

THE PERISHING OF PAPER IN INDIAN LIBRARIES.

by J. J. Sudborough and Miss M. M. Mehta.

The deterioration of paper in Europe and America is not unknown, and Committees have been appointed in both continents to report on the matter. Reports of such Committees will be found as follows :—

1. Report of committee on the deterioration of paper. (Journal of the Society of Arts, 1898, 46, 597-601.)
2. Durability and economy in papers for permanent records. (Report submitted by H. W. Wiley and C. H. Merriam, U. S. Department of Agriculture. Report No. 89, Pub. 1909.)

The following is a summary of the English Report :—

Actual disintegration has been brought to light in papers of all grades from pure rag to mechanical wood pulp papers, and in some cases is quite independent of wear and tear. It is the result of chemical change in the fibres themselves. In other cases the damage could be traced to the use of illuminating gas upon the atmosphere of the rooms in which the books had been stored. In the case of rag papers the effects appear to be due to acid bodies. The acids may have been present in the original paper as made, or may have resulted in reactions going on in the paper itself after making, or may have been due to products of gas combustion. In the case of mechanical wood pulp the effects are traceable to oxidation pure and simple, the disintegration is accompanied by an alkaline reaction of the paper.

Discoloration of ordinary celluloses (as contrasted with mechanical wood pulp) under usual conditions of storage is proportional to the amount of rosin they contain or more generally to the rosin and the conditions employed for fixing it in the ordinary process of engine-sizing. The practical conclusions arrived at are :—

1. Book paper should be sized with a minimum amount of rosin. A proportion of 2% rosin (calcd. dry) on the paper may be suggested as a maximum and for

nearly all ordinary purposes of printing hard sizing (produced by large quantities of rosin) is unnecessary.

2. Papers should be finished with the normal slight excess of alum which gives to the paper the slightly acid reaction of the alum *i. e.* acid to litmus and neutral to methyl-orange.
3. Care must be taken that the paper contains a minimum of chlorides.
4. The danger of over-bleaching in order to produce a pure white colour must be avoided and this is more necessary with cheaper papers where esparto and wood are used.
5. Heavy loading tends to diminish the strength of a paper and a maximum of 10% of mineral matter is regarded as the extreme limit of sizing.
6. Classification of fibres. The following gives the relative values of fibres :—
 - (a) Cotton, flax and hemp.
 - (b) Chemical wood pulp. 1. Sulphite process.
2. Soda and sulphate process.
 - (c) Esparto, straw celluloses.
 - (d) Mechanical wood pulp.

The Committee recommend that book paper required for publications of permanent value should fulfil the following conditions :—

Fibre not less than 70% of fibres of class (a.)

Sizing not more than 2% of rosin with the normal acidity of pure alum.

Loading not more than 10% of total mineral matter.

The American report deals largely with specifications for papers for Government use. They recommend that departmental publications which are distributed to the public should be printed on paper made from bleached chemical wood pulp or its equivalent. The paper should be as light and thin as is compatible with sufficient strength and opacity and the colour should not be injurious to the eyesight. A small edition of each publication, or certainly of those of scientific value, should be printed on high

grade paper for distribution as permanent records to public and institution libraries. The paper should consist of at least 75% rag stock and should be strong and thoroughly made to withstand much handling. The surface should be machine finish and the colour "natural." Specifications for coated paper for half tone illustration and for substitutes for coated papers and for writing and wrapping papers are given.

J. P. Korschilgen in a paper on durability of paper and testing the same (Papier Zeit., 1905, 30, 2570—2572 and 2722—2723; Abs. in J. S. C. I., 1905, 24, 983) draws attention to the importance of the folding test for determining the durability of a paper.

The loss of tensile strength and elasticity produced by folding the paper backwards and forwards a given number of times in the Schopper Creasing Machine is the most reliable mechanical test for durability. The presence of old rag fibres, deficient beating, bad felting, over drying and hydro-cellulose are readily detected.

W. Herzberg (Mitt. K. Material Prüfungs Amt., 1908, 26, 105—137; Abs. in J. S. C. I., 1908, 27, 639) discusses the question of the preservation of book papers in public libraries, and as the result of an examination of 435 samples taken from treatises and periodicals from the Berlin University Library he found that the proportion which would stand the folding test as given for a new paper of even low grade was extremely small. It is pointed out that a specification for book papers based on composition alone is not sufficient and some of the worst samples from the point of view of folding were made of rag fibre. The *quality* of the raw material and its suitable treatment in the process of manufacture are really of more importance. These can be ensured by a "strength" specification.

In Indian libraries and Record offices it is frequently found that the paper has become quite brittle, even books which have not been much used show the phenomenon, and in many cases the brittleness is so marked that one or two single folds of the paper cause it to break along the fold. This is the phenomenon which we call "perishing" and one object has been to attempt to arrive at the cause of the perishing and to suggest methods of preventing it in the future. Our attention was first drawn to this perishing by Mr. Chapman, Librarian to the Imperial Library, Calcutta, and at the request of the Government of India the Institute of Science took up the investigation.

That perishing is more common in India than in Europe or America is indicated by the fact that Mr. Chapman in 1915 sent a list of 8 volumes taken from Indian libraries and showing marked signs of perishing and requested the keeper of the British Museum to examine copies of the same books in London. The result was that the London copies showed no distinct signs of perishing, although in one case there was discoloration and in another foxing.

Mr. Chapman also communicated with the Librarian of Congress, Washington, with the hope that some observations might have been made on the perishing of paper in the libraries of some of the Southern States. But the replies from the Librarian and from the Director of Commerce, Washington, proved that the phenomenon had been met with in the Southern States but that no records had been kept of the actual volumes perished, of their dates, or of the proportion of perished and unperished volumes in any one library.

The extent to which perishing has occurred in certain Indian libraries can be gathered from the fact that Mr. Chapman's estimate for the R. A. Mess Library, Meerut, where practically all the books have been in India for 70 years or more is above 90% perished. Mr Chapman also thinks this proportion probably holds good for books in the Imperial Library which have been in the country for 70 years and upwards. Our own examination of the libraries of the Literary Society of Madras and of the Maharaja Serfogi's Sarasvathi Mahal Library, Tanjore, indicate that distinctly more than 50% of books, as distinguished from manuscripts, have perished or are in the process of perishing.

According to Mr. W. Raitt, (Proceedings of the All India Conference of Librarians, Lahore, January 1918) perishing is due to the use of ingredients other than rags (linen and cotton fibre) in the manufacture of the paper and hence the phenomenon would not be met with in books published before 1860. Our own observations show that this is not correct, as perishing can be met with in books dating from the early eighteenth century and is quite common in rag papers of the early 19th century.

Some of the points to which we have directed our attention are :—

- I. In the case of a book which shows distinct signs of perishing in one Indian library, do copies of the same book in other Indian libraries also show perishing?

- II. Are there any noticeable differences in the same book in hill station libraries and libraries such as those of Calcutta, Bombay and Madras?
- III. When a given volume shows signs of perishing is the whole volume equally perished or are there distinct differences; if such differences exist is the change from perished to sound pages gradual or abrupt; and are similar variations met with in copies of the same book in other libraries?
- IV. To what extent perishing is affected by:—
 - (a) the nature of the fibre,
 - (b) the nature of the sizing materials,
 - (c) the nature of the bleaching agents used in the manufacture of paper.
- V. What is the nature of the chemical change which occurs during the process of perishing? Is the change purely chemical or due to micro-organisms?
- VI. Can perishing be produced artificially and what are the best methods of keeping books in India from undergoing perishing?

I. COPIES OF THE SAME BOOK IN DIFFERENT LIBRARIES.

We have examined carefully the following works in various libraries:—

1. *Memoirs of the Operations of the British Army in India during the Mahratta War of 1817, 1818, 1819* by Lt.-Col. Blacker. London, Printed for Black, Kingsbury, Parbury and Allen, Leadenhall St. 1821.
2. *Voltaire* by John Morley. London, Chapman & Hall, 193 Piccadilly, 1872.
3. *Comparative Grammar of the Modern Aryan languages of India* by J. Beames, 3 Vols. London. Trubner & Co., 57—59, Ludgate Hill 1872, 1875, 1879.
4. *A Journey from Madras through Mysore, Canara and Malabar* by F. Buchanan. 1st edition 3 Vols. London W. Bulmer & Co., Cleveland Row, St. Jamess, 1807.
5. *Memoirs of the Geological Survey of India*, Vols. VI to XXII, Calcutta.

The following tabular statements show that copies of the same book taken from Madras, Calcutta, Bombay, Meerut and Serampore show very much the same type of perishing.

1. Memoirs of the Operations of the British Army in India during the Mahratta War of 1817, 1818 and 1819 by Lt.-Col. Blacker. London. Printed for Black, Kingsbury, Parbury and Allen—1821.

Madras Literary Society Library.	Native General Library, Bombay.	R. A. Mess Library, Meerut.	Connemara Public Library, Madras.
Title page, dedication and preface brittle and discoloured. Appendix and chapters very brittle and discoloured. Maps in good condition.	Title page, dedication and preface in fairly good condition. Chapters very brittle and discoloured. Appendix perished but not quite so brittle. Maps in good condition.	Title page dedication, preface and contents perished but not brittle. Chapters perished, but on the whole condition and colour much better than the M. L. Society and N. G. Library copies. Maps in good condition.	Much the same as the M. L. Society's copy, but not quite so bad.

2. Voltaire by John Morley—London. Chapman and Hall, 1872.

Serampore College Library.	Native General Library, Bombay.	M. L. Society Library.	Nilgiri Library, Ootacamund.
Perished and brittle, very slight discolouration. Catalogue at the end of the book is in a much better condition than the rest of the book—1872.	Perished Catalogue at the end of the book in a better condition than the rest of the book—1871.	Brittle, worse than Serampore College copy and slightly discoloured. No catalogue at the end. 1872.	Quite in good condition, 1872. Since 27—9—73 in Nilgiri Library.

3. Comparative Grammar of the Modern Aryan Languages of India by J. Beames, 3 vols. London, Trübner—1872,
1875, 1879.

1.	2.	3.	4.	5.	6.	7.
Bombay Branch of the Royal Asiatic Society.	Madras Literary Society.	Native General Library, Bombay.	Asiatic Society of Bengal, Calcutta.	Adyar Library, Madras.	Nilgiri Library, Ootacamund.	Secretariat Library, Simla.
Volumes I, II and III moderately perished. Contents of Vol. III are in better condition than the rest of the book.	Vol. I more brittle and more discoloured than the B. B. R. A. Society copy. Table of contents also brittle.	Vol. I quite perished. Vol. II exactly same as Bengal Asiatic Society copy. Vol. III in the process of deterioration.	Vol. II moderately perished. Table of contents in a better condition than the rest of the book.	Vols. I, II and III in much better condition than copies from Madras, Bengal and Bombay.	Vols. I and II in perfectly good condition.	Vols. I and II fairly good condition. In Vol. II pp. 150—165 not quite so strong and in Vol. I p. 177—224 and 241—304 rather weak. *Vol. III excellent condition.

* This volume has labels Royal Engineering College and P. W. D. Section Library and has evidently been in England for some years.

4. A Journey from Madras through Mysore, Canara and Malabar by F. Buchanan, 1st Edition,

W. Bulmer and Co. 1807, 8 volumes.

	Indian Institute of Science, Library.	University Library Bombay.	Native General Library, Bombay.	Asiatic Society of Bengal.		Serampore College Library.	Secretariat Library Simla.
				1ST COPY.	2ND COPY.		
VOL. I 1807.							
Title page. Table of contents.	Good,	...	Good.	Good.	Good.	Good.	Good.
Introduction.							
Chapter	Badly coloured and perished, as a rule two single foldings sufficient to break the paper.	...	Badly coloured and perished, one single fold enough to break the paper.	Badly coloured and perished, so brittle that even difficult to handle.	Colour fairly good, perished, the paper stands six foldings before it breaks.	Badly coloured and perished, one single fold enough to break the paper. Some pages even difficult to handle.	Margins good but tender under print.
Plates	Fairly good.	...	Fairly good.	Fairly good.	Fairly good.	Fairly good.	
VOL. II 1807.							
Title page and Table of contents.	Good. Badly perished, dark brown, 2 foldings sufficient to break the paper.	Good. Badly perished, one single fold enough to break the paper, dark brown.	Good. Badly perished and single fold enough to break the paper, dark brown.				Good
Chapters							Tender under print.
Plates		Fairly good.	Fairly good.	Fairly good.			

4. A Journey from Madras through Mysore, Canara and Malabar by F. Buchanan, 1st Edition, London,
W. Balmer & Co., 1807, 3 volumes.—(continued).

	Indian Institute of Science Library.	University Library Bombay.	Native General Library Bombay.	Secretariat Library Simla.
VOL. III 1807.				
Title page	Good.	Perished and discoloured four foldings enough to break the paper.	Good.	Discoloured but strong.
Index	Good.	Same as title page.	Good.	Good.
Appendix at the end of the book.	Good.	pp. i-viii and xviii-xxxi good, but ix-xvi same as title page.	Good.	
Chapters	Pp 433-479 good. Remainder of the book perished, two foldings enough to break the paper.	Pp 433-479 good. Remainder of the book perished, one fold- ing sufficient to break the paper.	Pp 433-479 good. Remainder of the book perished, two fold- ings enough to break the paper.	Somewhat brittle under print, 2 folds and strong pull breaks paper, but pp 433-479 strong and some paper at end blotchy.
Plates	Fairly good.	Fairly good.	Fairly good.	

A copy of Buchanan in the St. Xavier's College Library, Bombay, was in very good condition.

5. Memoirs of the Geological Survey of India.

	Copy 1. Indian Institute of Science, Library, Bangalore.	Copy 2. Imperial Library, Calcutta.	Copy 3. Madras Literary Society Library.	Copy 4. Bombay University Library.	Copy 5. Thomason College Library, Roorkee.	Copy 6. Secretariat Library, Simla.
Vol. VI—1869.	pp. 1—38 brittle. 39—242 good, 243—377 indications of perish- ing can be marked. Remainder of the book in good condi- tion.	pp. 1—94 brittle and discoloured, 95—135 rather less brittle and less discoloured than pp. 1—94. 137—162 even better, paper good colour, 163—141 good, 243—282 slight- ly perished and dis- coloured. 283—290 in fairly good condition. 291—375 slightly per- ished and discoloured, 377—394 quite good.			Rather worse than Imperial Library copy.	Whole volume good.*
Plates,		Good except plate 8, Some perished.			Somewhat perished.	
Vol. VII—1869.	pp. 1—342 in fairly good condition.	pp. 1—342 in a fairly good condition.	pp. 1—255 in a fairly good condition.		Same as Bombay University copy.	All good.*
Maps.	Khasia hills slight- ly perished. Kurhu- bali coal field worse. Deogarh coal field worse.	Same as in I. I. of Science copy.	Same as in I. I. of Science copy.			All good.*
Vol. XV—1880.	pp. 1—126 brittle, two foldings cause paper to break.	Agrees page for page with the I. I. S. copy.	Agrees page for page with the I. I. S. copy.	pp. 1—127 slightly perished, 129—192 much worse & brittle.		All good.*

* Vols. VI, VII, XV had been in the Cooper's Hill College Library, England for some years.

A report from the University Library Madras is to the effect that Vols. XV, XXIII, and XIX are badly perished, but that maps are in good condition.

A copy of the Memoirs in the Library of the Geological Survey of India, Simla exhibited the same differences as the Institute of Science copy, but on the whole the perishing was not quite so marked.

A single part 2 of Vol. XIX, obtained from St. Xavier's College Library, Bombay, and another copy of the same part from the University Library, Lahore, agreed exactly with the Indian Institute of Science copy.

The Librarian of the Geological Society of London states that both paper and plates in the copy of the Memoirs in his library are in excellent condition.

A copy of the Memoirs in the Connemara Library, Madras, was in exactly the same condition as the set in Madras Literary Society's Library.

4. Memoirs of the Geological Survey of India.—continued.

	Copy 1. Indian Institute of Science, Library, Bangalore.	Copy 2. Imperial Library, Calcutta.	Copy 3. Madras Literary Society Library.	Copy 4. Bombay University Library.	Copy 5. Thomason College Library, Roorkee.	Copy 6. Secretariat Library, Simla.
Vol. XVIII—1881.	pp. 1—56 including title page and plate very brittle, one fold breaks the paper. pp. 61—150 in rela- tively good condition, paper good colour, but brittle 151—311 very brittle.	Agrees page for page with the I. I. S. copy.	Whole book very brittle.	Page for page agrees with the I. I. S. copy.		Same as I. I. S. copy.
Vol. XIX—1883.	pp. 1—161 very brittle, 163—215 much less brittle, 217—242 even better.	do.	Agrees page for page with the I. I. S. copy.	pp. 1—98 brittle 99—161 more brittle. 163—178 fairly good, 179—215 slightly perished. 217—242 even better.	Same as Imperial Library copy.	Same as Bombay University copy.
Plates.	Good.			Plate XIV spotted and brittle. Remainder in good condition.		
Mads.	Good.			Good.		
Vol. XXII—1883.	Whole book brittle except three maps at the end of the book.	do.			Same as Imperial Library copy.	Good.

II. HILL STATION LIBRARIES.

It has been stated on p. 122 that, when copies of the same work in London and Calcutta are compared, it is sometimes found that the Indian copy has appreciably perished, whereas the London copy is in quite good condition.

