

up to 6 or 7 copies in quick succession. Verifax and Ready-print are examples of the Gelatine Dye Transfer process.

31 Ektalith Process

The Ektalith process is a variant form of the Verifax. It produces quickly high quality, low-cost masters for offset and diazo printing, making use of camera speed and verifax type materials.

4 Thermography

41 Thermofax

In the Thermographic process, a special thin heat-sensitive paper such as Thermofax, is used to produce a positive dry dye-copy in a single step. The heat-sensitive paper is exposed in contact with the original document to a source of infra-red radiation. The carbon or metallic contents of the printed sheet absorbs the radiation, converts it into heat which causes a colour change in the positions of the paper in contact with the print. Opaque double-side printed as well as translucent and one-sided document can be transmission-printed on the Thermofax sheet.

42 Ektafax Process

The Ektafax process is a thermographic process by which multiple copies of documents on plain paper or other materials can be produced. It uses an intermediate sheet called a master on which is coated a polymeric substance and a dye. The heat induced chemical reaction forms the image on the master. The master is placed with its coating side in contact with the document, and the two are passed through the thermographic exposing unit. The master is then placed in contact with a sheet of plain paper and the two passed through the Ektafax Transfer Unit. The heat and considerable pressure

causes some of the dye in the text of the master to be transferred to the receiving sheet. In this way about a dozen legible copies can be made from one master.

43 Dry Silver Process

The Dry Silver process is a negative working process using light-sensitive coating, which can be either on paper or a film base. After exposure, the paper or film can be developed to form a visible image by the action of heat.

5 Electrostatic Process

The Electrostatic process is based on the principle of photo-conductivity and electrostatics.

51 Xerography

In the Xerographic process a selenium coated metal plate is used as a photo-conductor. The steps involved are:

1 Plate charging — that is, the Selenium plate is exposed to a corona discharge in the dark, which imparts a uniform electrostatic charge to its surface;

2 Exposure — that is, the photoconductive surface is exposed through a lens to the projected image of the document, when light from the white background area dissipates the charge;

3 Development — that is, a black powder called the developer is put on the plate when the toner particles adhere to the image areas due to electrostatic attraction;

4 Image transfer — that is, a sheet of paper is placed over the plate and the toner image is transferred to it by applying an electrical charge of opposite polarity to the paper surface;

5 Fusing — that is, the toner image is fused to the paper by the application of heat; and

6 Cleaning of the residual toner.

Various Xerographic processes include Micro-Xerography, Long-distance Xerography (LDX), and Xerox Copyflo and printers.

52 ELECTRO-FAX

In the Electro-Fax process the image is formed on a metal plate or drum coated with zinc oxide, instead of the selenium in the Xerographic plate.

6 Diazo Process

In the Diazo Process the ability of diazonium compounds to react with a coupler to form a visible dye image is made use of. When a sheet of diazo coated material is placed in contact with a document, sufficiently transluscent to permit light to pass through it, the characters of the text prevent the light from reaching the photo-sensitive diazo coating. Where the light is freely permitted through the non-text areas the diazonium is rendered inert. When processed, the diazonium salts in the text areas unaffected by light react with a coupler to form a visible image. This gives a direct-positive copy. There are three major variants of diazo process, classified according to the method of developing the latent image. These are vapour, moist, and thermal methods.

7 Kalvar

In the Kalvar photographic process, though diazonium compounds are used, it is a markedly different process from the diazo process. A polyester film base coated with a thin layer of diazonium compound is used. When this is placed in contact with a transluscent document and exposed to ultra-violet light, the diazonium compound decomposes and liberates nitrogen in the form of tiny bubbles. Heat treatment

utilises the gas to form hardened microscopic plastic bubbles. This is followed by a fixing step, that is exposing the entire film to ultra-violet light. The result is a virtually grainless film whose opacity is proportional to the density of the bubble formation, which in turn is proportional to the exposure.

8 Dual Spectrum

In the Dual Spectrum process visible light is used to form a latent image and infra-red is used to make the latent image visible on the copy paper. The intermediate sheet containing a light-sensitive coating on one side is placed with its coated side aganst a surface of the document. The two sheets are then placed on to an exposing surface with the document on top for about 15 to 20 seconds. The intermediate sheet is removed and placed on a heated platen or drum to form an image on the receiving sheet by action of heat in 5 to 20 seconds.

9 Other Processes

91 Electrolytic Process

In the electrolytic process the sensitised material consists of three layers: A paper base, a thin layer of metallic substance acting as a conductor, and a photoconductive coating of zinc oxide in a resin binder. On exposure a latent image of the document is formed due to the differences in electrical resistance. The exposed sheet is placed in an electroplating solution and a direct current applied, causing metal-ions in the solution to deposit on the zinc oxide surface in the image areas to form a visible metallic image.

92 Process Under Development

The Imagic, Photo-chromic and Thermoplastic recording processes are under active development.

CHAPTER QM

CHARACTERISTICS OF COPYING PROCESS

1 Enumeration of the Factors

The principal characteristics of the document copying processes to be considered are:

1 Whether the process is wet or dry;

2 The methods by which copies can be made;

3 The kind of copy produced;

4 The kind of intermediate or master produced by the process for subsequent edition printing;

5 Quality of permanence of the copy produced;

6 Quality of copy of continuous-tone original;

7 Ability to reproduce fine details, such as small type faces and fine lines;

8 Quality of the contrast of the copy;

9 Ability of the process to reproduce coloured lines;

10 Kind of paper stock to be used;

11 The tendency of the copy to curl;

12 Quickness of the process to produce copies;

13 Economy of the process, including the potential waste of material, and equipment cost, etc; and

14 Other special characteristics.

2 Table

The following tables show the characteristics of the different processes in relation to the factors enumerated in the preceding section.

TABLE 1
QUALITY OF THE COPY PRODUCED

Quality	Silver Halide	Stabilization	Autopositive	Verifax	Ektalith	D T R	Diaversal	Polaroid	Dry Silver	Thermo-Fax	Eichner	Ektafax	Xerography	Electrofax	Diazo	Kalvar	Dual Spectrum	Electrolytic	Imagic	P C M I	Copy-Chrome
1 Permanence																					
Archival	x		x					x				x	x	x				x	x	x	
Limited		x		x	x	x	x		x						x		x				x
Unknown										x	x					x					
2 Quality of copy of continuous-tone original																					
Excellent	x	x						x												x	
Fair			x						x					x	x		x				x
Poor				x	x	x	x			x	x	x	x						x		
3 Reproduction of fine details																					
Excellent	x	x	x		x	x	x	x	x				x	x	x	x	x	x		x	x
Fair				x								x							x		
Poor										x	x										

TABLE 1 (Contd.)