This leads to the conclusion that in all probability climate is an important factor in the process of perishing. We have attempted to find out whether there was any appreciable difference in condition of the books in such Hill Station libraries as those of Simla and Ootacamund and plain stations such as Madras, Bombay and Calcutta. One of the difficulties we have met with has been to ascertain how long a given volume has been in a library. In the Secretariat Library, Simla, a cursory examination showed that quite an appreciable number of volumes showed distinct signs of perishing; in a few of these cases it could be proved that the book in question has only recently been brought to Simla and hence was of no value for purposes of comparison. An examination of the books in the Station Library, Simla and the Niligiri Library, Ootacamund indicated that, on the whole, the books are in a very sound state, although in neither case are there many books which have been in the libraries for more than 50 years or so. On the other hand it is clear that libraries such as The Madras Literary Society Library and the Native General Library, Bombay, contain large numbers of perished books.

The following are the results of more detailed comparison in one or two cases.

1. Mr. Chapman has made a comparison of certain volumes in the Niligiri Library with copies of the same works in Madras and Calcutta, and the following is a list :—

BOOKS.

1. Report of the Madras Salt Commission 1876, Madras. O. C. L.*
2. General Report on the Administration of the Bombay Presidency for 1864—65. O. C. L.
3. The Criminal Law of the Madras Presidency compiled by C. R. Baynes. Madras, 1848. O. C. L.
4. The Civil Procedure of the East India Company's Courts in the Presidency of Fort St. George. S. R. Davies. Madras 1856. O. C. L.

*N. L.=Niligiri Library, Ootacamund.

O. C. L.=Ootacamund Collectorate Library.

O. S. J. C. L.=Subordinate Judge's Court Library.

5. Manual of the Trichinopoly District by Moore Madras 1878. O. C. L.
6. Manual of the Cuddapah District by Gribble. Madras 1875. O. C. L.
7. Orissa. Vol. I. by Hunter. London 1872. N. L.
8. Statistical Account of Assam. Vol. I. by Hunter. London 1879. N. L.
9. The Imperial Gazetteer of India. Vol. I. by Hunter. London 1881. O. C. L.
10. History of the United Netherlands by Motley. Vol. IV. London 1867. N. L.
11. Annals of the Early Caliphate by Muir. London 1883. N. L.
12. Voltaire by Morley. London 1872. N. L.

PERIODICALS.

1. Blackwood's Magazine. Vols. VI--IX, 1820—21 ... N. L.
2. Fortnightly Review. Vol. I. New Series 1867 ... N. L.
3. Contemporary Review. Vol. I. 1866 ... N. L.
4. Quarterly Review. Vol. XCV, 1834 ... N. L.
5. Edinburgh Review. Vol. XCIX, 1854 ... N. L.
6. Records of the Geological Survey of India Vols. VIII XI, XIII, XIV, (1875, 1878, 1880, 1881.) ... N. L.

All these books and journals are in excellent condition whereas copies in Madras and Calcutta have perished more or less completely.

MANUSCRIPTS.

Papers with water marks "S. Wise & Co., 1822," "Whatman 1830," "Whatman 1836," "Morbey and Sanders 1841" and "Morbey and Sanders 1843" are in excellent condition in Ootacamund, whereas papers with the same water marks in the Madras and Calcutta Record Offices are perished or perishing and the Madras samples are worse than the Calcutta.

Perishing is not unknown in Ootacamund libraries as shown by the following examples:—

1. Barton. Reminiscences of Sport in India, London 1885, 2 folds and slight pull sufficient to break paper. October 1886. N. L. The Calcutta copy is completely perished.
2. Marshall. A phrenologist among the Todas, London 1873. Slightly perished, 2 folds and moderate pull. N. L. Copy in the Madras Secretariat Library much worse.

3. McCann. Report on the Dyes and Tans of Bengal, Calcutta 1883. O. C. L.
4. A. D. Campbell. A new abridged edition of the code of Regulations for the Internal Government of the Madras Territories from 1802—1829. Vol. II. O. S. J. C. L.
5. Wm. Chambers. Descriptive papers relating to the Seven Pagodas. Edited by Cap. M. W. Carr. Madras 1869. O. C. L.
6. Acts of the Legislative Council of India relating to the Presidency of Madras from 1859—1861, compiled by Williams, Madras 1864. O. C. L.

In February 1920 one of us examined a number of books in the Station Library Simla. With six exceptions these dated from 1830 to 1895 and belonged to the classes of Biography, Travel, History and Novels and although the actual dates of acquisition were not known, the librarian was able to state that they had not been recently added to the library.

555 volumes were examined and of these only 50 showed signs of perishing, indicating only 9·0 per cent. of perished books. Copies of the same volumes were then examined in other libraries, in most cases however the number of books was comparatively small, but Table I gives the results obtained.

TABLE I.

Name of Library.	No. of Vols. examined.	No. perished	Per cent volumes perished.	Corresponding volumes in Simla. Per cent-Perished.
Station Library, Simla ...	555*	50	9	...
Nilgiri Library, Ootacamund ...	60†	12	20	15
Madras Literary Society's Library, Connemara Public Library and the Adyar Library, Madras. }	206	146	71	8
Bombay Branch of the Royal Asiatic Society's Library. }	115	96	66	8
The Native General Library, Bombay. }	69	45	65	14
Imperial Library, Calcutta ...	140	100	71	16

*For list of books see Appendix I.

† Sets of the Dublin University Magazine, Colburn's U. S. Magazine and the Edinburgh Review are all in sound condition and a set of the Fort St. George Gazettee from 1856—1909 in the Collector's Office is also sound whereas a set in the Imperial Library Calcutta shows perishing from 1856—1877.

The following numbers are of interest for purposes of comparison although they do not refer to the same books as were examined in Simla.

	No. of Volumes examined	Number perished	Percentage perished
Royal Artillery Mess Library, Meerut.	89	63	71*
Maharaja Serfogi's Sarasvathi Mahal Library Tanjore.	144†	104	72

The following statement gives the result of Mr. Chapman's examination of all books dating from 1554 to 1770 contained on pages I-117 of the catalogue of the Madras Literary Society's library.

Total No. of Volumes Examined.	No. perished.	Per cent. perished.
35	24**	68.6

In connection with the effect of climate on the perishing of paper the following cases of certain volumes are of interest:—

1. Imperial Institute. Technical reports and scientific papers. London 1903. Printed by R. Clay & Sons.

(a) Copy from the Imperial Library Calcutta where it has been since 1907 at least. Paper slightly discoloured and some pages show spotting on margins but all are brittle and two single folds are sufficient to break paper without pulling.

(b) Indian Institute of Science copy. Received from London in 1913 and been in Bangalore from that date. Not discoloured and paper not appreciably perished.

2. Memoirs of the Geological Survey of India. A comparison of the condition of the copy in the Simla Secretariat Library with the other copies as given on pages 128 and 129.

3. Beames' comparative grammar of the Modern Aryan Languages, see page 125 for comparison of different copies.

It is quite clear from the above comparisons that climatic conditions in different parts of India play an important part in the perishing of paper and that the climate of Hill Stations such

*This per cent. shows all the bound volumes were taken but only a proportion of the perished ones. For list of volumes in sound condition see Appendix II.

†These are all English books dating from 1753 to 1829 and the books examined were all those given on a certain number of pages in the Library Catalogue. For list see Appendix III.

**About 100 of these are slightly perished at edge only. The perishing in many of the books is not uniform, in some volumes there are pages in excellent condition and others distinctly perished. eg. No. 24 given in appendix IV.

as Simla and Ootacamund is much more favourable to the preservation of paper for a number of years than the climate of Madras, Bombay or Calcutta. This does not mean that low grade papers can be kept indefinitely in Hill Stations, but merely that the process of deterioration is much slower. It is highly probable that many of the volumes which are badly perished in India will show slight signs of perishing in London. The perishing up to the present has been so slight when compared with India that in many cases it has escaped detecting, but in the course of time the perishing will be quite noticeable in English Libraries.

III. DISTRIBUTION OF PERISHED PAPER IN A BOOK.

A. *General appearance of perished paper* :—

Much perished paper is discoloured; in cases where the paper is very badly perished the colour may be quite brown, in appearance almost like incipient charring. Examples will be found in :—

1. Buchanan's Journey, 1st Edition, London 1807.
Copy from Asiatic Society of Bengal's Library
cf. p. 126.
2. W. G. Browne's Travels in Africa, Egypt and Syria
from the year 1792 to 1798. London, 1806.
3. General Orders issued from the Adjutant General's
Office from March 1st to end of August 1808
Vol. XI—Madras Government Press. 1805.
4. The Quarterly Journal of Science Literature and
Arts. Vol. XXII. London, John Murray. 1827.

In such cases the paper has usually a characteristic odour and, and as a rule, the discoloration is uniform throughout the page, although in some cases it is deeper at the edges than in the middle of the page.

Examples of badly perished paper are met with, however, which show very little discoloration. Most of these are more modern papers and some of them are made of esparto. A good example is the copy of the Imperial Institute Technical Reports and Scientific Papers 1903, from the Imperial Library Calcutta (*cf.* p. 133). Another example is met with in the Memoirs of the Geological Survey, India, where the discoloration is not marked even in cases of badly perished paper.

In contradistinction to the above there are examples of perished paper in which the discoloration is by no means uniform, but distinctly blotchy. Examples of this type are met with in:—

- (a) Certain volumes of General Orders, Madras. *cf.* p. 160.
- (b) Arriani expeditionis Alexandri. 1704, Ludgv. Batavorum. *cf.* p. 139.

In such cases it is often found that the circular discoloured patches are much more brittle than the less coloured parts.

B. The whole volume is not unnecessarily uniformly perished.

An examination of the statements dealing with Buchanan's journey and the Memoirs of the Geological Survey of India (pp. 126 to 129) shows that the whole volume is not necessarily uniformly perished.

The following tabular statements give details of a few of the numerous cases which have been examined:—

1. Vol XI of the Records of the Geological Survey of India, 1878.

	Page.	Condition.	Formes.
Part I	1-56	Quite sound	A-G
	56-100	Brittle, 2 folds & slight pull breaks	H-U
Part II	161-233	do	A-I
Part III	255-266	More brittle	A-C
Part IV	267-282	Much stronger, only slightly perished	A-B
	283-311	Quite sound	C-F

2. Buchanan's journey from Madras through Mysore Canara and Malabar. London 1807. Vol. III.

Indian Institute of Science copy.

	Pages.	Condition.	Formes.
Title page		White and sound	
Contents page		do	
pp. 1-432		Some what coloured and brittle especially under print, 2 folds breaks	B-3I
pp. 433-479		White and sound	3K-3P
Appendix I-XXXI		do	a-d
Index		do	e-l

3. History of England by M. Guizot, Translated by Moy Thomas Vol. III. London, Sampson Low, Marston, Searle and Rivington, 1882.

Copy from St. Xavier's College, Bombay.

Pages.	Condition.	Formes.
1-144	Fairly good	A-L
145-496	Very brittle, but not much discoloured	L-JJ
497 to end	Perished but not so badly as pages 145 to 496	KK to end

4. Voltaire by John Morley. London, Chapman and Hall 1872.

Copy from Native General Library, Bombay.

The title pages and whole of chapters perished, but advertisement pages at end of book are of thinner paper and are in much better condition.

5. Asiatic Researches. Vol. XVI. Calcutta 1828.

Copy from the Library of the Bombay Branch of Royal Asiatic Society.

Pages.	Condition.	Formes.
Title page and table of Contents	Perished	Aa-Yy
1-454	Good and not discoloured	B-Z, 2A-2Z, 3A-3Z, 4A-4S
455 to end including appendix	Badly perished and quite brown colour	4T-4Z and a-f
Plates	Strong	

A copy from the Madras Literary Society shows exactly the same differences.

6. The Quarterly Review XLV. April and July 1831.

Calcutta Public Library Copy.

Pages.	Condition.	Formes.
Contents	Discoloured and perished	
1-16	Spotted, moderately perished	B
16-128	Spotted and perished	C—I
129-340	Not spotted and strong	K—Z
341-356	Slightly discoloured and perished	2A

6. The Quarterly Review XLV. April and July 1831.

Calcutta Public Library Copy.—*Continued.*

Pages.	Condition.	Formes.
356-404	Discoloured under print but quite strong	2B-2D
405-436	Discoloured and moderately perished	2E and 2F
437-468	Badly spotted and badly perished	2G and 2H
469-484	Not spotted and very slightly perished	2I
485-534	Very spotted and very badly perished	2K-2M
535-555	Not spotted and slightly perished	2N-2O

In this same volume is bound No. 82 of the Anti-slavery Reporter. Vol. IV No. 10 June 25th. 1831. Pages 289-316. This is slightly discoloured, is not however spotted and is extremely strong.

7. The Quarterly Journal of Science, Literature and Arts. Vol. XXII London, John Murray, 1827. Printed by Wm. Clowes.

Calcutta Public Library Copy.

Pages.	Condition.	Formes.
Contents page	Slightly discoloured and perished	
1-176	Badly discoloured and extremely badly perished, four folds break	B-M
177-208	Better colour and badly perished	N and O
209-224	Same as 1-176	P
225-294	Similar to 177-208	Q-U
295-310	Same as 1-176	
311-418	Same as 177-208	Y-2E

Plates discoloured but quite strong and not brittle.

The Quarterly Journal of Science, Literature and Arts Vol. XXI. London, John Murray, 1826. Printed by Wm. Clowes.

Calcutta Public Library Copy.

Pages.	Condition.	Formes.
Title page and contents	Brown and very brittle	a, b
1-16	Slightly discoloured but brittle	B
17-416	Brown and extremely brittle	C-2D
Plates	No. 1 discoloured and brittle in middle Nos. 2, 3 and 4 brittle Nos. 5 and 6 sound	

8. Third part of appendix to the notes on the late transactions of the Mahratta Empire, containing copies and extracts

from official documents relating to the military operations against Jesvant Rao Hol ar. Fort William 1805.

Copy from Tanjore Maharaja Serfogi's Sarasvathi Mahal Library.

Pages.	Condition	Formes.	Watermark on paper.
1-IV	Perished		
Errata	Good		Curties and Son 1803
1-12	Perished	A-C	Nil
13-20	Good	D & E	Curties and Son
21-28	Badly perished	F & G	Nil
Appendix A 1-4	Good		Nil
„ A 5-6	Badly perished		Nil
„ B 1-11	Good		Curties and Son
„ C 1-5	Perished		Nil
„ D 1-8	„		Nil
161-164	Good		Hooke and Son 1801
165-178	Perished		Nil
179-182	Good		T. Stains
183-190	Perished		Nil
191-192	Good		Budger
193-198	Perished		Gater 1801
199-240	Badly perished		Thomas Edmond
241-256	do		C. Jones 1803
257-258	Perished		Nil
259-262	Badly Perished		W. Sharp

9. Royle's Illustration of the Botany, etc. of the Himalayan Mountains. Vol. I. London, 1839.

Copy from the R. A. Mess Library, Meerut.

Pages.	Condition.	Watermark
Title pages	} Badly perished	Nil
Dedication		
Preface		
Table of Contents		
Introduction V-XX	Sound	Balston & Co. 1830
„ XXI-XXXVI	Badly perished	Nil
„ XXXVII-LII	Perished	Balston & Co. 1839
„ LIII-LXXXVIII	Badly perished	Nil

9. Royle's Illustration of the Botany, etc. of the Himaalyan Mountains. Vol. I. London, 1839.

Copy of the R. A. Mess Library, Meerut.—*Continued.*

Pages.	Condition.	Watermark.
1-384	Sound	Balston & Co. 1830
385-432	Slightly perished	Balston & Co. 1839
433-472	Badly perished	Nil

10. Arraini expeditionis Alexandri. 1704. Ludgv Bata-
vorum.

Copy from Serampore College Library.

Title page and Introduction badly discoloured but not badly perished.

Formes.	Condition.
A-T	Fairly good colour and strong
Y	Better than Z
Z	Very bad colour, badly speckled and somewhat perished
Ee & Ff	Very badly perished
Gg	Stouter paper and not badly perished
Hh	Good colour and not perished
Kk & Nn	Badly coloured and perished
Nn2 & Nn3	Good colour and strong
Oo to end	Badly perished

A survey of many examples has proved conclusively that it does not follow that the paper in any particular book is uniformly perished. Certain pages can be in excellent condition, whilst other pages are slightly perished or even very badly perished.

C. In any volume the passage from sound to perished or badly perished paper is usually abrupt and corresponds with a new forme.

An examination of the details given on pages 135 to 139 shows clearly that in the examples given the change from sound to perished or badly perished, or from perished to badly perished is abrupt. It is usually quite easy to select the page at which the change occurs. In practically none of the cases examined by us was there a gradual or more or less indefinite passage from good to badly perished paper. The change is often so abrupt that an examination of the edges of the book indicates the exact page at which the change from good to perished paper occurs.

It will also be noticed that the change almost invariably coincides with a new forme. It is thus clear that the whole original sheet of paper constituting a forme has undergone the same change and that different sheets in many cases have quite different resisting powers to the process of perishing.

From this it follows that an important factor influencing the perishing of paper is the material of which the paper is made or the way in which the material is treated during the process of manufacture.

The fact that in most cases the perishing is more or less the same for a given page but may be quite different in the case of adjacent pages supports the view that the type of perishing is purely chemical and is not due to micro-organisms.

In certain cases it is found that the paper is distinctly speckled or blotchy. (*cf.* p. 135.) and the possibility of perishing owing to the growth of colonies of micro-organisms in such cases is possible.

We sent samples of the two kinds of perished paper to be examined by Messrs. Balston & Co. and they confirm our conclusion that the first type of perishing is primarily chemical and the second type probably due to micro-organisms.