Quality	Silver Halide	Stabilization	Autopositive	Verifax	Ektalith	D T R	Diaversal	Polariod	Dry Silver	Thermo-Fax	Eichner	Ektafax	Xerography	Electrofax	Diazo	Kalvar	Dual Spectrum	Electrolytic	Imagic	P C M I	Copy-Chrome
4 Contrast of copy																					
High	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x
Moderate																	x			x	
Low																					
5 Reproduction of coloured lines																					
Good	x	x		x	x	x	x	x	x				x				x			x	
Limited			x							x	x	x		x	x	x					x
6 Tendency to curl																					
High																		x			x
Noticeable	x	x	x	x		x	x	x	x	x				x	x		x				
Low					x						x	x	x			x			x		

TABLE 2
CHARACTERISTICS OF THE PROCESS

Quality	Silver Halide	Stabilization	Autopositive	Verifax	Ektalith	D T R	Diaversal	Polaroid	Dry Silver	Thermo-Fax	Eichner	Ektafax	Xerography	Electrofax	Diazo	Kalvar	Dual Spectrum	Electrolytic	Imagic	P C M I	Copy-Chrome
1 Nature of process																					
Wet	x	x	x	x	x	x	x							x	x						
Dry								x	x	x	x	x	x			x	x	x	x	x	x
2 Method of copying																					
Contact copying	x	x	x	x		x	x				x				x	x			x		x
Contact-reflex copying	x	x	x	x		x				x	x	x			x						
Optical copying	x	x	x		x	x	x	x		x			x	x	x		x		x		
Microcopying	x												x			x					
Projection printing	x	x	x			x	x		x		x		x	x	x			x		x	
3 Kind of copy produced																					
Positive, from positive	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x		x		x
Negative, from positive	x	x	x		x	x			x						x	x		x	x		
Positive, from negative	x	x	x			x		x					x		x	x				x	
Negative, from negative	x	x	x			x	x	x		x		x		x	x	x	x		x		

TABLE 2 (Contd.)

Quality	Silver Halide	Stabilization	Autopositive	Verifax	Ektalith	D T R	Diaversal	Polaroid	Dry Silver	Thermo-Fax	Eichner	Ektafax	Xerography	Electrofax	Diazo	Kalvar	Dual Spectrum	Electrolytic	Imagic	P C M I	Copy-Chrome
4 Paper stock used																					
Plain, any colour				x	x						x	x	x						x		
Specially coated	x	x	x			x	x	x	x	x				x	x		x	x			x
White	x	x	x			x	x	x						x	x		x	x			x
Off-white	x					x			x	x				x							
5 Potential waste																					
Considerable																					
Moderate	x	x	x	x		x	x	x		x	x						x		x		x
Low					x				x				x			x		x	x	x	
6 Approximate time for making 21.3 × 27.5 cm copy (in sec)		20	15	30	60	30		120	10	4	15	25	2	10		30	20	10	8		

CHAPTER QN

CHARACTERISTICS OF COPY

1 Difference from the Original Document

We have seen that the reprograph copy is produced by a variety of methods based on such physical and chemical phenomena as optics, photosensitivity, thermosensitivity, photo-conductivity, electrolysis, photo-chromism and electrostatics. The impression in the original document is usually made either by handwriting or typewriting or printing. Therefore, the characteristics of the reprography copy differ from those of the original document. These differences may be in respect of

1 Size;
2 Physical characteristics;
3 Clarity of image; and
4 Permanence.

These differences may be caused by the processes used in reprography.

2 Size of Copy

In chapters QC to QH, the methods for the production of different sizes of image of the original — ranging from a micro image to considerably larger than the size of the original, have been mentioned.

3 Physical Characteristics

The physical characteristics of the reprograph may differ from that of the original in the following respects:

1 Thickness;
2 Tint;
3 Image on one side only or on both sides;
5 Translucency;

5 Coated surface, which may crack when folded; and
6 Surface which does not accept ink or pencil marks.

In some cases, the reprograph is superior and in others inferior, to the original.

4 Clarity of Image

The clarity of image depends upon the equipment and processes employed in the reprography. The factors that affect the clarity of image may be one or more of the following:

1 Exposure;
2 Speed of the film;
3 Contrast;
4 Exposure latitude;
5 Resolving power; and
6 Colour sensitivity.

In table 2 in Sec QM22, the various characteristics of the different processes have been indicated.

5 Permanence

51 DEFINITION

The term 'Permanence' may be defined in two ways:

1 Lasting or intended to last indefinitely without change (archival permanence); and

2 Lasting for a relatively long time (commercial permanence).

'Archival permanence' means the maximum period of time during which a microfilm may be stored without significant deterioration and preventing subsequent use of the film. If the film is correctly processed, washed and stored, it should outlast any normal paper.

For practical purposes, 'Commercial permanence' may cover a 25 to 30 year period.

52 Permanency According to Purpose

Reprograph copies are produced for various purposes. Some are for convenience or for temporary use; and others for preservation. Therefore, tolerance conditions for these two kinds of uses vary. Therefore, permanence is to be determined in terms of the user's requirements.

In table 1 in Sec QN21, the degree of permanence of the copy obtained by the different processes has been indicated.

CHAPTER QP

DUPLICATING METHOD

1 Number of Copies Required

One duplicating process may be more economical than another for making certain numbers of copies. Therefore, information on the number of copies required and the characteristics of the different duplicating processes will help in the choice of a suitable process.

2 Differentiation of Copying and Duplicating

Until recently, the equipment, methods and techniques used for making a single copy of a document were quite different from those used for making a large number of copies of it. Therefore, copying and duplicating have been traditionally considered as two different methods of reproducing documents. In recent years, however, the two are being brought into closer interrelation due to the improvements in reprography techniques.

3 Production of Master

Some of the newer document copying processes can produce masters or intermediates for subsequent use in printing of a large number of copies of the documents by diazo, offset, or spirit duplicating methods. The following table gives information about the different document copying processes:

SN	Process	Master for		
		Diazo	Offset	Spirit-duplicating
1	Silver halide	x	x	
2	Stabilization	x		
3	Auto positive	x	x	
4	Verifax	x	x	
5	Ektalith	x	x	
6	Diffusion Transfer Reversal	x	x	x
7	Diaversal	x		
8	Thermo-Fax		x	x
9	Eichner	x	x	x
10	Ekta-fax	x	x	
11	Xerography	x	x	
12	Electro-fax	x	x	
13	Diazo	x	x	
14	Kalvar	x		
15	Dual Spectrum	x	x	
16	Imagic	x	x	

4 Masterless-Duplicating Method

In the Xerographic process, the cost of making copies directly from the original now compares favourably with the cost of making them by short-run duplicating methods. This is making a tremendous impact on the methods of making multiple copies of documents. It has brought document-copying and document-duplicating into close inter-relation.

5 Recommended Method

The following table indicates the commonly used methods of making multiple copies and the suitability of each for making different number of copies.

Duplicating method	Approx N of copies
Carbon copy	15
Photostat	20
Blue print	25
Diazography	25
Xerography	500
Spirit duplicator	10 to 150
Mimeography	50 to 3,500
Silk screen technique	300 to 2,500
Multigraph	300 to 10,000
Multilith	100 to 25,000
Offset	500 to over 500,000
Letterpress	1,000 to over 500,000
Rotogravure	100,000 to over 500,000

CHAPTER QQ

STANDARDS FOR REPROGRAPH COPY

1 Need for Standard

In recent years, the use of reprography has steadily increased. As a part of the document procurement and exchange programme, there is an increasing flow of reprograph copies not only from one library to another within a country, but also from one country to another. In order to promote productivity in the use of the different kinds of the reprographs, certain norms are necessary. As a minimum provision, guidance and standardisation on the following will be helpful:

1 Sizes of copy;

2 Image characteristics in relation to density and contrast, exposure, illumination and processing;

3 Handling, particularly of micro-copy;

4 Packing for postal transmission; and

5 Storage.

In the succeeding sections, some of the relevant standards are mentioned. The standards on storage are listed in Sec QR3.

2 International Standards Organisation (ISO)

R169–1960 Sizes of photocopies (on paper) readable with/without optical devices.

R193–1961 Micro-copies on transparent bases, sizes of recommended bases.

R218–1961 Micro-copies, scale of 35 mm micro-films for international exchange.

R260–1962 Terms relating to micro-copies and their bases.

3 Indian

Indian Sandard code of practice for processing of microfilms (silver halide) [Doc EC 2(61)].

Indian Standard Guide for handling, processing and storage of monochrome photographic prints [Doc: EC 2(72)C 1].

4 British

BS:1917–1952 Film strip and lantern slides.

BS:1371–1956 Microfilm-readers and reels (amendment PD3245, December 1968).

BS:1896–1960 Sizes of sensitised materials for document reproduction.

5 American

PH5.3–1958 Specifications for 16 mm and 35 mm film in reels or in strips.

PH5.5–1961 Specifications for micro-opaques.

PH5.28–1957 Specifications for photographic films for permanent record.

A number of other American standards on photography including films, plates, papers, analytical methods, apparatus, processing and reprography, have been published in the PH Series.

6 International Standard

It is desirable that the ISO formulates international standards for the different aspects of reprography. The existing national standards may form the basis wherever helpful.

CHAPTER QR

STORING OF PROCESSED MICROFILM

1 Factors for Consideration

The conditions for storage of processed microfilm will depend upon the length of time the film is required to remain in good readable condition. In Sec QN5, it has been mentioned that permanency has to be determined in terms of the purpose for which the micro-copy is made. Films to be kept for archival permanancy require more carefully controlled conditions of storage than those to be kept for a few years only. It is also known that 'aging blemishes' may arise due to inadequate or incorrect exposure of the film during the reprography process. Therefore, the factors affecting the characteristics of the microfilm during storage include:

1 Environmental conditions

- 11 Humidity;
- 12 Temperature;
- 13 Fire hazard;
- 14 Air-entrained impurities;
- 15 Kind of reel used;
- 16 Characteristics of storage container;
- 17 Housing for container; and
- 18 Storage room.

2 Conditions of exposure of the film during reprography; and

3 Method of processing of the film.

2 General Recommendation

Much research has been and is being done on the storage of microfilm. The general recommendations are:

1 The relative humidity of the air in contact with the microfilm to be kept between 40 and 50 per cent, at the temperature range of 16 to 27°C. The National Bureau of Standards of the USA recommends a relative humidity of 30 to 35 per cent at 10 to 15°C and 15 to 20 per cent at 10 to 16°C, for films in frequent and infrequent use respectively;

2 An optimum storage temperature of about 21°C;

3 Storing of the film in steel cabinet well away from the original document, so that duplicate copies of the documents can be made from the microfilm in case the original is damaged; and

4 More strict conditions and standards should be carefully followed for antifire storage.

21 OFFICE CONDITIONS

Micro-copies are today in frequent use in offices. They have, therefore, to be stored for convenient access. An environment which has low temperature variations will generally be suitable for storage over reasonably long periods. Where the temperature variations are appreciable, it may be necessary to place a special moisture absorbent material in the container holding the film.

3 Standards for Storage

The following are some of the standards relating to the storage of microfilm:

31 INDIAN

IS:3130–1965 Code of practice for storage and use of microfilms of permanent value.

32 BRITISH

BS:1153–1955 Recommendations for the storage of microfilm.

BS:2698–1960 Containers and notes for filmstrips.

33 AMERICAN

PH5.4–1957 American standard practice for storage of microfilm.

PH4.20–1958 Photographic filing enclosures for storing processed photographic films, plates, and papers.

CHAPTER QS

COPYRIGHT AND REPROGRAPHY

1 Copyright Law

For centuries earlier to the invention of printing from movable metallic types, copying of documents was considered a legitimate pursuit. Many great classical works of the pre-printing era have been preserved through the work of the scribes. The first specific law on copyright was enacted in England in 1710. It had its roots in the efforts of the Crown and the Church of England, in cooperation with the Stationers Company, to maintain a strict "monopoly of printing and bookselling for the purposes of censorship as well as of profit," in the sixteenth and seventeenth centuries. Since those days copyright laws have been enacted in many countries. There are variations in the provisions in the law in different countries.

2 Fair Use

In the implementation of copyright laws, two apparently opposing interests have to be reconciled. On the one hand, a document must be made available in adequate number of copies for the reading public; at the same time, the author should not be deprived of an adequate reward for his contribution to society. A fair balance has to be maintained between these two social pressures. The problem has become acute with the extensive use of reprograph copies. The question turns on what is termed as 'fair use' of copies made of a document. There is no clearcut line to indicate where 'fair use' ends and 'unfair use' begins. By convention a scholar getting a reprograph copy of a page or a few pages of a document made for use in his study does not deprive the author

or the publisher from sale of the document. This is fair use. But, if multiple copies of chapters of a book are made, say for classroom use, it would amount to a violation of copyright.

3 Consensus

The general consensus as contained in the statements on the subject by the Royal Society of London and that of the US Joint Committee on Fair Use in Photo-copying is that

1 When a library makes a single copy of a document for the use of a reader, it is a natural extension of services traditionally given by the library; and

2 The present demand of readers for copies of a document can be satisfied without greatly harming the interests of the copyright owner and of the publisher.