In some few instances it has been noticed that, where a highly discoloured page has been in contact with a page belonging to a forme which has retained its colour, the actual page in contact with the discoloured page is slightly discoloured, but in no case of a book has it been noticed that the brown perished page has affected the strength of the next page of the good forme adjoining.

One instance of such an effect has, however, been noticed in the case of loose papers in a file from the Empress Mills, Nagpur.

- A Sheet (a) of thin, transparent, crisp type-paper made of cotton fibre dated 26th January 1889 was in contact with (b) a sheet of the factory diary made of esparto which had perished badly (Date not known). This portion of (a) was only slightly discoloured but badly perished.
- (c) Sheet of yellowish coloured paper with date 1888 stamped on it. This was perished to a certain extent and the fibre was mainly chemical wood

pulp. The portion of (a) in contact with this was also badly perished. (Rather more than c).

- (d) Part of a sheet of ruled foolscap with date in writing 1889. This was fairly strong and the fibre was chemical wood-pulp and a little esparto. The portion of (a) in contact with this was quite strong. Also portion of (c) in contact with this was much more perished—in fact quite brittle—than portion which was in contact with (a).

D. Are the variations in perishing the same in copies of the same work from different libraries.

If the perishing of the paper depends mainly on (a) the nature and quality of the paper and (b) the climatic conditions under which the book has been kept, it should follow that the same formes in different copies of the same work kept under similar conditions should have perished to much the same extent, since a given forme in several copies of a particular book would, in most cases, be produced from the same batch of paper.

Hence copies of the same book which have been kept in Bombay, Madras, or Calcutta should exhibit the same variations in perishing in passing from forme to forme.

The comparison given on pp. 124-129 for (a) Buchanan's Journey, (b). The memoirs of the Geological Survey of India, (c) Memoirs of the operations etc. illustrate this most clearly.

Numerous other examples might be given, but a few will suffice.

1. Asiatic Researches Vol. XX Part 2. Calcutta, Bishop's College Press 1839.

The following is the result of an examination by Mr. Chapman of a copy in the Library of the Asiatic Society of Bengal.

Pages.	Condition.	Formes.
Title page, contents page and errata page.	Discoloured and brittle	A-K
245-284	Clean and sound	
285-304	Discoloured and brittle	L-P
305-336	Sound	Q-Y
337-356	Discoloured but partly strong	Z-D ₂
357-472	Sound	E ₂ -K ₃
473 to end.	Strongly discoloured and brittle	L ₃ to end.

A copy of the same volume in the Imperial Library agrees with the above page for page, and a copy in the Madras Literary Society's Library agrees exactly except that pages 473 to the end, although brittle, are not badly discoloured.

2. F. C. G. Schroeter's Dictionary of the Bhotanta or Bantan Language. Serampore 1826.

The copies in the Adyar Library Madras, the Asiatic Society of Bengal's Library and the Imperial Library have been compared by Mr. Chapman.

In all copies pp. 25-32 (forme D) and pp. 168 to end (formes 5 f to end) are badly discoloured and are somewhat brittle. There are however considerable differences in the amount of discolouration in the several copies but no noticeable difference in the strength of corresponding pages in the different copies, the great bulk of the paper is strong.

3. Transactions of the Royal Society of Edinburgh. Vol. VII. 1815.

Pages.	Copy 1. Madras Literary Society.	Copy 2. Asiatic Society of Bengal.
Title Page.	Discoloured but sound.	Same as M. L. S. Copy.
Contents page.	Brittle, 2 folds and moderate pull break.	Do
1-167	Brittle, 2 folds and gently pull break.	Do
169-176	Very discoloured and very brittle, 1 fold breaks.	Same as pp. 1-167.
177-216	Brittle, 2 folds and gentle pull.	Same as M. L. S. Copy.
217-232	Clean and strong.	Same as page 1-167.
233-234	Brittle, 2 folds break	Do
235-267	2 folds and moderate pull.	Do
269-276	2 folds and gentle pull.	Same as M. L. S. Copy.
277-284	Very discoloured and very brittle, 2 folds break.	Do
285-292	2 folds and gentle pull.	Do
293-380	Very discoloured and very brittle, 2 folds break.	Do
381-547	Strong except pp. 501-508 which are discoloured and brittle.	Agrees with M. L. S. Copy except pp. 461-465 completely perished and pp. 501-508 are only slightly perished.
Plates I-XV	Slightly perished, 2 folds and moderate pull break.	

Volume VIII—1817.

Pages.	Copy 1. Madras Literary Society.	Copy 2. Asiatic Society of Bengal.
Title page.	Strong.	Same as M. L. S. Copy.
Contents page.	Perished, 2 folds and gentle pull	Do
1-16	Less perished, 2 folds and moderate pull.	Do
17-72	Very perished, 2 folds.	Not so badly perished as M. L. S. Copy with exception of pp. 17-24 and 41-56.
72-80	Strong.	
81-88	Perished, 2 folds and gentle pull.	
89-96	Strong.	Moderately perished.
97-112	Moderately perished, and moderate pull.	Badly perished.
113-120	Do	Same as M. L. S. Copy.
121-127	Badly perished, 2 folds and gentle pull.	Do
128-240	Badly perished, 2 folds.	Do
241-248	Strong.	Badly perished.
249-264	Moderately perished.	Do
265-279	Badly perished.	Same as M. L. S. Copy.
280-296	Moderately perished.	Very slightly perished.
297-392	Strong.	Do
393-424	Moderately perished.	Slightly perished.
425-432	Strong.	Moderately perished.
433-469	Moderately perished.	Same as M. L. S. Copy except that pp. 515-562, are badly perished and and pp. 464-480 only very slightly perished.

4. Blackwoods Edinburgh Magazine. Vol XV January to June 1824.

Pages-	Copy 1. Imperial Library.	Copy 2. R. A. Mess, Meerut.
1-16	Slightly perished.	Same as I. L. Copy.
17-24	Sound.	Do.
25-53	Very slightly perished.	Do.
53-172	Slightly perished.	Do except that pp. 121-128 and 133-140 are badly perished.
173-188	Badly perished.	Sound.

Pages.	Copy 1.	Copy 2.
	Imperial Library.	R. A. Mess Meerut.
189-236	Very slightly perished.	Sound
237-244	Badly perished.	Do.
245-298	Very slightly perished.	Do.
299-306	Very badly perished.	Same as I. L. Copy.
307-314	Slightly perished.	Very slightly perished.
317-322	Badly perished.	Do.
323-330	Very slightly perished.	Very badly perished.
331-338	Very badly perished.	Do.
339-354	Very slightly perished.	Badly perished to pp. 346 and slightly from 346 to 362.
355-366	Very badly perished.	Slightly perished.
367-382	Slightly perished.	Same as I. L. Copy.
383-390	Very badly perished.	Do.
391-398	Badly perished.	Do.
399-486	Very badly perished.	Same as I. L. Copy.
487-494	Slightly perished.	Badly perished.
495-526	Very badly perished.	Slightly perished.
527-534	Slightly perished.	Sound.
535-550	Very badly perished.	Sound except pp. 543-550 which are very badly perished.
551-558	Slightly perished.	Sound.
559-567	Badly perished.	Do.
567-574	Very badly perished.	Do.
575-590	Slightly perished.	Do.
591-598	Badly perished.	Slightly perished.
599-606	Slightly perished.	Sound.
607-614	Badly perished.	Do.
615-666	Sound.	Do.
667-682	Slightly perished.	Do.
683-742	Sound.	Do.

It is clear that on the whole the copy in the R. A. Mess Meerut Library is in a better condition than the Imperial Library copy although certain pages *e. g.* 121-128, 133-140, 323-330, and 487-494 are more badly perished in the R. A. Mess Library copy.

5 Calcutta Review Vol XVIII. Calcutta 1852.

Pages.	Copy 1. Bombay Branch of Royal Asiatic Society.	Copy 2. Imperial Library, Calcutta.	Copy 3.* Secretariat Library, Simla.
1-232	Perished.	Exactly same as copy No. 1.	Exactly same as copy No. 1.
233-402	Sound.		
1-XXVIII	Perished.		
XXIX-XLIII	Sound.		

6. Posthumous papers bequeathed to the Hon. the East India Co., Journals of Travels in Assam, Burma, Bootan, &c. by the Late Wm. Griffiths arranged by John McClelland, Calcutta, Bishops College Press 1847.

Formes.	Pages.	Copy 1. St. Xaviers College, Bombay.	Copy 2. Imperial Library, Calcutta.
a	Title page and 7 following pp. of contents, errata, &c.	Badly discoloured and somewhat brittle.	Same as copy 1.
b-c	1-XVI	Good colour.	Do.
d-e	XVII-XXXII	Badly discoloured and brittle.	Do.
b-3t	1-512	Good colour and good condition.	Yellow but fairly strong.
3a-3x	512-529	Brown; spotted and quite brittle.	Same as copy 1.
	Plates	Spotted; some fairly strong others weak.	Do.

N. B.—Pages adjacent to backs of plates are rather discoloured.

E. Comparison of sets of journals in different libraries.

We have also examined several sets of papers, journals and magazines in different libraries in order to ascertain:—

(a) Whether at any given date there is an abrupt change in the condition of the paper.

(b) If such abrupt changes occur, is the date the same for different sets of the same journal and also for sets of different journals.

(c) What is the cause of the abrupt change.

* Does not appear to have been long in Simla.

The first sets to be examined were files of Bombay Courier and Madras Gazette in Bombay and Madras. This examination yielded most interesting results as shown in the following tabular statement.

I. BOMBAY COURIER.

Year.	A.	B.
1794—1815	Strong	1811—1816 quite strong
6—1—1816	do	...
20—1—1816	Slightly perished	...
27—1—1816	Markedly do	1817—1826 completely perished
1816—1828	Completely do	1826 Fairly good
1829—1832	Missing	1836-1839 Slightly perished
1833—1837	Perished	...
1838	Part sound, part perished	...
1839	Sound	...

2. MADRAS GAZETTE.

	A	C
1795—1811	Sound	Missing
Sep. 12—1812	do	"
Sep. 19—1812	Slightly perished	"
Aug. 28—1813	do	"
1814—1819	Missing	"
Jan. 8—1820	Completely perished	"
1820—1834	do	Completely perished

3. MADRAS GOVERNMENT GAZETTE.

	A	C
1802—1814	Sound	
1815—1816	Missing	
1817—1832	Completely perished	
1822	All missing except a supplement, which is in sound condition	
Jan—Oct. 2, 1828		Perished
Oct—Dec. 11, 1828		Discoloured but sound
1830—1831		Perished

A=Connemara Public Library copy.

B=Bombay Branch of the Royal Asiatic Society.

C=Imperial Library, Calcutta.

It will be noticed that in the 3 sets of papers there is an abrupt change in the state of the paper between 1812—1817. An examination of samples taken from the **Bombay Courier** proves that there is a marked change in the fibre from which the paper was made and this change corresponds with the change in the durability of the paper. From 1811—1816 the fibre is cotton with flax or hemp, from 1817—1826 it is straw cellulose* and from 1826—1832 cotton and flax.

4. CALCUTTA REVIEW.

Vol.	Date.	1 Bombay Branch of Royal Asiatic Society Library.	2 Imperial Library (Report as received from Mr. Chapman) 1st Reading Room. Set.	3 Native General Library, Bombay.	4 2nd Set from Calcutta, (Reported as- received from Mr. Chapman.	5 3rd Set from Calcutta.
I	1844	Good	Good	Good	Good	
II	„	Missing ...	Slightly perished	Completely perished	„	
III	1845	Slightly perished	do	do	Slightly perished	
IV	„	do	do	Missing		
V	1846	Title page and pages 3 & 4 of the contents in good condition. Pages 1 & 2 of the contents and pages 1-242 perished. pp. 243-482 in good condition. i-1 perished. li-lxxii including advertisement in good condition.	Indications of perishing are apparent in pp. 1-242 and 1-5. pp. 243-482 and li-lxxii are in good condition.	Exactly same as Imperial Library copy.	...	
VI	„	pp. 241-248, 265-272, 281-288 and 305 slightly perished, rest of the number in good condition.	Good			
VII	1847	Good	Good	Good	Good	
VIII	„	pp. 1-282 slightly perished, Contents title-page and pp. 283 up to the end in good condition.	do	do		
IX	1848	Good	do	do	Indications of perishing.	

* Or perhaps birch-wood cellulose.

4. CALCUTTA REVIEW—*Contd.*

Vol.	Date.	1 Bombay Branch of Royal Asiatic Society Library.	2 Imperial Library (Report as received from Mr. Chapman) 1st Reading Room Set.	3 Native General Library, Bombay.	4 2nd Set from Calcutta, (Reported as received from Mr. Chapman.	5 3rd Set from Calcutta.
X	1848	Pp. 425-566 and xxv-xxxii slightly perished, rest of the number in good con- dition.	Good	Good	...	...
XI	1849	Good	do	do	...	...
XII	"	Slightly perished	Indications of perishing are apparent.	Slightly perished.	Indications of perishing.	...
XIII	1850	pp. 221-248 slightly perished, rest of the book in good condi- tions.	do	Very slightly perished.	do	...
XIV	"	Good	Good	Good	Indications of perishing.	...
XV	1851					
XVI	"	Slightly perished except pp. 483-514 which are in good condition.	Slightly perish- ed.	Very slightly perished.	do	...
XVII	1852	Perished but pp 369-488 brittle also.	Perished to a considerable extent.	Perished rather badly.	Perished to a considerable extent.	...
XVIII	"	Contents with the exception of first two pages in good condi- tion. pp. 1-232 and i-xxviii perished ra- ther badly. pp. 233- 492 and xxix-xliii are in good condition	pp. 1-232 & i- xxviii have per- ished to a consi- derable extent. pp. 233-492 and xxix-xliii are in good condition.	Exactly same as the other two copies. Contents in good condi- tion.	...	...
XIX	"	Perished but pp. 393-477 and xxiii- xxx brittle also.	Slightly perish- ed.	Perished to a considerable extent.	Perished to a considerable extent.	...
XXI	1853	Good except pp 381 to end w h i c h are slightly perished.	Good	Good	Slightly per- ished.	...
XXII	1854	Good	do	do	Good	...

4. CALCUTTA REVIEW,—Contd.

Vol.	Date.	1 Bombay Branch of Royal Asiatic Society Library.	2 Imperial Library (Report as received from Mr. Chapman) 1st Reading Room Set.	3 Native General Library, Bombay,	4 2nd Set from Calcutta, (Reported as received from Mr. Chapman.	5 3rd Set from Calcutta.
XXIII	1854	Good except pp. 155-254 which are slightly perished.	Good	Good	Good	...
XXIV } XXV } XXVI }	1855	Slightly perished	Slightly perished.	Slightly perished.	...	Good
XXVII	1856	Good	Good	Good	Good	...
XXVIII	1857	"	Slightly perished.	do	...	...
XXIX	"	In good condition up to page 170, rest of the book slightly perished.	do	Slightly perished.	Slightly perished.	...
XXX	1858	Missing	do	...	...	...
XXXI	"	Slightly perished	do	do	Perished to a considerable extent.	Slightly perished.
XXXII	1859	Good	Good	Good	Slightly perished.	...
XXXIII	"	pp. 1-252 and i-iv contents pages in good condition, rest of the book slightly perished.	Slightly perished.	Slightly perished.	do	Slightly perished.
XXXIV	1860	Good	Slightly perished.	Slightly perished.	Slightly perished.	...
XXXV	"	Missing	Indications of perishing.	do	do	...
XXXVI	1861	Good	Good	Good	...	...
XXXVII	"	"	Indications of perishing,	do	Indications of perishing.	...
XXXVIII	1863	pp. 1-172 good, rest slightly perished.	Good	do	do	...
XXXIX	1864	pp. 1-198 slightly perished, rest in good condition.	Good	Good	do	...
XL	"	Good	do	do	...	...

4. CALCUTTA REVIEW.—*Contd.*

Vol.	Date.	1 Bombay branch of Royal Asiatic Society Library.	2 Imperial Library (Report as received from Mr Chapman) 1st Reading Room Set.	3 Native General Library, Bombay.	4 2nd Set from Calcutta, (Reported as received from Mr. Chapman.	5 3rd Set from Calcutta.
XLI	1865	Pp. 95-296 slightly perished, rest in good condition.	Good	Missing	Indications of perishing.	...
XLIII	1866	Good	do	Good	do	...
XLIV } XLV }	1866 1867	Slightly perished	Indications of perishing.	Slightly per- ished.	Slightly per- ished.	Slightly perished.
XLVI	1867	Slightly perished except pp. 437 to end in good condition.	Indications of perishing.	Slightly per- ished.	Indications of perishing.	...
XLVII	1868	Missing	do	do	...	...
XLVIII XLIX	1869	do	Good	Good	Good	Good
L	1870	Good	Indications of perishing.	do	Slightly per- ished.	...
LI	"	Slightly perished	Slightly perish- ed.	Slightly per- ished.	do	Slightly perished.
LII	1871	Missing	Good	Good	Good	do
LIII	"	Slightly perished	Indications of perishing.	Slightly per- ished.	Indications of perishing.	...
LIV	1872	do	Slightly perish- ed.	do	Slightly per- ished.	do
LV	"	do	do	do	do	...
LVI	1873	pp. 1-202 slightly perished, rest in good condition.	Good	Good	Slightly per- ished.	...
LVII	"	Missing	Slightly perish- ed.	Slightly per- ished.	do	...
LVIII	1874	Good	Good	Good	Indications of perishing.	Indications of perishing
LIX	"	pp. 1-214 slightly perished, rest in good condition.	Slightly perish- ed.	Missing	Good	...
LX	1875	Slightly perished	Good	Slightly per- ished.	Slightly per- ished.	Slightly perished.
LXI	"	Good	do	Good	Good	...