4 Library's Responsibility

Large libraries and other centres providing reprograph facility usually protect themselves by taking a signed statement from the client as to the bona fides of 'fair use' of the copy.

5 New Clauses Necessary

There are a large number of writings on copyright in relation to fair use and reprography. The use of computers for storage and retrieval of documents and the television and facsimile transmission of document images from a central point are raising new problems in copyright law.

PART R

BOOK BINDING

CHAPTER RA

LAWS OF LIBRARY SCIENCE AND BOOK BINDING

1 Law 1 and Book Binding

The ultimate unit of a book printed on paper is a Sheet of Paper. It yields four, eight, sixteen or more pages of matter printed on it, according to the format of the book. When the sheet is folded and cut open, the pages run consecutively. A book consists of several such sheets so arranged that the pages of the book and the signatures of the formes run consecutively. It is not convenient to use a set of sheets cut open and arranged thus. To make it fit for use, the leaves of each sheet should be stitched together and all the gatherings should also be stitched together. But even this is not sufficient. Paper being frail, the leaves at the two ends of the book will fold and warp; they may also eventually perish. Further, the book as a whole will not be rigid. To prevent all this, the book should be strengthened by being protected with cover made of a relatively stronger and more rigid material. For normal books the material used is a card-board. Further, left by itself, the card-board has a repulsive look and is rough for touch. Therefore, the card-board is usually covered with paper or cloth or leather. The totality of these processes is denoted by the term 'Binding'. The result of the processes is also denoted by the term 'Binding'. Binding then is necessary to make a book fit for use to the satisfaction of Law 1.

2 Law 2 and Quick Binding

Law 2 of Library Science calls for a large number of copies of each book. This large number raises the question of the time required to bind all the copies of a book produced by the printing press. The time will be inordinately long if each

copy is bound by hand. This will delay the release of the book for use by every reader. This delay will offend Law 2. Therefore, a quick method of binding is necessary.

21 Law 2 and Mass Binding

Apart from this, as the use of books began to spread among the poorer classes, the reader found it too costly to have his copy bound privately. Thus, social pressure was created to reduce the cost of binding. To reduce it, it was necessary to provide the binding even before the book was sold out. Thus, hundreds and thousands of copies of one and the same book had to be quickly bound either in the printing press itself or in a bindery auxiliary to it. This led to "Mass Binding."

22 Binding Machinery

To do Mass Binding quickly, machinery was a necessity. As usual necessity became the mother of invention. By 1825, A Leighton is said to have brought out editions ready bound in machine-made cloth cases. There is no need whatever to make the binding of the different copies of an edition differ from one another. There is no individuality to be respected among different copies. There is nothing to prevent one from treating all the copies as mutually replaceable. It is in these impersonal conditions that machinery fits in naturally and without any harm. There are now machinery practically for every operation in book binding. Here is a list of the machines in the family of book binding machines.

1 Folding Machine. — It folds the printed sheets. It can fold in one operation four 16-page signatures. It can make 3,000 such operations in an hour.

2 Bundling Machine. — It squeezes the air out of the sections and ties them in bundles suitable for handling.

3 Gathering Machine. — It gathers the signatures and completes the copies of the book.

4 Sewing Machine. — It sews the sections of a copy on tapes or cords. It can sew about 3,000 sections per hour.

5 Nipping Press. — It presses the sewed copies. It is a semi-automatic press capable of exercising a pressure of ten tons.

6 Trimming Machine.— It cuts and trims the three edges of each copy of the book. It is a three-knife machine.

7 Gluing Machine. — It applies glue to the back of the sections of each copy of the book and attaches them to one another.

8 Rounding and Backing Machine. — Rounding and backing are done simultaneously on the same machine. This machine can turn out 1,500 copies an hour.

91 Triple-Lining Machine. — It applies the paper lining, the head band, and the tail band.

92 Board-Cutter. — It cuts the boards forming the inner core of the covers of each copy of the book. It is a rotary.

93 Slitting Machine.— It cuts the cloth used as covering material.

94 Case Making Machine. — It fixes the cloth properly on the boards.

95 Casing Machine. — Copies of the book are fed into this machine. Pasting and positioning the case and discharging the cased copies of the book are all automatic in this machine.

96 Pressing Machine. — This is a power press in which the bound copies of the book are kept for some hours before they are released for use.

23 EDITION BINDING — PUBLISHER'S CASING

All the above 14 pieces of machinery can be set each to do its job in proper succession. In other words, binding can be done in the "Assembly Line," as it were. Quick Mass-Binding of all the copies of an edition of a book is denoted by the term 'Edition Binding'. It is also called 'Publisher's Casing'. The term 'Publisher's Case' denotes the finished cover that is attached to the book after stitching. The speed of Edition Binding is said to have now reached 3,000 copies per hour. In Edition Binding, one copy of the edition is indistinguishable from any other copy.

3 Reinforced Library Binding

Publisher's Casing is weak. The Case is not strongly attached to the book. It may be sufficient for a privately owned copy not exposed to much use. On the other hand, a library copy of a book will be used by many readers. It will have to stand much wear and tear. Further, the life of a copy should be prolonged as long as the paper does not perish. The volumes of learned periodicals form a class by themselves. Though they may not be exposed to much wear and tear, they should be kept permanently as they form the bed-rock of research. Therefore, Publisher's Casing is not suitable for library copies. A special kind of binding known as 'Reinforced Library Binding' has been developed for library copies. Normally, each library binds its own copy. Therefore, Mass Binding does not arise here.

CHAPTER RB

ANATOMY OF THE BOUND BOOK

0 Chain of Eleven Links

Viewed from the angle of binding, a book is a chain of eleven links. It is a symmetrical link with paper as the central link. The following diagram gives a schematic representation of the book as such a symmetrical link:—

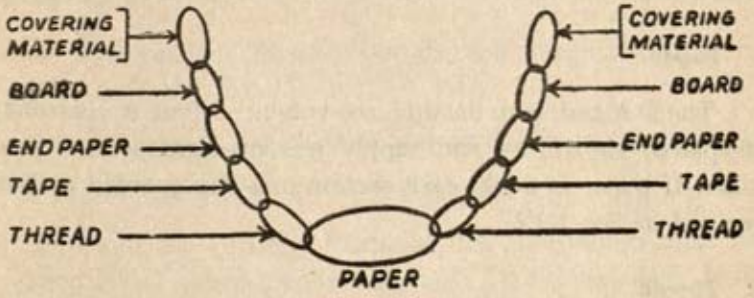


Fig 7. Bound book : Parts

The diagram discloses the parts of a bound book needing attention while binding.

01 Strength of the Chain

It is a truism that the strength of a chain is determined by that of its weakest link. This means that it is uneconomical to make any of the other links more durable or strong than the weakest one. Of the eleven links, the paper on which the book is printed has to be accepted by the librarian and the binder, exactly as it is found in the book. It therefore follows that the quality of the materials used to form the remaining links should be commensurable to the durability and the strength of the paper of the book bound. In particular, in the

case of ephemeral books on poor paper, binding can use cheap materials and it can be done cheaply. Again, for a book printed in weak antique or feather-weight paper which will perish soon, binding can be done cheaply. A book printed on art paper is a problem. If it is only of ephemeral value, its binding can be done cheaply. If it happens to be a book of permanent value, special and often costly methods should be adopted in binding it. Let us examine each of the links in the chain forming the book. We shall start from the centre and proceed outwards. We assume that the book will have to stand much wear and tear and will have to last long.

1 Paper

The first task is to unstitch the volume, collate it, rearrange misplaced signatures, and supply missing signatures, if possible. If paper is weak, each section must be guarded as prescribed in Sec RF2.

2 Thread

The thread used for sewing must be strong and durable. It should not injure paper at any time. Wire thread may be strong. But it will rust. Therefore it is not durable. Further, when rusting begins, the rust will disintegrate the paper. Bleached thread — cotton or linen — will be soft to handle. But the process of bleaching invariably diminishes the strength of the thread. Thus unbleached thread of suitable thickness is indicated. Whether it should be of cotton or linen depends on the quality of the paper on which the book is printed. Nylon and terylene thread have been put into the market.

3 Tape

The tape round which the thread is taken and against which the sheets of the book are stitched must be of the best

unbleached linen, for heavy books of permanent value. For books of the next order of importance, hempen cords may be used instead of linen tapes.

4 End-Paper

End-paper is the extra fold of paper, sewed along with the sections at the beginning and the end of the book. It serves three purposes:

1 It bears the brunt of the strain when the book is opened and closed;

2 It covers up the inside of the board which will otherwise be unsightly; and

3 It also prevents the first and the last few leaves of the books from crumpling or warping by use.

To be fit for all these functions, the End-Papers must be of good, thick, strong paper. It must have stout linen joint and must be sewn on as a section.

5 Board

51 DEFINITION OF 'BOARD'

Paper transitions into Board. The dividing line between them is not definite or rigid. The International Standards Organisation has fixed a weight of 250 gm per square metre as the minimum for a Board.

52 STRAW-BOARD

The term 'Straw-Board' denotes board made from unbleached straw-pulp. It is yellowish in colour. It is not very strong.

53 MILL-BOARD

The term 'Mill-Board' denotes a homogeneous board usually made of waste paper, with a thickness not less than 1 mm.

54 BOARD FOR BINDING

The Board is the foundation of binding. If it cracks, warps, or breaks, the covering material will wear out very fast. It is therefore necessary that a strong, thick, hard Mill-Board should be used. Block Board made from old rope is the best. Machine-made Grey Boards come next in order. Straw-Boards should be used only for least-used books.

6 Covering Material

A variety of Covering Materials is available. They fall into two classes:

1 Leather; and

2 Woven Textile Fabric.

Leather is nature's product and cannot be hurried. With the phenomenal increase in the number of books, the world's output of leather for binding has become too inadequate. The pressure of this fact led to the adoption of cloth as covering material in the nineteenth century. Leather should be used for heavy, oft-used, and fairly permanent books; and cloth may be used for others.

61 LEATHER

Quality in leather is the resultant of

1 Tightness and length of fibres;

2 Durability of surface; and

3 The natural fat or oil content.

The structure of the leather determines strength. Animals in temperate and tropical regions that have developed short hair excel those in colder zones where the vitality of the animal is expended in the development of hair as protection against cold. For example, the leather of the Cape Goat of South Africa is inferior to that of the Nigeria Goat. In general, the leather from a mature animal should be preferred. Excess of oil makes leather creasy. It is therefore naphtherised — that is, dried and then revitalised.

62 Tanning and Paring

The leather should be vegetable-tanned — say with sumac or mimosa. Acid-tanned leather should be severely avoided. It is the layer below the surface that is fibrous and tough. The thickness of the leather should not therefore be unduly reduced or pared.

63 Kinds of Leather

1 Goat-skin, usually called morocco, is the best, if it is of tropical goats. It has a strong net-work of grain. Moulds can be taken of its grains and soft sheep leather can be given the grain by pressure in these moulds. This fraud can be detected by scratching the leather with the finger-nail. Morocco is the leather to be prescribed for general use.

2 Pig-skin is very strong if it is alum-dressed and not unduly de-greased. It may be prescribed for books of special value.

3 Sheep-skin is cheap but very weak. It should not be used for library books.

4 Calf-skin resembles goat skin in structure. Though basically strong, it is not durable. Because they have a smooth surface, it has been largely used. But it should not be prescribed for library books. It is believed that the 'calf-skin' found in older books is really skin of maturer animal.

5 Greenland seal-skin is very strong. Its richness in oil makes it flexible as well as durable. But it is too costly.

6 Kangaroo-skin is becoming popular.

7 Skins of snake, lizard, and crocodile are occasionally used in binding private books. I saw in Boston Athaeneum Library a book bound in human skin. I was told that it was so bound according to the will of the owner of the book who had stipulated that it should be bound in his own skin. These do not count for library binding.

64 Woven Fabric

Leather is too expensive for the great majority of books. Woven fabric is therefore commonly used for books that are either not permanent, or not of much use and therefore need not stand much wear and tear. The following are the fabrics that may be used. They are arranged in the decreasing sequence of strength and durability.

1 Linen Buckram or any other similar cloth is the strongest. It has a smooth surface. It is stiff and therefore not suitable for small books. It is the most costly textile used in library binding.

2 Leather Cloth is really proxylin-treated book cloth. It is said to be water-proof and smudge-proof unlike starch-filled book cloths.

3 Cotton cloth may be used for the front and back, but not for the spine. It is called Calico.

There is a great variety of Book-Cloth available now. Colour, beauty of finish, and capacity to take tooling should be looked for.

65 Paper

To reduce the cost of binding, marble-paper is used to cover the sides of the book. For, the sides are not exposed to as much stress and strain as the back or the corners.

CHAPTER RC

PROCESS OF BINDING

0 Stages of Binding

For using the right materials, the right process is necessary. The chief stages in the process are:

1 Sewing;
2 Trimming;
3 Rounding;
4 Backing;
5 Attaching to the board;
6 Covering; and
7 Tooling.

01 Generic Names for Groups of Operations

The following are the generic names used to denote certain groups of consecutive operations in the work of bookbinding:

1 'Sheet Work' is the generic name for the three operations of folding, gathering, and sewing.