I. CALCUTTA REVIEW—*Contd.*

Vol	Date	1 Bombay Branch of Royal Asiatic Society Library.	2 Imperial Library (Report as received from Mr. Chapman) 1st Reading Room Set.	3 Native General Library, Bombay.	4 2nd Set from Calcutta, (Reported as received from Mr. Chapman.	5 3rd Set from Calcutta.
LXII	1876	Good	Good	Good	Missing	
LXIV	1877	...	...	...	Indications of perishing.	
LXV	"	pp. 1-203 and i- viii good; pp. 205- 422 and viii-xxiii perished slightly.	do	Very slightly perished.	do	
LXVI	1878	Good	do	Good	do	Indications of perishing
LXVII	"	pp. 1-543 good, rest slightly perished.	do	do	do	do
LXVIII	1879	Good	do	do	do	do
LXIX	"	do	do	do		
LXX	1880	Good	Good	Good	Rest give indica- tions of perish- ing except, LXX-LXXI, LXIV-LXVII, LXXIX, LXXXVI- LXXXVII- CIV-CVI, and CXVI-CXXVI, which are in good condition.	Rest and all good or only slight indica- tions of perish- ing except LXXXII & LXXXIII which are slightly per- ished.
LXXXI	1885					
LXXXII LXXXIII	1886	Slightly perished	do	Slightly per- ished.		
LXXXIV— LXXXVII		Good	Good	Good		
XC	1890	Slightly perished	do	Missing		
XCI— XCVII	1890 1893	do	do	do		
XCVIII	1894	do	Indications of perishing	Slightly per- ished.		
XCIX	"	Missing	do	do		
C	1895	Good	Good	Good		
Index to the Calcutta Review Vols. I—L.	Pub- lished in 1873.	Slightly perished	Slightly perish- ed.	...	Slightly per- ished.	Slightly perished.

5. TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH.

Vol.	Date.	Asiatic Society of Bengal.	Madras Literary Society
I	1788	Discoloured and badly perished	Same as A.S.B. Copy.
II	1790	Varies, but not so badly perished as I.	Not so perished as Vol. I except formes A-L & bb-hh.
III	1794	Same as II	Rather better than II.
IV	1798	Even better than III	Same as A. S. B. Copy.
V	1805	Still better	
VI	1806	Almost as bad as I	do
VII	1814	Varies. Some forms are extremely badly perished and others	Same as A.S.B. Copy.
VIII	1817	sound.	
IX	1821	Similar to VIII but perished formes are even worse than VIII.	do
X	1824	Rather better than VII to IX but still worse than I.	do
XI	1828	Better condition	do
XII	1834	Better than any of the previous volumes. Plates have perished somewhat.	
XIII	1836	Slightly better than XII	
XIV	1840		
XV	1844	Different type of paper. Discoloration not marked, but paper brittle.	
XVI	1845		
XVII	1845		
XVIII	1848		
XIX	1849	Some formes sound, others similar to XVIII.	
XX	1853		
XXI	1857		
XXII	1861	Better condition than XXI, but some plates are brittle.	
XXIII	1864	Same as XX or XXI.	
XXIV	1867		
XXV	1869	Most formes perished and all weaker than XXI and XXII.	
XXVI	1872	Discoloured but strong.	
XXVII	1876	Some formes brittle.	
XXVIII	1879		
XXIX	1880		
XXX	1883		
XXXI	1883	Better than XXVII-XXX.	
XXXII	1887	Some formes brittle.	
XXXIII	1888	Better than XXXII.	
XXXIX	1900	Yellow but fairly strong.	

6. QUARTERLY REVIEW.

Vol.	Year.	R. A. Mess Meerut.	Imperial Library, Calcutta.	Madras Literary Society.
XXV—XXVIII	1821—1823	Fair condition...	Discoloured but strong, but XXVIII, XXIX XXX are brittle	Same as I. L. Copy.
XXIX	1823	Brittle ...		
XXX—XXXI	1823—1825	Fair condition...	XXXI missing.	...
XXXII—XXXV	1825—1827	Brittle ...	Brittle.	...
XXXVI—XXXVII	1827—1828	About half brittle, remainder fair condition.	Very brittle	Same as I. L. Copy
XXXVIII	1828	Brittle ...	Missing.	...
XXXIX	1828—1829	Fair condition...	Brittle.	...
XLI—XLII	1829—1830	Brittle ...	XLI missing. XLII brittle.	XLII perished but not brittle.
XLIII	1830	Fair condition...	Part fair condition part brittle.	Same as I. L. Copy.
XLIV—LIII	1830—1835	Brittle ...	XLIV brittle	Most brittle but some pages strong.
LIV—LVI	1835—1836	About half brittle and half fair condition.	LIV part strong and part brittle.	
LVII	1836	Brittle ...	LXVI—LXI all brittle	Same as I. L. Copy.
LVIII—CIII	1837—1860	Fair condition...	LXII—LXXXVI not examined. LXXXVII, CIX, CVIII, CXIII all brittle. Inter- mediate Vols. not examined. CXIV good condition	Same as I. L. Copy. Same as I. L. Copy.

In last two sets the sound condition is maintained from Vol. CXIV (1863) onwards.

7. THE EDINBURGH REVIEW.

Three sets of the Edinburgh Review have been examined *viz.*, in the R. A. Mess Library, Meerut; the Imperial Library, Calcutta; and the Madras Literary Society's Library. No detailed comparison can be made as many of the volumes are different editions and in some the title pages are lost. All sets, however, show marked perishing, whichever edition is examined.

From Vol. I to XXIX (1804—1818) there is more or less complete perishing. From Vol. XXX (1st Edition) onwards there is always a certain amount of sound paper in each volume.

occasionally in earlier volumes strong pages are found *e. g.*, Vol. VI 2nd Edition in Imperial Library contains formes I and K (p. 129—160) which are in good condition and Vol. XXVIII in L. S. Library has strong pages.

On the whole it is found that the volumes printed in 1804 are sound, those between 1807 and 1818 are very brittle and from 1818 onwards are better.

8. BLACKWOODS EDINBURGH MAGAZINE.

Volume.	Year.	Imperial Library.	R. A. Moss, Meecrut.
I,	1817	Most brittle but part in better condition, <i>e. g.</i> , pp. 435—532	
II	1818	do.	
III	1818	Fairly good condition except pages 623 to the end which are brittle	
IV	1819	Most in fairly good condition	
V	1819	pp. 1—506 in good condition	
I-XIV	1820-1823	Very brittle	Very brittle
XV	1824	Part in good condition and part brittle	} Parts in good condition and rest brittle
XVI	1824	Mostly brittle	
XVII	1825	All brittle	do.
XVIII	1825	Missing	
XIX	1826	Part in good condition and part brittle	do.
XX	1826	...	do.

From 1826 onwards there is very gradual improvement.

9. JOURNAL OF THE ASIATIC SOCIETY OF BENGAL.

Vol.	Year.	(1) Asiatic Society of Bengal.	(2) R. A. Mess, Meerut.	(3) Bombay Branch of Royal Asiatic Society.
I	1832	Slightly perished, withstands 12 fold- ings and slight pull.	Brittle	Distinctly perished.
II	1833			
III	1834	Missing	do.	do.
IV	1835	Same as I and Plate XIV is brittle	do.	do.
V	1836	Same as I & II	do.	do.
VI	1837	Same as I & II	do.	do.
VII	1838	do. Plates weak	do.	Slightly perished
VIII	1839	Missing	Missing	pp. 1-76 sound, 77 to end slightly perished
IX	1840	Most of the pages in good condi- tion but few are brittle especial- ly under the print. Some plates are weak.	} Same as copy (1)	} Similar to copy (1)
X	1841			
XI	1842			
XII	1843	Good condition	} Good condi- tion but a few pages perished	} Same as copy (2)
XIII	1844	do.		
XIV	1845	do.	Missing	Slightly perished
XV	1846	do.	do.	Sound
XVI	1847	do. but parts discoloured	} Same as copy (1)	} Sound but pp. 285 to end perished
XVII	1848	do.			do.
XVIII	1849	Good condition	Good condition	do.

In set 3 from vol. XIX (1850) onwards to vol. XXXIII (1865) the great bulk of the paper is in good condition with the exception of a few plates. Vols. XXXIV (1866) to XLI (1872) are either slightly perished or distinctly perished and from Vol. XLII (1873) to Vol. LXXIII (1905) most of the paper is in good condition with the exception of several volumes *e. g.* XLVIII, XLIX, LII-LVIII (1883-1889) in which the paper is slightly perished.

QUARTERLY JOURNAL OF SCIENCE, LITERATURE AND
THE ARTS.

part.	Year.	1 Geol. Survey, Calcutta.	2 R. A. Mess, Meerut.	3 Imperial Library Calcutta.
	1822	Sound	Signs of perishing	
XI	1822-23	Excellent	Excellent	
XXIII	1824	Sound	Brittle	
XL	1824-'26	Excellent	Very slight- ly perished	
	1826	Brittle except pp. 1-16	Completely perished	Same as copy No. 1
	1826	Brittle	do	do
	1826	Mostly brittle; formes N & O not so dis- coloured	do	do
	1826	Fair condition with ex- ception of one forme X	Same as copy No. 1	All perished but forme X worst
	1827	Half brittle and half strong	Half brittle and half strong	All perished
	1827	Good condition	Very slight- ly perished	do

From 1828 the Geol. Survey volumes are in good con-
dition, the R. A. Mess's ceases at 1827. In both sets the Index to
I-XX is completely perished.

TO WHAT EXTENT PERISHING IS AFFECTED
BY :—

- (a) The nature of the fibre, (b) The nature of the
sizing materials, (c) The nature of the bleaching
agents used in the manufacture of the paper ?

The following is a list in chronological order of some
of the more important improvements introduced in the
manufacture of paper during the past six centuries:—

- 1498 Paper mill existed in Hertfordshire.
1670 Invention of Hollander beating engine for disintegration
of rags.

1719	Possibility of making paper from wood suggested.
1774	Discovery of chlorine by Scheele.
1792	Patent for bleaching rags taken out by Campbell.
1799	Manufacture of bleaching powder by Tennant.
1799	First continuous machine.
1807	Rosin size introduced by Illig.
1820	Bleaching with bleaching powder in stationery chests introduced.
1821	Steam cylinders first used for drying paper on the machine.
1840	Manufacture of mechanical wood-pulp by Keller.
1851	Straw used for paper making.
1862	Sodium thiosulphate (hypo or antichlor) used for removing chlorine.
1854	Manufacture of chemical wood-pulp (Soda process).
1860	Esparto grass first introduced.
1866	Manufacture of sulphite wood-pulp.
1898	Apparatus for continuous bleaching and washing of wood-pulp introduced.

The following statement shows the results on tests made with some 244 samples of papers from Indian libraries. The date and name of the book, the nature of the fibre and the sizing materials, and the condition of the paper are given in appendix III.

Total number of samples 244 : Cotton only 55; Flax only 25; Cotton and flax mixed 125; Esparto 39.

TABLE II.

	Sound			Slightly perished			Distinctly perished			Quite Brittle		
<i>Cotton Papers. Total 55.</i>												
	28			6			16			5		
	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>
Rosin	11	10	7	2	3	1	3	8	5	3	0	2
Gelatine	10	5	13	2	1	3	4	6	6	1	1	3
<i>Flax Papers :-- 25</i>												
	10			6			2			7		
Rosin	7	3	0	5	1	0	0	2	0	3	1	3
Gelatine	4	6	0	2	4	0	0	0	2	5	0	2

	Sound			Slightly perished			Distinctly perished			Quite Brittle.		
<i>Flax and Cotton Papers</i> :— 125.												
	47			28			31			19		
	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>
Rosin	27	20	0	14	14	0	7	23	1	8	8	3
Gelatine	15	15	17	5	8	15	12	8	11	6	4	9
<i>Esparto Papers</i> :— 39.												
	7			7			13			12		
	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>c</i>
Rosin	1	5	1	0	6	1	4	6	3	0	3	9
Gelatine	7	0	0	7	0	0	8	2	3	8	3	1
a=Absent b=Small amount c=Large amount												

The rosin and gelatine were tested for in the usual manner (*cf.* Sindall, Paper Technology, Chap. X.)

The numbers expressed in per centages are as follows:—

TABLE III.

	Sound.	Distinctly perished or quite brittle.
Cotton	51 per cent.	38 per cent
Flax	40 „	36 „
Flax and Cotton	38 „	40 „
Esparto	18 „	64 „

It is quite obvious that the proportion of samples of sound paper is relatively low and the proportion of perished samples relatively high in the case of esparto, and this is all the more remarkable when it is remembered that all the esparto samples date from 1860 onwards whereas the samples of the other papers date from 1650 to the present time.

There are no marked differences between flax and cotton. The percentage of sound samples in the case of cotton is rather higher, but this is probably due to the fact that many of the Eastern made papers—practically all of which were in good condition—consisted of cotton fibres.

Rosin and gelatine do not appear to make any appreciable difference. Most of the esparto papers are free from gelatine.

We have examined 170 samples of paper from Indian manuscripts in the Maharaja Sarfoji's Saraswathi Mahal Library in Tanjore. These date from 1650—1830 and the following is an analysis of the condition of the manuscripts:—

TABLE IV.

Quite strong	...	60	} ... 70 per cent.
Fairly „	...	10	
Slightly perished	...	4	} ... 30 per cent.
Distinctly perished or brittle	...	26	

These figures are extremely interesting when compared with figures for the English books from the same library. 144 books were examined (cf p. 133) and the following is the analysis :—

TABLE V.

Quite strong	...	10	} ... 28 per cent.
Fairly do.	...	18	
Slightly perished	...	24	} ... 72 per cent.
Distinctly do.	...	24	
Brittle do.	...	24	

The books and manuscripts are all earlier than 1832, but in the manuscripts the proportion of old paper is much higher than in the case of the English books. We have examined the fibre and sizing materials of most of the samples. The fibre is frequently pure cotton or a mixture of cotton and flax and rarely only flax *viz.* in the case of a few of the manuscripts. Many of the manuscripts are characterised by the absence of rosin and the presence of starch.

The marked difference in the per centage of perished samples in the case of English books and Indian manuscripts in the same library is not due to the use of different fibres and cannot be due to the absence of rosin in the manuscript papers, as the figures given on page 157 show that rag papers free from rosin are in many cases perished.

A comparison of the manuscript papers with samples from the books indicates a marked difference in appearance. Many of the manuscripts are written on coarse types of paper : some quite stout and strong, others thin and soft but all characterised by the coarseness of the fibre. The appearance is quite unlike an ordinary Western paper even of the 17th or 18th century. In all probability these are Eastern papers, made by hand and without boiling with alkali or bleaching with chlorine or bleaching agents. A rough paper of the type was manufactured in Mannargudi near Tanjore from old jute bags until within some

20 years ago. After pounding and washing, the fibre was sprinkled with lime, pressed hard with the feet and left for several days, it was then pounded and washed and the whole series of operations repeated some 4 times; when the fibre had been bleached. The only sizing material was a paste of rice flour and the paper was finished by being carefully rolled by means of a wooden roller.

In addition it may be noted that 10 of the papers bear English water marks dating from 1807—1828 and all these are in excellent condition.

Extremely characteristic of the manuscripts is the fact that the great bulk of perished samples have been coated with a golden yellow pigment. It is stated that this was used in order to preserve the paper. If so, the result has been disastrous, as practically all the perished samples are from pages which have been treated in this way. In certain manuscripts alternate pages are coated with this yellow pigment and it is invariably found that the yellow page is much more tender than the opposite page free from pigment, and in one case, where one or two splashes of the pigment were observed on a page, it was found that the paper under the pigment was somewhat brittle whereas the rest of the paper was sound. The pigment appears to be sulphide of arsenic as several examples examined gave reactions for arsenic. Some of the papers which have been treated with this pigment are of a finer texture than the Eastern papers described above, but whether of Western or Eastern make it is impossible to say. They are nearly all papers of firm texture and sometimes with one surface more or less glossy.

It is clear that the few samples of English papers bearing water marks have stood well and also the great bulk of the coarse fibre papers of Eastern origin.

From these facts we conclude that certain high grade European papers and most coarse fibred, not strongly bleached Indian papers are capable of withstanding chemical change even in moist hot climates.

In connection with English papers of known age and manufacture we have made the following analysis of the papers constituting 4 volumes of General Orders obtained from the Library of the 9th Division Bangalore. The papers date from 1794 to 1883 and the volumes have been kept in Madras and Ootacamund and for a few years in Bangalore.