2 'Forwarding' is the generic name for all the operations of binding a book after the sheets are sewn together. It includes trimming, gluing, rounding, backing, attaching the board, and covering.

3 'Finishing' is the name given to the decoration, if any, which is made on the covering material of the binding and the edges of the book.

1 Sewing

Sewing is the very essence of binding. The sewing must be done One-Sheet-On. There should be three to six tapes.

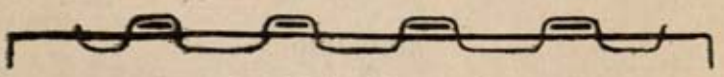


Fig 8. Binding : Sewn sections

As shown in the above diagram, the single thread is carried through the fold of the section of the end-paper and round the tapes from head to tail. At the end of the section it is taken across to the next section by a 'Kettle-Stitch' and then upto its head. The thread is thus carried up and down across the entire back of the book through the end papers on both sides. This is 'Flexible All-Along Sewing'. While this must be done for the strongest work, Sewing-Two-Sheets-On may be allowed for the majority of books.

When the book is cut away from the sewing frames, about one or two inches of the tape are left projecting from either side of the book. These are later to be inserted into the board. These are called 'Slips'.

2 Trimming

The edges of the leaves are cut with the 'Plough'. It is not usual to cut old and valuable books. The edges should be sparingly trimmed in other cases.

3 Rounding

The process of sewing increases the thickness of the back of each section by the thickness of the thread. Some of this additional thickness may be sunk into the paper and yet there



ROUNDING

Fig 9. Binding: Rounding of back

will be an appreciable amount of swelling of the back of the book. The book will therefore have the shape of a trapezium instead of a rectangle. This must be set right. The only method, as shown in the diagram, is to Round the Back. This is what geometry suggests. A straight line gives the shortest distance between two points. If they are to be connected by a longer line, it must be a curved line.

The back of the book is first knocked flat and covered with thin glue well worked between the sheets. Before the glue becomes too hard, the back is tapped with a hammer until it takes a uniform convex form. This is 'Rounding'.

4 Backing

After rounding, the book is held between wedge-shaped 'Backing Boards'. Over the edge of these boards, the backs of the sections are tapped and fanned out evenly. The result is that a groove is formed at the front end of the back, so as to receive the boards. The result of this is that the edges of the joint are slightly higher than the total of the bulk of the book plus the thickness of the boards.

5 Attaching the Board

In Reinforced Binding, Split-Board is used. This is made by two mill-boards — one thick and the other thin — being glued together with the thin board closer to the book. About 2.5 cms of margin near what corresponds to the spine of the book is left unglued. That is why it is called Split-Board. The slips — that is, the loose ends of the tape — are laid with glue in the inter-space in the Split-Boards. It is also usual to cut away the outer of the four leaves of the end-paper so as to leave only a width of about 2.5 cm and lay it with the glue along with the tapes in the inter-space in the

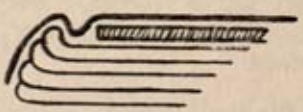
Split-Boards. The second leaf of the end-paper at either end is then pasted down on the inside of the board.

51 Squares

"Squares" are the projections of the boards beyond the edges of the leaves. The Squares should be of even width and generally about as deep as the thickness of the covered board.

52 French Joint

The greatest strain is experienced by the covering material at the joint between the board and the book. The covering material must therefore be strengthened at this joint. We cannot make it thicker along the thin line of the joint alone. The only alternative is to increase the area of the covering material at the joint. This is done by leaving a small space between the back edge of the board and the groove made by the backing. This is 'French Joint'. The covering material is driven into the groove, as shown in the accompanying diagram. This gives a greater area of the covering material to stand the strain of closing and opening the book.



FRENCH JOINT

Fig 10. French joint

53 Tapeless Attachment

When World War II was on, there was a scarcity of tapes. Again necessity became the mother of invention. 'Tapeless Attachment' was the result. In this the back of the book is lined with strong mull. A good durable and flexible adhesive is used to secure the mull to the sections on the one hand

and the boards on the other. The mull should come as near to the head and tail of the book as possible, since the strain is greatest just at these points when the book is used. The mull should be so placed that the warp — the strongest threads — is across the back and not down it.

6 Covering

Covering of the board is usually done before the book is attached, if a woven fabric is used as the covering material. Leather is usually applied after the book is attached to the board.

If the edges are to be gilded or coloured, it should be done before covering is begun.

If head-band is to be used, it too should be inserted before covering is begun. It should be a little lower than the height of the Squares. Head-band is worked in silk by a kind of 'Buttonhole Stitch' enclosing a strip of leather or gut. It helps protecting the leather of the head from being pulled away from the back when the book is taken from the shelves. Instead of a head-band, the leather at the head may be turned in over a strong cord.

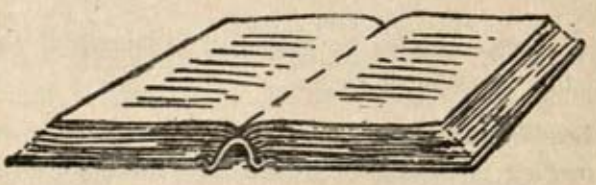
61 SIDES

The leather is pared and softened with flour paste and then applied to the sides. The parts of the leather that turn over on to the inside of the board are mitred at the corners and trimmed evenly. The End-Paper pasted on the inside of the board should be of the same thickness as the leather turned in. This is Full Binding.

62 SPINE

The spine on the back of the sections may be lined with a sheet of paper or muslin or similar tape-like material. This

is called 'Stripping'. In "Back-Stripping," the tape is folded round the spine of the book. In "Flat Stripping," it is not folded round. The covering material is firmly pasted down the spine. This is called 'Tight Back' or 'Flexible Back'. In "Hollow Back" the covering material does not touch the spine. It is called 'Hollow Back' because when the book is kept open, one can see down between the back of the book and the back of the board. In Tight Back Binding, the strain is distributed over the whole spine. But in Hollow Back Binding, it is all thrown over the joints.



FLEXIBLE BACK



HOLLOW BACK

Fig 11. Hollow Back and Tight Back

63 HALF-BINDING

Much of leather and of the cost of binding may be saved by "Half-Binding." In this, the leather is applied only on the spine, round the spine, and on to the sides only to about an inch and at the corners. When these are dry, the rest of the surface of the sides is covered with cloth or paper.