1. General Orders, Madras 1834 Jan. 2nd to Dec. 18th.

Water mark on paper	No. of sheets	No. perished.	Per cent perished
J. Whatman 1832	9	4	44
J. Whatman: Balston & } Co. 1831 & 1832	31	0	0
E. Wise 1831, 1832, 1833	28	14	50

2. An abridgment of General Orders of Fort St. George from Vol. I to 26 inclusive. In two volumes. Vol. I Madras 1814.*

J. Whatman 1821 and } some 1822	40	4 badly 4 partly	20
J. Whatman: Balston & } Co. 1821 & 1822	36	0	0
S Wise	73	12 badly 3 partly	21

3. Further continuation of abridgement of General Orders of Fort St. George from Vol. 54 to 64. Vol. VI Madras 1832.

J. Whatman 1826, } 1827, 1828	79	39 badly	50
J. Whatman: Balston } & Co. 1828	59	3 slightly	5
E. Wise 1826, 1828, } 1829	33	13 badly	40

4. General Orders from Adjutant General's Office Madras Vol. XII, Madras Government Press. 1806.

Pages.	Condition.	Water Mark.
1-32	Very badly discoloured 2 folds and slight pull breaks.	Pages 3 and 27 bear date 1798.
33-36	Not quite so badly discoloured but 2 folds and slight pull breaks.	...
37-60	Rather more evenly discoloured and more brittle 2 folds break.	47 and 55 ,, ,, 1801
61-100	Not so badly destroyed, quite strong.	Between pp. 95-164, 6 pages bear watermark J. Brigg, 1794 and all these and intervening pages are in excellent condition.
101-164 and Index 1-13	Even better colour and quite strong	

It is thus clear that certain English papers such as those with water marks J. Whatman: Balston and Co., and J. Bigg also the papers mentioned on p. 160 carrying the watermarks Whatman

* This is an obvious misprint as the paper bears water marks 1821-1822.

1807, W and T Chandler 1807—09 have withstood climatic conditions which have proved fatal to so many other papers including Whatman 1826—28, S. Wise 1820—1820—21, E. Wise 1831—33 and others of unknown make.

In connection with the influence of chlorine and bleaching powder on the deterioration of paper we give the following extracts.

1. Paragraph from article on paper in Muspratt's Chemistry Vol. III page 649 published about 1854.

“The thorough neutralisation of chlorine is an important matter. When machines began to be generally introduced, the engines in many mills were not adapted for the increased quantity of work a machine could perform as compared with vats. Too little time was therefore given to preparation of the pulp and the chlorine was not sufficiently washed out; and as chlorine, if left in the pulp, continues to act on the paper causing a premature decay, complaints were consequently very frequent, but since antichlor (sodium thiosulphate) came into use (about 1850) the complaints have been seldom heard.”

2. Paragraph from letter from Messrs. Wm. Clowes & Sons, Ltd. Dated 8—12—1919.

“We have looked at some of the old hand books on “Paper Making,” and find that at the beginning of the last century, owing to the shortage of material, or the increased demand for paper, poor material, such as jute, was introduced with rags. This increased the difficulties of bleaching the pulp, with the result that more bleaching powder (chloride of lime) was used, and also more chlorine gas used in the gas bleaching process. An attempt was made to improve the bleaching by heating the pulp. This had a detrimental effect as it shortened the fibre.

The arrangements for washing out the bleaching powder were not sufficiently good to remove this increased quantity of powder, so that a certain amount of chlorine was left clinging to the material. This has had the result of attacking the weakened and shortened fibres and thus rotting the paper.”

It is clear that the process of bleaching may have a great effect on the strength and keeping properties of a paper and on reference to the data for sets of journals given in Part III, it is found that in several cases there is pronounced perishing in the early nineteenth century, *e. g.*

Edinburgh Review: 1804 sound, 1807—1818 perished, 1818 sound. Blackwood's, Edinburgh Magazine: 1816—26 more or less perished, from 1826 improvement.

Journal of the Asiatic Society of Bengal; distinct improvement in 1843 Quarterly Review: 1821—1862 most volumes brittle, 1863 onward sound.

Transactions of the Royal Society of Edinburgh: 1788 brittle, 1789—1805 much better, 1806—1828 badly perished.

V. WHAT IS THE NATURE OF THE CHEMICAL CHANGE WHICH OCCURS DURING THE PROCESS OF PERISHING.

I. The materials from which the paper is manufactured differ chemically.

Rag paper is made from rags and consists of what is called normal cellulose, which is extremely resistant to reagents, and hence a rag paper, if prepared from high grade rags and if the materials do not suffer too drastic a treatment during the various stages of the manufacture, should prove an extremely lasting paper. That rags, cotton and linen can produce such a high grade paper which will withstand the Indian climate for centuries follows from what has been said in previous pages about the sound condition of certain books and manuscripts found in India.

The fact that numerous examples of cotton and linen papers have undergone appreciable perishing in India, may be due to a number of different causes, *e. g.*

(1). The cotton or linen employed may have been used for a long time as a fabric, and only when old and repeatedly subjected to washing been transformed into paper. Its repeated use as a fabric and continual washing especially within recent years when bleaching agents are so frequently used in laundries, would make the fibre less strong.

(2). If the rags were in a very dirty condition the preliminary prolonged treatment with alkali to remove dirt may have lessened the strength of the fibres.

(3). When chlorine and bleaching powder were first used for bleaching pulp there is no doubt that sufficient care was not taken (a) to be sure that the pulp was not over-bleached and the cellulose itself partly oxydised (b) to be sure that all the chlorine was removed before proceeding to the next stage. The introduction of "hypo" (sodium thiosulphate or antichlor) about 1852 rectified, to a large extent, this mistake.

(4.) The non-removal of the last traces of acid during the process of washing. This is a common mistake and produces rapid and complete perishing as the mineral acids, even in small quantities, quickly destroy the cellulose fibre.

II. Chemical wood pulp is made from the ligno-celluloses present in ordinary wood tissue and the preliminary treatment consists in removing the lignone (or lignin) and separating the cellulose—usually a product intermediate between a normal cellulose and an oxycellulose—by warming with caustic soda or sodium sulphite solutions and finally by bleaching.

If properly made a chemical woodpulp paper ranks next in order of value to rag paper and deterioration may be due to causes similar to those given under rag pulp.

III. Esparto and straw papers are derived from quite a different chemical substance; what was usually termed oxycellulose and was regarded as an oxidised product of cellulose. It is now usually regarded as a mixture of cellulose with a lignone-pentosan and in any case contains constituents (Cross J. R. S. of Arts 1920) which are much more affected by chemical reagents than normal cellulose and hence will be less resistant to the usual influences which tend to produce perishing.

IV. Mechanical wood pulp contains both the lignone and the cellulose and hence will be readily affected by reagents and less resistant than the pure cellulose.

The nature of the change which goes on when a rag paper perishes may be due to either :—

- (1) a process of hydrolysis and the formation of hydrocelluloses or
- (2) a process of oxidation and the formation of oxycelluloses.

A number of experiments have been carried out with the object of ascertaining the relative amounts of :—

- (a) Free acid
- (b) Oxycellulose
- (c) Hydrocellulose

in samples of perished and sound paper.

A. *Free Acid.*

A trial experiment was made to ascertain whether any volatile acid was present in perished paper. For this purpose a

mixture of the paper and water was subjected to steam distillation and the distillate titrated with standard alkali using phenolphthalein as indicator. The result was negative and hence the following method was adopted for determining the amount of free acid present in a given sample of paper. A given weight of the dried paper was macerated in an open porcelain dish with warm water and the whole mass was heated for about two hours thus reducing the paper to a pulp. The hot extract was run off and the pulp digested five or six times with hot distilled water. A few drops of phenol-phthalein were added to the extract and the whole treated with 0.0390 N. barium hydroxide solution.

As the aqueous extracts from the two copies of Buchanan's travels in the worst condition as well as from many more books, which were strongly discoloured, were dark brown in colour, it was rather difficult to mark the correct end-point whilst titrating. In such cases the volume of the extract from about 1 gram of paper was made up to 500 cc., 50 cc. were taken each time and diluted with 100 cc. distilled water before titration. The quantity of alkali required for the pure distilled water was also determined and the value deducted from that required for the total quantity of the extract.

The results of the analysis are given in Tables VI—IX.

TABLE VI.

Paper used.	Number of c.c. of 0.05 alkali required for acid from 100 grams of paper.		
	i.	ii.	Mean.
Buchanan (good)			
(a) Introduction	53	47	50
(b) Chapter	167	160	164
Buchanan (medium)			
(a) Introduction	77	76	76.5
(b) Chapter	477	482	479.5
Buchanan (worst)			
(a) Introduction	109	113	111
(b) Chapter	498	502	500

Buchanan = Buchanan's Journey from Madras through Mysore Canara; Vol. I. London 1807. The three copies are those referred to on pages 126 and 127.

TABLE VI.—(Continued.)

Paper used.	Number of c.c. of 0.05 alkali required for acid from 100 grams of paper.		
	i.	ii.	Mean.
Beames: (a) Table of contents	134	141	137.5
(b) Chapter worse than Table of contents	222	209	215.5
Morley: (a) Advertisement	114	112	113
(b) Chapter worse than advertisement	210	220	215

Beames=Comparative Grammar of the Modern Aryan Languages by J. Beames. London 1872.

Morley=Voltaire by John Morley, London 1872.

TABLE VII.

Modern Note and News papers.

	i.	ii.	Mean.
Newspapers:—Madras Times (March 12th, 1919)	16	18	17
Bombay Chronicle (1919)	20	17	18.5
Times of India (1919)	33	25	29
The Bangalore Daily Post, March 17, 1919	11	13	12
Note Papers:—Best thin white rag typewriting paper	50	45	47.5
Note paper without water mark	72	64	68
Water mark (Academic)	27	22	24.5
„ The Barkeley superfine	61	58	59.5
„ Imperial Treasury De la Rue	22	17	19.5
„ Turkey Mill Cambric	70	83	79

Old Papers.

		Mean.
Old Indian Made paper with Gujarathi writing (1794)	Good	150
„ „ (1828)	Quite good	105
„ Rag paper. No date	Soft paper, not strong but not at all brittle.	146

TABLE VIII.

Old Books.

Book.	Condition.	Colour of paper.	c.c.s. of 0.05 N. Alkali for 100 grams of paper.	Mean.
Mathew Arnold's Friendships Garland—1871.	Fairly good.	Slightly discoloured,	117 } 125 } ...	121
Friendship's Garland, Imperial Library, copy—1871.	Completely perished.	Brown darker at the edges.	1078 } 1061 } 1089 }	1076
Adam's History of Japan—1874.	do.	do.	855 } 835 }	845
Calcutta Review, Vol. XVIII 1852.	do.	Brown.	274 } 255 }	280
Bœhtlingk's Ring Cakuntala— 1842.	Completely perished.	Dark Brown.	92 } 88 }	90
Arriani Expeditiones—1704.				
1. Cutting marked A.	Paper shows no sign of deterioration.	Slightly discoloured.	78 } ...	78
2. Cutting marked D.	Perished.	Brown.	262 } 246 }	254
Illustrated Dictionary of Eng- lish language on basis of Webster. Collings & Co., London.	Completely perished.	Dark Brown.	896 } 902 }	899
Chinese Repository—1842.	Completely perished.	Yellowish.	1322 } 1285 }	1304
Persian Book—1867.	Slightly perished.	Very faint yellow.	130 } 130 }	130
Wayside Thoughts by D'arcy W. Thompson 1868.	Completely perished.	Dark Brown.	724 } 746 }	736
Cassell's History of the War between France and Ger- many.	do.	do.	1174 } 1209 }	1192
do,	Slightly perished.	Yellow.	744 } 746 }	745
Brown's travels in Africa Egypt and Syria—1806	Completely perished.	Dark Brown		462
Vol. 22 of Journal of Science, Literature and Arts.				
1. pp. 57—62.	Badly perished.	Brown.		224
2. pp. 100—106	do.	Yellowish.		223

Acidity in different parts of the same page.

The strength required to tear the margins of many of these books is more than that required for the centre portion. The edges are without print and the centre part printed. To ascertain if this difference were due to increased percentage of

pages were divided as to separate the margin from the central part (and in one or two cases the central part of this was divided separately) and the percentage of acid determined separately in centre part and margins by macerating a weighed quantity of each type of paper in warm water as before.

TABLE IX.

		c. cs. of 0.0500 Ba(OH) ₂ required for 100 grams of paper.		
		i.	ii.	Mean.
1. Buchanan, medium :				
Chapter — outer	...	284	277	281
" inner	...	358	352	355
" centre	...	353	358	356
2. Buchanan, good —				
Chapter — outer	...	128	124	126
" inner	...	144	138	141
" centre	...	170	167	169
3. Morley :				
(a) Chapter outer	...	187	179	183
" centre	...	192	192	192
(b) Advertisement				
Chapter outer	...	104	97	101
" centre	...	103	106	105
4. Collins Illustrated Dictionary.				
(a) Page yellowish white in middle surrounded by a dark margin with an extremely narrow pale edge. All brittle.				
Outermost pale edge	514	525	519	
Dark inner margin	956	945	951	
Yellowish centre portion	967	972	970	
(b) Page dark brown with the exception of a very narrow rim which is paler in colour and brittle.				
Pale margin	802	813	807	
Brown centre portion	1285	1297	1291	
5. Wayside thoughts W. D. Thompson 1868.				
Page with a dark brown margin and a paler centre, all quite brittle.				
Margin	1252	1239	1245	
Centre	1345	1345	1336	

In Nos. 1 and 2 the fibre is cotton and flax, in Nos. 3 and 4 sparto and in No. 5 straw and cotton. The numbers indicate that in the case of badly perished books the centre portion of a page has a higher acid value than the margin. Whether this is due to chemical action of the printing ink or not we cannot say.

The experiments show that in quite recent papers, and also in samples of old papers which have not perished appreciably the acid value is relatively low, that in cases of badly perished or quite brittle papers the acid value can be extremely high and if different copies of the same book are examined the acid value tends to increase with the degree of perishing. One of the few examples of a badly perished paper with a comparatively low acid value is Bochtlingk's Ring Cakuntala.

It is thus clear that the process of perishing is accompanied by the production of appreciable amounts of water soluble, non-volatile acids. Taking the highest acid value obtained, and assuming that the acid produced is of the type of saccharic acid, the value would indicate the formation of 8 per cent. of acid (saccharic) calculated on the weight of the paper.

Examples of perished paper were extracted in a Soxhlet apparatus with (a) alcohol (b) ether in order to determine whether the acid present could be removed by these solvents. In the case of the ethereal extracts water was added to the extract and the whole well shaken during the process of titration.

The results obtained are given in Table X and shew that the total acidity is removed by alcohol in about 8 hours, but that in the case of ether the acid is removed less readily and even after 20 hours extraction when practically no more acid is removed only 78 per cent of the total acid is found in the ethereal extract.

TABLE X.

A. Alcohol.	Buchanan perished, chapter.	Buchanan good, chapter.	Memoirs of the operations of British Army in India.
Weight of paper	3.48	3.88	1.75
1st extract after 5 hours required cc. of 0.039 alkali	15.20	9.40	5.40
2nd extract after 3 hours	1.50	0.68	1.28
3rd extract after 3 hours	0.82	...	0.70
cc. of 0.039N alkali required for pure alcohol.	1.32	0.88	0.66
Total 0.039N alkali required	17.52 - 1.32 = 16.20	10.08 - 0.88 = 9.20	7.30 - 0.66 = 6.64
ccs. of 0.05N NaOH for alcoholic extract from 100 gms.	361	184	294
ccs. of 0.05N NaOH for water extract from 100 gms.	358	166	273

TABLE X.—*Continued.**B. Ether.*

Buchanan worst copy chapter.

		c.cs. of alkali.
1st extract 5 hours	...	2.72
2nd " " "	...	2.08
3rd " " "	...	1.06
4th " " "	...	0.440
Weight of paper	...	1.71
Total required	...	6.26
Total for ether extract from 100 gms.		284
Total for water extract from 100 gms.		358

Estimation of water soluble matter.

A few experiments were made to ascertain whether perishing and high acid value are accompanied by an appreciable increase in the water soluble contents of the paper. About 50 cc of the liquid extract used for the determination of acidity were taken in a weighed porcelain dish and the weight of soluble substances present per 100 gms of paper was determined by evaporating it to constant weight on a water bath.

TABLE XI.

	i.	ii.	Mean.	Condition.
Buchanan — introduction ...	2.8	2.9	2.85	Good.
„ chapter ...	4.3	4.4	4.35	Moderately perished and discoloured.
„ introduction ...	3.6	3.8	3.7	Good.
„ chapter ...	9.2	9.2	9.2	Perished brown
Beames — contents ..	6.5	6.5	6.5	Moderately perished.
„ chapter ...	6.8	6.9	6.85	Perished, very little, different from contents.

B. Oxycellulose.

Cellulose which has been in contact with bleaching solution for a lengthened period will be found to have lost much of its original strength and firmness, and, in addition, to have acquired properties that are wanting in its pure state. This change is due to the formation of what is technically known as oxycellulose.

It was thought possible that the chemical changes taking place in a perishing paper might be due to oxidation and result in the formation of oxycellulose.

Cross and Bevan (*Zeit. Angew. Chem.*, 1906, 19, 2101) and H. Ditry, (Abs. in *J. S. C. I.* 1907, 26, 988 and 1026) have shown that cellulose, in presence of numerous oxidising agents, tends to form a peroxide, accompanied by free acid. It was thought possible that in the earlier days of the use of bleaching powder before anti-chlor (sodium thiosulphate) was used small amounts of such a peroxide might be left in the manufactured paper which might act as a catalyst in producing slow oxidation of the paper by atmospheric oxygen.

Qualitative.

It is stated in "Cellulose" by Cross and Bevan, 1916, p. 57, that oxycellulose dissolves in dilute solutions of alkali and on heating the solutions develop a strong yellow colour. On treating paper with a few drops of two per cent. sodium hydroxide solution in a test tube the solution did turn yellow, but little or no change in colour was observed on heating. Samples of esparto, and pure new rag paper, as well as paper extracted with alcohol and ether, were tried with caustic soda solution; each gave, previous to heating, yellow colours of different shades. Where the paper was highly discoloured the colour of the alkali solution was found to be dark brown.

It is also stated that oxycellulose can be reprecipitated by treatment with alcohol. When a few drops of the yellow liquid, obtained by treating esparto as well as rag papers with dilute sodium hydroxide, were poured in alcohol, a white gelatinous precipitate was obtained. When the same test was tried on pure new rag paper it also gave a small amount of a white precipitate.

According to Cross and Bevan (*Cellulose*, p. 57, 1916) when warmed with concentrated sulphuric acid oxycellulose should develop a pink colour similar to that given by mucic acid. When treated with concentrated sulphuric acid, rag as well as esparto paper (which contained about 8 per cent of oxycellulose) first turned brown and then black due to charring. Nothing was seen of the pink colour, except in the case of one pure rag typewriting paper, which gave a maroon colour with concentrated sulphuric acid and turned dark brown after some time.

W. D. Bancroft also mentions (*J. Phys. Chem.* 1915, 19, 150) that sulphuric acid gives rise to a brown colour and then a black.

Estimation of Oxycellulose as phloroglucide.

The method adopted was that due to Krober and described in Allen's Commercial Organic Analysis Fourth Edition, Vol. 1 p. 402.

To calculate the furfuraldehyde from the phloroglucide the following formulae given by Krober were used.

- (1) For weights of phloroglucide "a" under 0.03 gram:—
Furfurol = $(a + 0.0052) \times 0.5170$.
- (2) "a" over 0.300 gram:—Furfurol = $(a + 0.0052) \times 0.5180$.
- (3) "a" from 0.03 to 3.00:—Furfurol = $(a + 0.0052) \times 0.5185$.

TABLE XII.

Book.	Weight of paper.	Weight of phloroglucide.	Formulae used.	Furfurol.	Furfurol on 100 gms paper	Fibre.	Weight of phloroglucinol taken.
Buchanan	5.960	0.0760	$(a + 0.0052) \times 0.5185$	0.0421	0.71	Flax	0.42
good	6.200	0.0902	do	0.0495	0.80	& cotton	0.17
Buchanan	6.420	0.1001	$(a + 0.0052) \times 0.5185$	0.0546	0.85	do	0.27
medium	7.090	0.1174	do	0.0636	0.90		0.27
Buchanan	5.380	0.0685	$(a + 0.0052) \times 0.5185$	0.0382	0.71	Flax	0.23
worse	6.500	0.0854	do	0.0470	0.72	& cotton	,,
Morley Chapter	6.180	0.0909	do	0.0495	0.80	Flax	1.13
	4.720	0.0616	do	0.0346	0.73		0.40
Comparative	6.540	1.1012	$(a + 0.0052) \times 0.5180$	0.5731	8.76	Esparto	1.32
Grammar.	6.460	0.9808	do	0.5128	7.90		,,
Note Book 20 years old.	5.900	1.0904	do	0.5675	9.62	do	,,
Typewriting paper.	3.350	0.0268	$(a + 0.0052) \times 0.5170$	0.0163	0.49	Cotton	0.45
Cross and Bevan's Cellu- lose.	2.330	0.0172	do	0.0116	0.50	do	,,
Travels in Africa, Egypt and Syria.	6.180	0.0854	$(a + 0.0052) \times 0.5185$	0.0470	0.76	Flax	0.50

The only papers giving high values for oxycellulose are the esparto papers containing natural oxycellulose. The

amount of oxycellulose in a perished rag paper (flax or cotton) always appears to be low and to be equal to less than one gram of furfuraldehyde per 100 grams of paper.

B. Hydrocellulose.

Hydrochloric acid disintegrates cellulose tissues and the product has been termed hydrocellulose by Girard and hydrolylose by Hitz.

It is said (Cross and Bevan), that numbers of organic as well as mineral attack cellulose producing hydrolytic changes, attended by disintegration of the fibre. The action is gradual at ordinary temperatures and is of course accelerated by applying heat. It is stated by the same authors that the products differ from cellulose in containing active carbonyl groups.

Girard (*J. S. C. I.* 1882, 42, 378) states that hydrolylose can be prepared by the action of organic acids such as tartaric, citric, acetic, as well as formic on cellulose. Weak acid solutions require a more or less prolonged contact at a temperature above the normal one. Under such treatment flexibility and natural elasticity of fibres disappear and become brittle and easily reducible to powder.

The brittle nature of the product is partly attributed by Hauser and Herzfeld (*Chem. Zeit.*, 1915, 39, 689) to the penetration of the cellulose structure by gelatinised products of hydrolysis.

Hydrocellulose is differentiated from cellulose by its cupric reducing properties. Published analyses vary over wide limits.

G. Z. Schwalbe (*Ber.*, 1907, 40, 1347-1351; *Angew. Chem.* 1910, 23, 924) points out that a determination of the cupric reducing power, if performed under rigidly defined conditions, affords a useful measure of the free carbonyl groups and hence of the chemical condition of the sample or the extent of change suffered by the cellulose.

Beadle (*Chapters on Paper Making* Vol. IV p. 29) states that in case where a great excess of aluminium sulphate is used a modified form of hydrocellulose is sometimes produced.

Experiments have been made with badly perished and slightly perished papers:—

(a) The extraction was carried out in a Sox

apparatus with boiling water and the cupric reducing power of the liquid determined:—

TABLE XIII.

	Time	Copper value.	Gms. of copper on 100 gms. of dry paper
Buchanan in worst condition	5 Hrs.	2.34	2.24
		2.13	
	15 "	4.59	4.51
		4.42	

(b) Reducing power of various samples of paper was determined by the cupric reduction method standardised by Schwalbe.

Two portions of about 3 gms. each of paper were weighed. One portion served for the determination of the above absolute dry substance, whilst the other was reduced to a fine state of division without drying and was mixed with 200 cc. of water in a round bottom flask with a sufficiently wide neck; a reflux condenser, through which passed a stirrer shaft, and a dropping funnel were fitted into the neck of the boiling flask. The contents of the flask were heated to boiling in an oil bath and 100 cc. of hot Fehling's solution added to the boiling liquid by means of the tap funnel, active stirring was necessary to prevent bumping. The mixture was boiled for 15 minutes, the time being calculated from the moment full ebullition set in. The liquid was then filtered hot by the aid of the pump and the residue containing the cuprous oxide was washed with boiling water until free from copper. The cuprous oxide in the residue was then dissolved by heating for 15 minutes on the water bath with 50 cc. of 6% nitric acid, and it was not found necessary to dissolve the last traces from the cellulose mass by digestion with ammonia. The mass was filtered by means of the suction pump, washed completely with boiling water, and the amount of copper determined by the electrolytic method. A current pressure of 8 volts, a current density of 2.0 amperes and a rotating electrode were used.

In order to obtain good results by this method a large number of precautions have to be taken. If the stirrer revolves too rapidly and a part of the cellulose be exposed above the Fehling's solution during boiling, the copper value may be increased abnormally and the fibre become black. Further the use of rubber stoppers and connections in conjunction with Fehling's solution increases the precipitation of copper.

Copper sulphate and sodium hydroxide solutions are not to be filtered but allowed to settle and the upper clear liquid used. Both these solutions should be heated to boiling separately and the alkali tartarate solution quickly poured into copper sulphate solution and this mixture immediately added to the contents of the flask, which are already in ebullition.

The precipitation of cupric hydroxide by absorption is comparatively high in the case of hydrated or modified celluloses, and the copper values had to be corrected by a determination of this "hydrate copper value" by immersing a fresh portion of the cellulose in cold Fehling's solution for 45 minutes; and this value deduced from that obtained by using boiling Fehling's solution. The values obtained for various samples of paper and calculated on 100 gms. of dry paper or cotton are given in table XIV.

TABLE XIV.

Reducing power of various kinds of paper.

	Condition,	Fibre,	Copper values.	Hydrate copper values.	Corrected copper values.	Gms. of copper on 100 gms. of dry paper.
(1) Pure absorbent cotton.			1.58 1.41	0.74	0.84 0.67	0.8
(2) Buchanan	... Worst, quite a wreck.	Cotton and linen with the former in majority	16.38 15.82	1.46	14.92 14.46	14.7
(3) "	... Better but perished to a considerable extent	do	7.08 6.10	0.88	6.20 5.22	5.7
(4) "	... Medium very brittle.	do	14.61 13.01 13.61	1.65	12.96 11.36 11.96	11.7
(5) Best typewriting paper.	Quite good	Cotton	1.61 2.27 2.01	0.74	0.87 1.53 1.27	1.4
(6) Brown's travels in Africa, Egypt, and Syria.	Completely perished and brittle.	Flax	18.18	1.50	16.68	16.7
(7) History of War between France and Germany.	Quite a wreck	Esparto	24.90 24.38	3.51	21.38 20.87	21.1
(8) Do	... Pages in better condition but quite brittle.	do	8.91 9.01	1.25 1.18	7.66 7.83	7.8
(9) Foolscap paper without water mark.	Quite good.	Chemical wood pulp.	3.31 3.53	0.86 0.89	2.45 2.64	2.5

The results with these few samples of paper show that the copper reducing powers of fresh unperished paper, whether rag, chemical wood pulp or esparto are comparatively low, whereas perished rag and esparto papers give high copper values, pointing to the production of hydrocellulose or some other reducing substances during the process of perishing. These results combined with the oxycellulose values given on p. 172 indicate that perishing in most cases is a process of hydrolysis rather than oxidation.

For many years Oxycelluloses and Hydrocelluloses were regarded as more or less definite chemical entities produced by the oxidation or partial hydrolysis of celluloses. This view has been largely modified within recent years (cf. p. 164) and it is now generally recognised that both types of altered celluloses contain much of the original cellulose mixed with degradation products; either oxidised or hydrolysed products. In the case of hydrocelluloses from cotton or wood these degradation products amount to about 24-26 per cent. of the total and bleaching powder oxycellulose contains about 60 per cent. of cellulose proper and 40 per cent. of oxidised degradation products. Many of the degradation products can be removed by boiling with lime (cf. C. G. Schwalbe and E. Becker, *J. pr. Chem.*, 1919, [ii], 100, 19; Cross, *J. R. Soc. Arts*, 1920, 68, 744).

VI. EXPERIMENTS ON THE ARTIFICIAL PERISHING OF PAPER.

Numerous experiments were made by sealing specimens of paper from the best of the three copies of vol. I of Buchanan's *Journal* (p. 126) in glass tubes with various gases both moist and dry and then heating the tubes at given temperatures for several weeks. The tubes were then broken and the acid value and strength of the paper samples compared with the original value.

When soft glass tubing was used difficulties were experienced owing to the alkali dissolved from the glass. The later experiments were therefore made in sealed Jena glass tubes; the results are given in Table XV.

TABLE XV.

A. Jena glass tubes, 1 month at 50°.

	No. of foldings required to break margin.	No. of foldings required to break paper under print.	Acid value.
Dry Air	40	2	123
Moist air	90	4	142
Dry nitrogen	50	3	105
Moist nitrogen	97	6	139
Dry carbon dioxide	15	2	127
Moist carbon dioxide	40	3	109
Dry oxygen	20	2	142
Moist oxygen	70	4	149
Vacuum of 1.0 mm.	2	1	156

B. Jena glass tubes, 1 month at 50° and 20 days at 63°.

Dry air	4	1	162
Moist air	10	3	171
Dry nitrogen	5	2	167
Moist nitrogen	45	12	121
Dry carbon dioxide...	5	2	168
Moist carbon dioxide	10	3	166
Dry oxygen	4	1	180
Moist oxygen	8	2	187
Vacuum 2.0 mm.	4	1	175

Samples of the original paper had an acid value of 117, the number of folds required for breaking the centre and margin of a page were respectively 5 and 140—170.

It is clear that in the latter experiments an increase in acidity has taken place, but to nothing like the same extent as in badly perished samples. The only exception appears to be in the case of moist nitrogen where the acid value has remained practically the same. It is also noticeable that the strength of the margins of the paper has diminished appreciably in most cases. Distinct differences are found between the samples in dry and moist gases, but this is in harmony with the fact that a thoroughly dry paper breaks more readily than a damp paper.

Effect of Acid Extract from perished paper on sound paper.

An experiment was made to determine whether the acid present in a sample of badly perished paper and applied to a

sound sheet of a paper will produce perishing within a month at 60°.

The badly perished papers selected were :—

a) History of war between France and Germany (cf. p. 167).

b) Buchanan's Journey from Madras, worst copy (cf. p. 126) and the sound paper were sheets of type-writing paper which showed no signs of perishing when heated alone at 60° for one month in a sealed tube.

The acid was extracted from the perished paper by repeated digestion with water and the sound paper then immersed in the solution, removed, dried and again immersed and the operations repeated until the whole of the acid liquor had been absorbed.

After heating for one month at 60° in sealed tubes, although the sound paper was badly discoloured owing to the colouring matter from the perished paper, no alteration in its strength could be detected. The heating was then continued for a second month at 80° and even then only slight perishing of the sound paper could be detected.

It is thus clear that the acids present in perished paper can have only a very slow destroying action on the fibre of the paper.

VII. PRESENCE OF MICRO-ORGANISMS.

It is a well known fact that micro-organisms can grow on damp paper and it is highly probable that certain types of perishing may be due to the growth of such organisms. We have made no detailed study of this type of perishing as it does not appear to be so common as the purely chemical perishing and can generally be prevented by good ventilation and taking care that books are always kept dry.

A number of observations have, however, been made by one of us on the growths obtainable by impregnating neutral broth with small pieces of perished paper placed there by means of sterilised forceps. After shaking, a drop of the broth was taken on a platinum loop and streaked successively on four dry agar slopes and the broth tube and slopes incubated at 36° for 24 hours, when fresh agar slopes were inoculated with the broth. Several samples of badly perished paper when treated in this way were found to be quite sterile as no colonies of organisms could be observed on the agar slopes. On the other hand, many papers which were only slightly perished were found to be teeming with organisms.

Samples of paper from the following books were found to be sterile.

Ring Cakuntala 1948. Centre of page.

The Oriental Christian Spectator Vol. 1. 1838 pp. 69, 203

Waverley Novels.

Wayside thoughts by D'Arcy N. Thompson. Fly page & p. 93.

Other pages not so perished showed growths.

Thompson's Essays on Education.

Buchanan's Journey Vol. II. Copy from Native General Library Bombay. Chapter.

A sample of paper from the title page of the same volume which was in good condition showed growths.

We have not been able to determine the cause of these differences. They may be due to the fact that in the badly perished samples no nutrient medium, such as gelatine, is available for the organisms or it may be that the high acid value of many of the papers is deleterious to the growth of micro-organisms.

VIII. SUMMARY.

(1.) It is quite clear that in India a considerable proportion of papers undergo perishing in plains stations, such as Calcutta, Madras, Bombay, Meerut and Tanjore. On the other hand, certain types of rag papers appear to keep for very long periods without perishing. Among such papers we have met with are some of the coarse Eastern made papers and certain European papers with such watermarks as Whatman: Balston and Co., Bigg, Budeen 1802, W. Elgar 1796, Curties and Sons, 1801 and 1805. The proportion of perished paper in Indian libraries appears to exceed anything that has been observed in European or American libraries.

(2.) In order to obtain a paper which will withstand the Indian climate it is necessary not only to have a rag paper, but also to take care that the fibres are not weakened before being used for the production of paper or during the processes of manufacture. The treatment likely to weaken the fibres would be:—

- (a) Prolonged digestion with alkali.
- (b) Over bleaching.
- (c) Non-removal of last trace of bleach by antichlor.
- (d) Imperfect washing and hence traces of acid left in the paper.

If a strong fibre is employed and if these sources of weakness are removed, a rag paper should be obtained which should last for centuries. Before being used for books which are to be kept as valuable records a paper should be subjected to severe tests, more particularly to the folding test in a folding-machine. If the result is not satisfactory the paper should be rejected.

(3.) In this connection it is worth bearing in mind that purity of colour might with advantage be sacrificed for the sake of obtaining a more durable paper.

(4.) Esparto papers appear to be unsuited to the Indian climate. The percentage of esparto papers which undergo perishing is much higher than the percentage of rag papers. We have no definite figures for chemical wood and mechanical wood pulp papers, but from the Report of the British Committee (cf p. 120) it is highly probable that papers made from chemical wood pulp would be intermediate between the rag and esparto and that the mechanical wood pulp papers would be inferior in resisting power to esparto papers.

(5.) Straw papers are also unsuited for India and it is worth bearing in mind that the bamboo gives a cellulose allied to that from straw and esparto. It is therefore highly probable that the factories which have been suggested for manufacturing bamboo pulp would produce papers in many respects similar to esparto and very liable to undergo perishing.

(6.) The common type of perishing appears to be largely a chemical one and not due to micro-organisms. The perishing is accompanied by the formation of large amounts of water soluble, non volatile acids and also by the formation of products with high copper reducing values—probably hydro-celluloses.

Perishing appears to be therefore a process of hydrolysis *i. e.* the addition of water to the cellulose molecules and a decomposition into simple products, rather than a process of oxidation.

(7.) The perishing is characteristic of whole pages and in fact whole formes of books. In many cases a given volume shows many different states of perishing *e. g.* certain pages may be dark brown and so brittle that they crumble when folded only once whereas other pages in the same book may be white and in excellent preservation. It is found however that in practically every case the change in the condition of the paper occurs with a change in forme. Such changes are frequently met with in periodicals issued in parts and in volumes of army orders &c. issued

from day to day. Differences are frequently met with between title pages and introduction and the main chapters or between plates and letter press.

(8). As a rule it is found that several copies of the same book exhibit much the same stages of perishing although they have been kept in libraries in different plain stations.