7 Finishing

The essential part of 'Finishing' consists of 'Lettering' and 'Decoration'. Lettering consists of author's name, title, date, and call number. This is essential. The position for these items on the spine and the use of gold or other material has been already discussed in Chap MD. Decoration is hardly necessary in the majority of library books. This has been discussed in Sec MD4.

CHAPTER RD

FAULTS IN BOOK BINDING

1 Sawing-In. — Sawing trenches across the backs of the sections for the cords to lie in. This is done to avoid appearance of ridges on the spine after it is covered.

2 Stabbing or Over-Casting. — Sewing by piercing the sections from front to back. If stabbing is done, the book will not open to the back, will not lie open, and will tear at the sewings.

3 Stapling. — Stabbing with wire. It may also denote sewing through the folds with wire thread. The wire will rust, become weak, break, and corrode the paper.

4 Tipping-In. — Pasting the edge of a single leaf to the next leaf. Plates are usually tipped in publisher's casing.

5 Perfect Binding. — A misleading, pretentious term. In this process, there is no sewing whatever. The backs of the sections are cut off leaving single leaves only. About a hundred years ago, the leaves were fixed together by caoutchouc. Later, naphtha solution and rubber latex and other adhesives were used in succession. The advantage is that the book opens quite flat. The fault is that the binding appears to be strong enough at the beginning; but that before long the adhesive perishes and the leaves fall out. Research in the W. J. Barrow Research Laboratory, Richmond, Virginia, has yielded several Polyvinyl Acetate (PVA) adhesive formulations suitable for binding purposes.

6 Bleeding. — Cutting the edges too much so as to affect the reading matter. This must be avoided.

7 Paring the leather too much.

8 Hollow back.

CHAPTER RE

PRESERVATION OF THE BINDING

1 Training the Reader

The Binding is the armoury of the book. It is its most exposed part. Any injury to the book must enter it through the binding. Preservation of the book therefore centres largely round preservation of the binding. The first duty of the Maintenance Section and the Reference Section in an open access library is to train the reader in pulling out a book from the shelf in a gentle way. In particular, he should be trained not to pull out the square of the covering material on the spine projecting at the head. The head-band should not mean licence to pull out the head of the covering of the spine of the book. In the case of very big and heavy books in frequent use, it is advisable to have a strap of leather going loosely across the back with each end fastened to the board of the book.

2 Over-Sized Book

Over-Sized books should be made to lie on their sides. If they are made to stand on their edges, the binding and the leaves bend, and the book loses its shape. If the book is heavy, this may also weaken the attachment of the book to the board and eventually affect the sewing also.

3 Warping

Warping of the cover is one of the ailments to which a book is prone. It makes the book unsightly to see and unruly to handle. Everybody agrees that moisture is the responsible snake in the grass. But there is a wide disagreement as to just what "the grass" is. Moisture likes the adhesive; it may be in the board; it can find shelter in the pores of the cloth and the paper. It is found that 60 per cent water content is

ideal. If it is less, the end-paper is unable to overcome the pull of the cloth and outward warping sets in. If it is more, inward warping sets in. Waterless adhesive is talked of. Long retention of the book in the press until the book is quite dry and flat is said to be somewhat preventive. The ideal is air-conditioning so that the stack room is always maintained at a humidity of 60 per cent.

4 Leather

The leather on the binding of books lasts very much better in a book frequently handled than in one left untouched. The natural grease from the hand keeps the leather fit. Periodical application of a mixture of paraffin wax and castor oil will prove useful — very much as we do with leather shoes. Shoes put away for a long period crack and become hard and brittle. Open access and occasional oiling will make leather binding everlasting.

5 Mildew

A group of omnivorous fungi known as mildew or mould is destructive of paper and leather. It produces white scars. It grows much when humidity is above 70 per cent and most when it reaches 90 per cent and the temperature is between 25 and 30 degrees centigrade. Ventilation controls moulds to some extent. To provide for aeration, books must be loosely arranged on shelves. In winter, steel shelves cause local lowering of temperature producing near the books pockets of more humid air.

6 Insect

Book-worm is the popular name for the larva of beetles. It eats paper and leaves its eggs on the surface of binding or on the edges of books. The eggs hatch within ten days during

summer. The larva eats its way into the interior of the book and reaches the surface again when ready for chrysalis stage. It has about five life-cycles in a year. Its damage is recognised by the pinholes and tunnels across the leaves of books. Silverfish has glistening silver-grey scales on the body, long antennea on the head, and filaments at the hind-end. It is less than half an inch in length. It hides away all day and feeds on binding, starch, and paper at night and in darkness. Experience shows that cockroaches and other insects are attracted to gnaw into the binding if the colour of the covering material is dark or deep green or anything bordering on darkness. White and yellow colours are the best from this angle. But, these show up dirt. Therefore, red colour seems suitable. The mixing of copper sulphate in the paste and the glue acts as a preventive against insects.

CHAPTER RF

MENDING

1 Re-sizing

To make damaged paper crisp and firm and to remove stains due to damping, re-sizing and washing are necessary. Before re-sizing, dust and dirt should be removed by rubbing gently with soft India rubber from the centre of the page to the outside. If rubbed in the reverse direction, the paper may be creased or torn.

2 Guarding

Guarding is the process of laying over the back of the section a strip of strong, thin, and flexible paper or linen. The strip is the Guard. All damaged folds should be guarded.

3 Over-Casting

If the sheets of a book are cut into single leaves, these must be made up into sections by guarding each adjacent pair of leaves or by over-casting.

4 Brittle Paper

Each leaf of brittle paper may have to be cased in transparent silk gauze, guarded, and then sewed. This is necessary in the case of archives; but it may be necessary in a printed book only if it is rare and needing preservation at any cost.

CHAPTER RG

SPECIFICATION FOR REINFORCED LIBRARY BINDING

0 Introduction

In 1930, I drafted for the Madras University Library a specification for reinforced Library Binding. On the basis of this and the experience gained in using this specification for nearly 35 years, the Indian Standards Institution brought out its publication IS:3050–1965 a *Code of practice for reinforced binding of library books and periodicals*. The following is taken from it.

1 Style and Colour

11 Style

The various styles of book binding and the particular use to which they are put by librarians are given below.

SN	Style	Recommended Use
1	Full morocco	Rare books and books of permanent value
2	Half morocco and linen or art canvas	Periodicals and books in constant use
3	Full linen or art canvas	Periodicals and books not in constant use
4	Half linen or art canvas or calico and marble	Pamphlets and books with weak paper

12 Colour

The colour of the covering material should be fast and soothing to the eye. Red is preferable.