(9). A comparison of books in the Station Library, Simla, and the Nilgiri Library, Ootacamund, with copies of the same books in Calcutta, Madras and Bombay proves conclusively that the perishing of paper is not nearly so rapid in the Hill stations as in the plains.

(10). The method of treating paper with arsenical preparations, probably arsenious sulphide, although it preserves the papers from insect depredations, is, in many cases, most harmful as it accelerates the perishing of the fibres of paper. Corrosive sublimate is frequently used as a wash for papers and specimens in Herberia, but what action this has in the course of many years we cannot say.*

(11). The question as to whether a book when partly perished can be preserved from undergoing complete perishing by transference to a Hill Station library is not easily answered. Its removal to a cooler climate should lengthen the life of the book appreciably, but the perishing would probably continue at a much slower rate. Organic acids are produced during perishing and these probably play a part in accelerating the rate of perishing, although as shown on p. 178 these acids have not a very pronounced corroding effect on paper.

(12). *Preservation of books, records, etc in India.*

A clear distinction must be made between :—

(A) Books of interest at the present time but not of permanent value. Such include the ordinary text books as used in University libraries, the light literature class as issued in lending libraries and many copies of periodicals and newspapers. As a rule such volumes retain very little value after 20 years or less and require no special treatment, except to be kept in well aired libraries and to be protected from insect attacks *e. g.* by the presence of naphthalene balls. Even if the majority of such

*In a letter from the Officiating Director Botanical Survey of India dated October 1st 1290 it is stated that this method of preserving books has been discarded as in the course of time the paper darkens and becomes brittle.

nes have completely perished at the end of 20 years the loss not be serious. Detailed specifications for paper for such is are unnecessary.

(B) Books and documents of permanent interest. e include:—

- (a) All sets of scientific and literary journals.
- (b) Copies of expensive modern works which it would be difficult to replace in the future.
- (c) Copies of old volumes of value.
- (d) Standard editions of famous authors.
- (e) All records of permanent value, whether Government, University or other.

Such books and documents need much more careful tment if they are to be preserved for any length of time in ia. There appear to be two alternatives, viz :—

- (1) To remove all such valuable books in any one Presidency to a library located in some Hill station where the climate is temperate.
- (2) To place such books in a library situated in the chief town of the Presidency, and to equip the library with an air conditioning plant so that temperature and humidity can be carefully controlled all the year round, day and night.

This latter method is being adopted in numerous American Libraries and has been introduced into the Ordnance Factory at Dum-dum for the air control of their packing department, but in is case the plant is only worked during the day time.

Of the two alternatives we strongly recommend the latter, for the following reasons :—

- (a) The books are in the building where they will be required for use, and hence damage in transit will be avoided.
- (b) The life of any book will be as long or longer than if placed in a Hill Station library.
- (c) The humidity and temperature control and air filtration entailed by adopting any such plant will render the books less liable to attack by micro-organisms (moulds, etc.) than they would be in the damp, climates of certain Hill Stations.

From financial considerations it is clear that only one such library for each Presidency town could be erected and it would be necessary for the authorities in possession of the books and records worth preserving to come to some general arrangement as to the housing and control of their respective books.

The whole building would probably be subject to such air control : not merely storage room but also the reading rooms. In this way the books would always be at a moderate temperature and in a relatively dry atmosphere.

This would not only reduce to a very appreciable extent the perishing of the paper by chemical action, but would also largely prevent the growth of micro-organisms which readily thrive under warm, moist conditions.

In dealing with valuable works a distinction must be drawn between those already in different libraries and those to be purchased in the future.

As regards the former all those printed on really first class paper will last for centuries; those on inferior paper which, has already started to perish, will continue to perish, but probably at a much reduced rate.

In the case of new volumes obtained from outside India it would be advisable to obtain a guarantee from the makers of the paper.

1. That the paper is pure rag and that the fibres were strong before being turned into paper.
2. That the paper has no distinct acidity.
3. That it will withstand severe test in the folding machine.
4. That the rosin and filling materials are below certain fixed values.

If the paper fulfils these conditions it should last for centuries.

For periodicals, journals, expensive books etc. it is quite possible that most publishers would be prepared to provide copies printed on such a paper at a price somewhat higher than that charged for copies printed on a wood pulp or esparto paper.

For Indian records and valuable works published in India a stock of such paper could be kept on hand and a certain number of copies printed off on this paper.

If the air conditioning method is adopted and no attention paid in the future to the quality of the paper, the lives of new books will probably be much the same as for the same books in England. The ultimate perishing of records printed on low grade paper cannot be prevented.

13. The question as to the effect of continual changes in temperature and humidity on the perishing paper has been raised. We can only state that on the whole books in Madras which are subjected to a continuous warm humid climate are rather more rapidly perished than books in Calcutta, but whether this is due to the continuous high temperature and relatively high humidity we cannot say.

14. We have not referred at all to matters such as the destruction of paper by insects and the deterioration by moulds and other micro-organisms.

Closed book cases containing naphthalene balls have been found most efficacious in Bangalore for preventing attack by insects and thorough airing and keeping dry is the best methods of preventing growths of micro-organisms.

15. We have had no time to devote to the question of the effect of different inks on the perishing. We have noted in several cases, particularly in the case of Buchanan's "Journey from Madras", that the paper under the print is far more tender than at the margin where there is no printed matter. This is not, however, universally true.

We have also noticed, in the case of certain old letters in which the paper itself has been quite strong, that each ink mark has produced serious corrosion and that the paper under the ink is cut right through. This is undoubtedly due to the action of acidic substances in the ink. Such corrosion does not spread very far from the actual ink marks and is quite local.

16. In conclusion we have to thank the Government of India for a grant which has helped to defray the costs of this investigation and also the numerous Library authorities who have assisted in the lending of books for investigation or in actually examining books themselves. Of these authorities we are deeply indebted to Mr. J. A. Chapman of the Imperial Library, Calcutta, who has taken a keen interest in the investigation and has himself devoted much time to examining numerous books in Calcutta, Madras, Meerut and Ootacamund. We have also received considerable assistance from Mr. Johan Van Manen, the

acting Librarian at the Imperial Library, Calcutta, and the authorities connected with the following Libraries:—

The Madras Literary Society, The Connemara Public Library, The Adyar Library, The Native General Library Bombay, The Bombay Branch of the Royal Asiatic Society, St. Xavier's College Library, Bombay, The Royal Asiatic Society of Bengal Calcutta, The Bishop's College Library, The Station Library, Simla, The Nilgiri Library, Ootacamund, The R. A. Mess Library, Meerut and the Maharaja Serfogi's Saraswathi Mahal Library, Tanjore, and to all of these we tender our sincere thanks.

We also wish to thank Messrs. Balston & Co. for their courtesy in replying to many enquiries.

DEPARTMENT OF GENERAL AND ORGANIC CHEMISTRY,
INDIAN INSTITUTE OF SCIENCE,
BANGALORE.

APPENDIX I.

List of Books examined in the Station Library, Simla.

1. Forty years of American Life by Dr. Thomas L Nichols. Two Vols. London, John Macwell & Co. 1864.
2. A colonial tramp etc. by Hume Nisbet in two Vols. London, Ward and Downey, 12 York Street, Covent Garden 1890.
3. The Merv Oasis, Travels and adventures East of the Caspian during the years 1879—80—81 etc. by Edmond O'Donovan. Two vols. London, Smith Elder & Co., 15 Waterloo Place 1882.
4. A Journey to Katmandu with the camp of Jung Bahadur etc. by Lawrence Oliphant. London, John Murray 1852.
5. The Land of Gilead with excursions in the Lebanon—by Lawrence Oliphant. Wm. Blackwood & Sons, Edinburgh and London 1880.
6. Minnesota and the Far West by Lawrence Oliphant. Wm. Blackwood & Sons, Edinburgh and London 1855
7. The Trans Caucasian Campaign of the Turkish Army under Omer Pasha by Lawrence Oliphant. Wm. Blackwood & Sons, Edinburgh and London 1856.
8. Journeys and Explorations in the Cotton Kingdom etc. by Frederick Law Olmsted. 2 Vols. London, Sampson Low Son & Co., 47, Ludgate Hill 1861.
9. Travels in India including Sindh and the Punjab by Captain Leopold Von Orlich. Translated from the German by H. Evans Lloyd. 2 Vols. London, Printed for Longman, Brown, Green and Longman 1845.
10. A Cruise in Japanese Waters by Captain Sherard Osborne, 2nd Edition. Wm. Blackwood & Sons 1859.
11. A Summer in Iceland by C. W. Pajkull. Translated by Rev. M. R. Barnard. London, Chapman and Hall 1868.
12. Life in Abyssinia, being notes collected during 3 years residence and travels in that country by Hansfield Parkyns in 2 Vols. London, John Murray 1853.
13. A Journey on a Flank from Kiev to Eaux-Bonnes 1859 by Lady Charlotte Pepys. 2 Vols. London, Hurst and Blackett 1860.
14. The Land of the Dragon. My boating and shooting excursion to the Gorges of the Upper Yangtze by Wm. Spencer Percival. London Hurst & Blackett Ltd. 1889.
15. Three months in Soudan by Ernestine Surtorius. London, Kegan Paul, Trench & Co 1885.

16. A trip to Barbary by a round about route by George Augustus Sala
London, Tinsley Bros. 1866.
17. Narrative of a journey round the Dead Sea and in the Bible Lands in
1850-51 by F. de Sanley. Edited by Count Edward de Warren
New Edtn., 2 Vols. London, Richard Bentley 1854.
18. The Heart of Africa etc. by Dr. Georg. Schweinfurth. Translated
by Ellen E. Trower with an introduction by Winwood Reade, 2 vols.
London, Sampson Low, Marston, Low and Searle 1873.
19. Visits to High Tartary, Yarkand and Kashgar etc. by Robert Shaw.
London, John Murray 1871.
20. Viti, an Account of a Government Mission to the Vitian or Fijian
Islands in the years 1860-61 by Berthold Seemann. Cambridge,
Macmillan & Co. 1862. *
21. Fifty years in Ceylon. An Autobiography by the late Major Thomas
Skinner C. M. G. edtd. by his daughter Anne Skinner, London, W.
A. Allen & Co. Ltd. 1891.
22. Adventures during a Journey Overland to India by way of Egypt,
Syria and the Holy Land by Major Skinner, 31st Reg. 2nd Edi-
tion, 2 Vols. London, Richard Bentley 1837.
23. A Journey through the Kingdom of Oudh in 1849-50 etc. by Major
Gen. Sir W. H. Sleeman in two Vols. London, Richard Bentley
1858.
24. A Narrative of an exploratory visit to each of the Consular Cities of
China etc. in 1844, 1845, 1846 by the Rev. George Smith, 2nd
edition. London, Seeley, Burnside and Seeley, Fleet St 1847.
25. Tent life with English Gipsies in Norway by Herbert Smith 2nd
Edition. Henry S. King & Co., London 1874.
26. Three Cities in Russia by Prof. C. Piazzzi Smyth, 2 Vols. London,
Lovell Reeve & Co. 1862.
27. Narrative of an Expedition into Central Australia etc. by Captain
Charles Stuart. 2 Vols. London, T. & W. Boone 1849.
28. The Folklore, Manners, Customs and Languages of the S. Australian
Aborigines etc. Edited by the late Rev. G. Taplin of Point Mac-
leay 1st Series, Adelaide 1879.
29. A Voyage to E. India wherein some things are taken notice of in our
passage thither, but many more in our abode there etc. Observed
by Edward Terry, 1787. London, printed for J. Wilkie, No 71,
St. Pauls Church Yard.
30. Notes of a Journey from Cornhill to Grand Cairo etc. by M. N. A.
Titmarsh, 2nd Edition. London, Chapman & Hall, 186 Strand 1846.
31. Sketches of Central Asia, Additional chapters on my Travels & Advent-
ures and on the Ethnology of Central Asia by Arminius Vambery,
London, Wm. Allen & Co. 1868.

32. Travels in Central Asia by Arminius Vambery. London, John Murray 1864.
33. North America by Anthony Trollope 2 Vols. 3rd Edition. London, Chapman and Hall 1862.
34. The West Indies and the Spanish Main by A. Trollope, 4th Edition. London, Chapman and Hall 1860.
35. Victoria and Tasmania by A. Trollope. London, Chapman & Hall 1874.
36. S. Australia and W. Australia by A. Trollope. London, Chapman and Hall 1874.
37. N. S. Wales and Queensland by A. Trollope. London Chapman and Hall 1874.
38. A Lenten Journey in Umbria and the Marches by Thomas Adolphus Trollope. London, Chapman and Hall 1862.
39. Life in Normandy, Sketches of French Fishing, Farming Cooking, etc. Vols. I and II, Second Edition. Edinburgh, Edmonston and Douglas 1863.
40. The Book of Ser Marco Polo. Newly translated and edited by Col. Henry Yule. Two Vols. Vol. II. London, John Murray 1871.
41. A Visit to Java with an account of the founding of Singapore by W. Basil Worsfold. London, Richard Bentley 1897.
42. A Jaunt in a Junk. A ten days Cruise on Indian Seas. London, Kegan, Paul, Trench & Co. 1884.
43. Voltaire—by John Morley. Macmillan & Co. 1886.
44. Warne's Crown Library. The fair God or the last of the Tzins by Lew Wallace. London and New York. Frederick Warne & Co. 1887.
45. The Heir of Redclyffe by Charlotte M. Yonge. London, Macmillan & Co. 1894.
46. The Pseudonym Library London. T. Fisher Unwin 1895. 48 Vols. up to Toxin by Ouida.
47. Cardinal Pole by Wm. Harrison Ainsworth, 3 Vols. London, Chapman & Hall 1870.
48. Chetwynd Calverley by Wm. Harrison Ainsworth 3 Vols. London, Tinsley Bros., 8 Gatherine St., Strand 1876.
49. Hilary St. Ives by Wm. Harrison Ainsworth 3 Vols. London, Chapman & Hall. 1870.
50. Jack Shepard by Wm. Harrison Ainsworth, Author's Copyright Edtn. London, Geo. Routledge & Son Ltd. No date. 1 Vol.
51. Merry England or Nobles and Serfs—by Wm. Harrison Ainsworth. 3 Vols. London, Tinsley Brothers. 1874.

52. *Chronicles of London Bridge by an Antiquary*, 2nd Edition. London, Printed for Thomas Tegg, 73 Cheapside 1839.
53. *John Law the Projector*, by Wm. H. Ainsworth 3 Vols. London, Chapman & Hall 1864.
54. *Old St Pauls* by Wm. H. Ainsworth. Author's Copyright Edtn. London, Geo. Routledge & Son, Ltd. No date.
55. *Myddleton Pomfret* by Wm. H. Ainsworth. 3 Vols. London, Chapman & Hall. 1868.
56. *W. H. Ainsworth's Novels*. Author's Copyright Edition. London, Geo. Routledge and Sons Ltd. No date. (1) *Mervyn Clitheroe*. (2) *Oringdean Grange**. (3) *Kookwood* (4) *Preston Fight.*** (5) *Stanley Brereton.** (6) *St. James's*. (7) *The Constable of the Tower*.
57. *The Flitch of Bacon* by Wm. H. Ainsworth. Authors Copyright Edtn. London, Geo. Routledge & Sons Ltd. Broadway, Ludgate Hill. Manchester and New York. No date. London, Bradbury Agnew & Co., Ltd. Printers. Another Edtn. London, Geo. Routledge & Sons Ltd., Broadway House, Ludgate Hill. Printed by A. Bonner 1 and 2 Took's Court, London, E. C.
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61. *Dr. Palliser's Patient* by Grant Allen. London, Samuel Muller, 29 Ludgate Hill E. C. 1889.
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71. *Dr. Wortles' School* by A. Trollope, 2 Vols. London, Chapman & Hall 1881.
72. *Orley Farn* by A. Trollope with Illustrations by J. E. Millais, 2 Vols. London, Chapman & Hall 1862.
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74. *Toilers and Spinsters and other Essays* by Miss Thackeray 2nd edtn. London, Smith Elder & Co. 1874.
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76. *The Village on the Cliff* by the Author of the *Story of Elizabeth*, London, Smith Elder & Co. 1871.
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78. *Comic Tales & Sketches* by Mr. Michael Angelo Titmarsh, 2 Vols. London, Hugh Cunningham 1841.
79. *Denis Duval* by W. M. Thackeray. London, Smith Elder and Co. 1867.
80. *Micellanies Prose and Verse* by Wm. M. Thackeray.
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 „ II. London, Bradbury and Evans 1856.
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Dr. Birch and his young Friends, 1849. *Our Street*, 2nd Edition. 1848. all in one Volume.
82. *The History of Samuel Titmarsh and the Great Hoggarty Diamond*. *Memoirs of Mr. C. J. Yellowplush and Burlesques* by Wm. M. Thackeray. London, Smith Elder and Co. 1872.
83. *The Works of Wm. M. Thackeray* in 24 Vols. Vol. 23 *the Four Georges and English Humorists*. London, Smith Elder and Co. 1879.