2 Collation

All the sections of the book shall be examined by the contractor in the library itself, in respect of their sound condition, collated, and secured in proper sequence. Whether the book will stand rebinding should be determined before the order for the rebinding is accepted. In the case of a periodical or a book published in instalments, all the issues of a volume and the sections making up the title, contents pages, and indexes shall also be collated and assembled in the proper sequence. Covers and advertisement sheets in periodicals shall not be bound in unless they are included in the pagination of the text or they are required to be retained for other reasons. As far as practicable, assembling into volumes more than 7 cm in thickness should be avoided. If a volume is torn and/or incomplete and if it is to be bound, the contractor should take special instructions on it.

3 Preparation for Sewing

The first and the last section of all books shall be enclosed at the back in linen or muslin strips. All sections broken at the back shall be lined inside and outside at the fold with strips of rag, tissue paper, or with unsized muslin or linen strips, preferably serrated. All torn pages shall be joined with transparent tissue paper or similar material without prejudice to readability. When the paper of the volume is deteriorated and brittle, it shall be reinforced with transparent tissue paper or other similar material without prejudice to readability. All folded plates, maps, plans, and other extended sheets not forming part of a normal section shall be mounted on guards of linen or muslin or tough paper. Pasting of leaves larger than the format of the book shall not be permitted. All extended sheets shall be reinforced at the folds. All folded plates, maps, plans, and other extended sheets

shall be reinforced and, where necessary, be mounted on jaconet or thin linen or muslin of good quality.

31 POCKETS

To hold maps, charts, and other similar materials which cannot be bound with the volume, a separate pocket shall be secured at the end of the volume in such a way that the over-all shape of the volume is as near to the normal as possible.

32 END-PAPERS

There shall be end-papers one at each end. Each end-paper shall consist of a section giving four leaves. The end-papers shall be cut across the machine direction from head to tail. The end-papers shall be provided with strong linen or cloth joints.

4 Sewing

Books printed on paper of good quality shall be sewn all along one section on (except where thinness of paper makes it necessary to sew two sections on) with thread of suitable thickness over linen or cotton tapes. Each of the end-papers shall be sewn on as a section. Unbleached linen or cotton tapes shall be used. The width of the tape shall be 2 cm. There shall be one tape within 2.5 cm from the head and another within 2.5 cm from the tail. The number of tapes will depend upon the height of the book as shown below:

Height in cm	N of Tapes
Not more than 15	2
Between 15 and 25	3
Between 25 and 35	4

For books of greater height, the number of tapes shall be increased suitably. The tapes, in excess of two, shall be equally spaced between the tapes near the head and the tail of the book. Straight line machine stitching shall not be used. Sewing shall be so done that when the book is opened, the pages of its two halves lie flat on a flat surface.

5 Split Board

The thinner member of the board shall be closer to the book.

6 Forwarding

The edges of the book shall be cut accurately leaving margins as wide as possible. In no case should the cutting affect the printed portion.

61 Deckle-Edged Book

A deckle-edged book should not be cut at the fore-edge and the tail-edge, but the top edge should be cut. Edges shall be sprinkled, stained, or left plain, as instructed.

62 Gluing, Rounding, Backing, and Lining

The spine shall be well rounded and backed. For thinner books, the round should be kept very small and increased proportionately for thicker books. In other words, the depth of the joint should be the same as the thickness of the boards. The spine shall be glued. The spine shall be lined with muslin extending to within 5 mm of head and tail of the book and well on to each end-paper.

63 Attaching the Boards

French Joints shall be used in binding. Each slip of the tape shall be firmly inserted into the split board. The outer-

most end-paper at each end shall be cut to the necessary width and inserted into the split board. The surviving outermost end-paper at each end shall be pasted down on the board.

64 COVERING

Leather used as covering material shall neither be pared too thin nor stretched too tightly — the former for considerations of strength and the latter to allow for play within the French joint. The covering material shall be attached directly to the spine of the book. Hollow binding is not allowed. The covering material of the spine shall extend over the boards to at least one-third of the width of the book. The boards shall be slightly rounded at the corners. The covering material shall be neatly folded and not mitred. Head-bands may be worked or a piece of string may be inserted into the turning of the leather at the head and the tail in the place of head-bands. Irregularities on the spine shall be smoothened out.

7 Lettering

The lettering shall be durable and easily readable. The lettering may be in fast colour or gold as prescribed. The title in the lettering shall normally be 22 mm below the head. The name of the author shall be on the upper half of the spine of the book, at least 25 mm below the title. The lettering done along the spine shall be such that it is directly readable when the book is lying flat, front cover uppermost. The bottom line of the call number on the spine of the book shall normally be 25 mm above the tail. The surface may be varnished with shellac or cellulose acetate or any other material not harmful to the covering material.

8 Materials

81 BOARD

The board shall be good quality, single ply, acid-free binder's board with qualities approximating to those of millboard.

82 LINEN

Unbleached book cloth made of flax shall be used.

83 END-PAPER

End-Paper shall be made of good, thick, strong paper with high folding strength.

84 GLUE

Best quality flexible glue mixed with a suitable insecticide conforming to IS:562-1962*, not harmful to man, shall be used.

85 PASTE

Paste shall be made from best quality starch and mixed with a suitable insecticide conforming to IS:562–1962*, not harmful to man.

86 LEATHER

Only leather from mature animals shall be used. It should be vegetable tanned and not acid tanned. It should not be artificially grained or dyed. Goat skin, also called morocco, is recommended. The leather shall further conform to the requirements prescribed in IS:2960–1964.

87 TAPE

Tape shall be of linen or unbleached cotton.

88 THREAD

Thread shall be strong and durable and shall be of linen or unbleached cotton and soft enough not to injure the paper at any time. *Note*: Wire stitching should not be used.

9 General Clauses

91 SIZES

The size of a book is to be determined by the measurement of the board, the square of which must not exceed one-eighth of an inch in books up to crown octavo, and proportionately for larger sizes. Extra charges for thickness is to be allowed only when the thickness of the volume exceeds one half the width of its boards. No extra charge is to be made for two or more volumes bound in one, unless the thickness of such a volume exceeds one half the width of the boards. In submitting the bills for work done, the measurement of the board should be given in cm in addition to the conventional mode of specifying the size.

92 INSPECTION

Covering material shall not be put on, before the library is invited for inspection and it approves the work done till that stage.

93 ALTERNATIVE SUGGESTIONS

When the preceding instructions are obviously inapplicable to any book or for any reason undesirable, the contractor is to submit suggestions for binding such a book with estimate of cost.

INDEX

Compiled by Maya Bhattacharyya

Note

1 The index number is the number of the part, chapter, or section of the occurrence of the item indexed.

2 For example, the index number KB2 means Section 2 of Chapter KB in Part K

3 The following contractions are used.

def = Definition
irt = in relation to
qirt = quoted in relation to

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