84. Sam Slick's Wise Saws and Modern Instances. 2 Vols. London, Hurst and Blackett 1853.
85. An American Monte Cristo. Julian Hawthorne. 2 Vols. London, W. H. Allen and Co., Ltd. 1893.
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87. Twice Told Tales. Julian Hawthorne. London, Geo. Routledge & Co. 1852.
88. The Hand of Ethelberta by Thomas Hardy. 2 Vols. London, Smith Elder and Co. 1876.
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90. Oliver Ellis or the Fusiliers by James Grant. London, Routledge, Warne and Routledge, 1861.
91. Charles Dickens. The Chas. Dickens Edtn. in 21 Vols. Xmas Stories. Printed by J. S. Virtu and Co., Ltd. City Road, London.
92. Hughenden Edition of Earl of Beaconsfield's Novels.
I Vivian Grey, London Longmans Green and Co. 1882.
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93. Waverley Novels, Centenary Edition, Edinburgh. Adam and Charles Black, 1871.
Vol. VI A legend of Montrose.
„ VII Heart of Midlothian.
„ VIII Bride of Lammermoor.
„ XIII The Pirate.
„ XIV Fortunes of Nigel.
„ XV Peveril of the Peak.
„ XVII St. Ronan's Well.
„ XVIII Redgauntlet.
„ XXIV Count Robert of Paris.
„ XXV Surgeon's daughter.
94. Journal and Correspondence of Wm. Lord Auckland with preface and introduction by the Bishop of Bath and Wells, 2 Vols. London, Richard Bently 1861 Vols. III and IV 1862.
95. A Memoir of Jane Austen by her nephew J. E. Austen Leigh. London, R. Bentley 1870.
96. Sir Samuel Baker, A memoir by T. Douglas Murray and A. Silva White. London, Macmillan and Co. 1895.
97. Verulamiana—by Francis Bacon to which is prefixed a life of the Author. London, Printed for Dutton, 45 Gracechurch St. etc. 1803.

98. The story of Lord Bacon's life by W. Hepworth Dixon. London, John Murray 1862.
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102. Beckett Archbishop of Canterbury, A Biography by James Craigie Robertson. London, J. Murray 1859.
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104. The life and times of St. Bernard 1091-1153 by James Cotter Morrison. London, Chapman and Hall, 193 Piccadilly, 1863.
105. Extracts of the Journals and Correspondence of Miss Berry 1783-1852 Edited by Lady Theresa Lewis. 3 Vols. London, Longmans, Green & Co., 1865.
106. Lives of the most eminent Literary and Scientific men of Great Britain. Dramatists Vols. 1 and 2. London, Printed for Longman, Orme, Brown Green and Longmans 1837 and 1838.
107. Robert Blake, Admiral General at Sea by Hepworth Dixon London, Chapman and Hall 1852.
108. Bismark. Some secret pages of his History by Dr. Moritz Busch. 3 Vols. London, Macmillan & Co. 1898.
109. Bismark by Dr. Moritz Busch. Condensed Edtn. 1 Vol. 1899.
110. The Real Lord Byron. New Views of the Poet's Life by J. C. Jeffre-son. 2 Vols. London, Hurst and Blackett 1883.
111. Correspondence of the Right Hon'ble Edmund Burke 1744—1797. Edtd. by Chas. William Earl Fitzwillian and Lt. Genl. Sir Richard Bourke. 4 Vols. London, Francis and John Rivington 1844.
112. The Tragedy of the Caesars etc. by S. Baring Gould. 2 Vols. London, Methuen & Co. 1892.
113. A short account of the Lives of the Bishops of Calcutta by W. Crawford Bromhead. Calcutta, W. Newman & Co. 1876.
114. The life of Carmen Sylvia. Translated from the German by Baroness Deichmann. London, Kegan, Paul, Trench & Co. 1890.
115. The life and times of Carey, Marshman and Ward by John Clarke Marshman. 2 Vols. London, Longman, Brown, Green, Long-

The Life of the Rt. Hon. George Canning by Robert Bell. London, Chapman and Hall, 186 Strand 1846.

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The Life of M. Tullius Cicero by Conyers Middleton, New Edition Revised. London, Printed for Longman, Orme and Co. etc. 1837.

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138. The Merrie Days of England. Sketches of the Olden time by Edward Mc. Dermott. London, Wm. Kent and Co. 1859.
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142. Studies in Contemporary Superstition by W. H. Mallock. London, Ward and Downing Ltd., 1895.
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146. The Map of Life, Conduct and Character by Wm. Ed. Hartpole Lecky. London, Longmans Green 1899
147. History of European Morals from Augustus to Charlemagne by Wm. Ed. Hartpole Lecky, 2 Vols. London, Longmans Green. 1869.
148. A fly on the wheel or how I helped to govern India by Lt.-Col. Thomas H. Lewin. London, W. H. Allen & Co. 1885.
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151. *Dissertations and Discussions Political Philosophical and Historical.* Reprinted chiefly from the *Edinburgh and Westminster Reviews* by John Stuart Mill. 2 Vols. London, John W. Parker & Sons, 1859.
152. *From Wisdom Court* by Henry Seton Merriman and Stephen G. Tattentyre 30 Illustrations. London, Wm. Heinemann 1893.
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169. *France: Social Literary Political* by Henry Lytton Bulwer. 2 Vols. London, Richard Bentley 1834.
170. *A Diary of Two Parliaments* by Henry H. Lucy. Gladstone Part. 1880-1885. Cassel & Co. Ltd. London, 1886.
A Diary of Two Parliaments by Henry H. Lucy. Disraeli Part 1874-1880. Cassel & Co., Ltd. 1885.
71. *The Works of Montaigne*. Edited by W. Hazlitt, 2nd Edtn. London, C. Templeman, 6 Great Portland St. 1845.
172. *Japanese Homes and their Surroundings* by Ed. S. Morse, London. London, Sampson Low Marston Searle & Rivington 1886.
173. *Ranke's History of the Popes* by Thomas Babbington Macaulay. London, Longmans Brown Green and Longmans 1851.
174. *Speeches on Parliamentary Reforms in 1831-32* by the Right Hon. T. B. Macaulay, corrected by himself. London, Longmans Brown Green and Longmans 1854.
175. *Speeches of the Right Hon. T. B. Macaulay* Corrected by himself. London, Longmans Brown Green and Longmans 1854.
176. *Critical and Historical Essays* contributed to the *Edinburgh Review* by T. B. Macaulay. 4th Edtn. 3 Vols. London, Longmans Brown Green and Longmans, 1846.
177. *Critical Miscellaneous* by John Morley Vol. III. London, Macmillan & Co. 1886.
178. *On Compromise* by John Morley. London, Macmillan & Co. 1886.
179. *The Miscellaneous Writings of Lord Macaulay* in 2 Volumes. London, Longman Green Longman Roberts 1860.
180. *Scenes or Camp life on the Satpura Range etc.* by Robert Armitage Sterndale. 2nd Edition. London, Sampson Low, Marston, Searle and Rivington 1877.
181. *A history of the Literature of Ancient Greece* by K. O. Müller continued by John Wm. Donaldson, 3 Vols. London, John W. Parker & Son, West Strand 1858.
182. *The six systems of Indian Philosophy* by Right Hon. F. Max. Müller. Longmans Green & Co. 1899.
183. *21 days in India being the Tour of Sir Ali Baba, K. C. B.* by George Aberigh Mackay 1th edtn. London, W. H. Allen & Co. 1886.

184. *Serious reflections and other contributions by the late G. A. Mackay* Bombay, Bombay Gazette Steam Press, 1881.
185. *The Marvellous Adventures and Rare Conceits of Master Tull Owlglass etc.* by Kenneth R. H. Mackenzie and adorned with diverting and cunning devices by Sir Alfred Crowquill. London, Trubner & Co. 1860.
186. *Ambushes and Surprises etc.* by Col. G. R. Malleson. London, W. H. Allen & Co, Publishers to India Office 1885.
187. *Gujarat and the Gujaratis* by Behramji M. Malabari. London, W. H. Allen & Co. 1882.
188. *The Miscellaneous Works of the Rt. Hon. Sir James Mackintosh. I* Vol. 2nd Edtn. Longman, Brown, Green and Longmans 1851.
189. *The Orientalist or Letters of a Rabi with notes* by James Noble. Edinburgh, Oliver and Boyd, 1831.
190. *The Conduct of Life etc.* by Ralph Waldo Emerson. London, Geo. Bell and Son, 1901.
191. *Essays and leaves from a note book* by George Eliot, 2nd Edition, Wm. Blackwood & Sons, Edinburgh and London 1884.
192. *Concerning John's Indian affairs* by Robert H. Elliot. London, Chapman and Hall 1872.
193. *England and its people, polity and pursuits* by T. H. S. Escott. New and revd. Edition. 5th thousand. London, Chapman and Hall, 1885.
194. *A Political Diary 1828-1830* by Edward Law, Lord Ellenborough. Ed. by Lord Colchester. 2 Vols. London, Richard Bentley & Son 1881.
195. *The Constitutional History of England* by Henry Hallam. 3 Vols. 10th Edtn. London, John Murray. No date.
196. *Introduction to the Literature of Europe in 15th 16th 17th centuries* by Henry Hallam, 4 Vols. 6th Edtn. London, John Murray, 1875.
197. *Pompeii, its history, buildings and antiquities etc.* Edited by Thos. H. Dyer. A New edition, revised and enlarged. London, Geo. Bell and Sons 1876. Bohn's illustrated Library.
198. *Hunting in the Himalayas etc.* by R. H. W. Dunlop. Illustrated by J. Wolf. London, Richard Bentley 1860.
199. *Speeches in parliament and some miscellaneous pamphlets* by the late Henry Drummond. Edtd. Lord Loraine, 2 Vols. London, Bosworth and Harrison. 1860.
200. *Notes from Nineveh and travels in Mesopotamia, Assyria and Syria* by Rev. J. P. Fletcher. 2 Vols. London, Henry Colburn. 1850.
201. *Glimpses through the Cannon smoke, a series of sketches* by Archibald Forbes. London, George Routledge and Sons. 1880.
202. *Views of Nature or Contemplations on the Sublime Phenomena of Nature* by Alexander Von Humboldt, Transd. from the German by E. C. Otte and Henry G. Bohn. London, Henry G. Bohn. 1850.

203. Henry Irving's Impressions of America etc. by Joseph Hatton. 2 Vols. London, Sampson Low, Marston, Searle and Rivington 1884.
204. The Intellectual life by Philip Gilbert Hamerton. London, Macmillan and Co. 1873.
205. Human Intercourse by Philip Gilbert Hamerton, London, Macmillan's Colonial Library, 1887.
206. View of the State of Europe during the Middle ages. Henry Hallam. 3 Vols. 12th Edtn. London, John Murray 1860.
207. Caesar, a sketch by J. A. Froude, New Edtn. London, Longmans Green 1894.
208. Orissa by W. W. Hunter Vols. 1 and 2. London, Smith Elder & Co. 1872.
209. The Annals of Rural Bengal by W. W. Hunter. London, Smith Elder and Co. 1868.
210. The Annals of Rural Bengal 4th Edtn. 1871.
211. Life and Letters of Erasmus by J. A. Froude, New Edtn. London, Longmans Green 1894.
212. Life and Letters of Erasmus by J. A. Froude, New Edtn. 1895. London, Longmans Green.
213. The Methods of Historical Study, Eight lectures in University of Oxford, 1884. Ed. A. Freeman. London, Macmillan and Co. 1886.
214. Short Studies in Great Subjects by J. A. Froude, New Edtn. in 2 Vols. London, Longmans Green 1876.
215. Voyages and Discoveries of the Companions of Columbus. Washington Irving. Philadelphia, Carey Lea and Blanchard, 1835.
216. London and its Celebrities, A 2nd series of Literary and Historical Memorials of London by J. Heneage Jesse, 2 Vols. London, Richard Bentley 1850.
217. Literary and Historical Memorials of London by J. Heneage Jesse. 2 Vols. London, Richard Bentley, 1847.
218. The Works of Samuel Johnson, LL. D. A New Edition in 12 Vols. London, Printed for E. Blackader, Took's Court, Chancery Lane 1808.
219. Half Hours with the Best Authors by Charles Knight. 4 Vols. London, Charles Knight. No date.
220. Up the Country etc. by The Hon. Emily Eden. 2 Vols. London, Richard Bentley, 1866.
221. Letters from India by the Hon. Emily Eden, Edited by her Niece. 2 Vols. London, Richard Bentley, 1872.

222. *Life of Monseigneur Dupanloup, Bishop of Orleans*, by Abbe F. Lagrange, Translated by Lady Herbert. 2 Vols. London, Chapman and Hall, 1885.
223. *Memoirs of Don Manuel de Godoy, Prince of the Peace*, Written by himself, Edtd. by Lt. Col. J. B. D'Esmenard, with an introduction, 2 Vols. London, Richard Bentley 1836.
224. *General Gorden's Letters from the Crimea, Danube and Armenia*, Aug, 18/54—Nov. 17/58. Edtd. by Demetrius G. Boulger. London. Chapman and Hall 1884.
225. *Charles George Gordon* by Col. Sir Wm. F. Butler. London, Macmillan and Co. 1889.
226. *Letters and Journals of Field Marshall Sir Wm. Maynard Gomm 1799—1815*. Edited by Francis Culling Carr Gomm. London, John Murray 1881.
227. *Goldsmith* by Wm. Black. London, Macmillan and Co. 1878. Englishmen of letters Series.
228. *The Story of Goethe's Life* by Geogre Henry Lewes (abridged from the life and works of Goethe). London, Smith Elder and Co. 1878.
229. *The Life and Works of Goethe etc.* by George Henry Lewes. 2 Vols. London, David Nutt, 270 Strand. 1855.
230. *Memoirs of the Court of England from the Revolution in 1688 to the death of George II* by John Heneage Jesse, 3 Vols. London, Richard Bentley. 1843.
231. *Life of Lord Jeffrey* by Lord Cockburn, 2 Vols. Edinburgh Adam and Charles Black. 1852.
232. *Events in the life of Charles George Gordon from its beginning to its end* by Henny Wm. Gordon. London, Kegan Paul, Trench and Co. 1886.
233. *Stonewall Jackson and the American Civil War* by Lt. Col. G. P. H. Henderson with introduction by F. M. Right Hon. Viscount Wolseley. 2 Vols. New Impression. London, Longman Green and Co. 1900.
234. *Lives of Indian Officers illustrative of the History of the Civil and Military Services of India* by John Wm. Kaye. 2 Vols. London, A. Strahan and Co. 1867.
235. *The Life of Richard Earl Howe* by Sir John Barrow, F R. S. London, John Murray 1838.
236. *Reminiscences of Michael Kelly of Kings Theatre etc.*, 2 Vols. London, Henry Colburn, New Burlington St. 1826.
237. *Autobiographical Recollections* by the late Chas. Rob. Leslie. Edited by Tom Taylor, 2 Vols. London, John Murray 1860.
238. *50 years Biographical Reminiscences*. by Lord Wm. Pitt Lennox. 2 Vols. London, Hurst and Blackett 1863.

239. *The Life of Edmund Kean* by F. W. Hawkins, 2 Vols. London, Tinsley Bros. 1869.
240. *The School for Fathers or Lionel and Clarissa* by Isaac Bickerstaff. London, printed for the proprietors under the direction of John Bell, 1791. Bell's British Theatre No. 9.
241. *The works of Wm. Cowper etc. with a life of the author* by the Editor, Robert Southey. London, Baldwin and Craddock, 1835.
242. *The History of English Dramatic Poetry to the time of Shakspeare and annals of the Stage to the Restoration* by J. Payne Collier, London, John Murray 1831.
243. *The Canterbury Tales of Chaucer etc.* by Thomas Tyrwhitt with Memoranda and Critical Dissertation by Rev. Geo. Gilfillan. 3 Vols. Edinburgh, James Nichol 1860.
244. *Works of Lord Byron with his letters etc.* by Thomas Moore in 14 Vols. London, John Murray 1832.
245. *The Natural History of Selbourne etc.* by the Late Rev. Gilbert White with additions and supplementary notes by Sir Wm. Jardine. Edited by Edward Jesse. London, Henry G. Bohn 1854.
246. *Fragments of Science etc.* by John Tyndall, 6th Edition, 2 Vols. London, Longmans Green 1879.
247. *A View of the Formation, Discipline and Economy of Armies* by the late Robert Jackson, M. D. 3rd edition revised with Memoirs of his life, London. Parker, Turnwal and Parker, Military Library Whitehall 1845.
248. *The Birds of India being a Natural History of all the Birds known to inhabit Continental India etc.*, by T. C. Jerdon Surgeon Major Madras Army. Calcutta for the Author by the Military Orphan Press, 6, Bankshall Street. Vol. I, 1862, Vol. II part 1 1863 Vol. III 1864. Vol. III is published by Geol. Wyman & Co., Calcutta.
249. *The Butterflies of India, Burma and Ceylon etc.* by Major G. F. L. Marshall, Royal Engineers and Lionel de Niceville Calcutta. Printed and published by the Calcutta Central Press Co., Ltd., 6, Council House Street. Vol. I, 1882. Vol. II, 1886 by Lionel de Niceville. Vol. III 1890 by Lionel de Niceville.
250. *Flora of British India* by J. D. Hooker, Vol. I. London L Reeve & Co., 5, Henrietta Street, Covent Garden 1875. Vol. II, 1879. Vol. III, 1882. Vol. IV, 1885. Vol. V, 1890.
251. *Flora Indica or Description of Indian Plants*—by the late Wm. Roxburgh, Printed from Carey's edition of 1832. Calcutta, Thacker Spink & Co. 1874.
252. *Flora Simlensis* by the late Col. Sir Henry Collett, K. C. B. with an introduction by W. Booting Hemsley, F. R. S. Calcutta and Simla, Thacker Spink & Co., 1902.
253. *Handbook of the Ferns of British India, Ceylon and the Malay Peninsula* by Col. R. H. Beddome. Calcutta, Thacker Spink & Co., 1885.

254. *The Large and Small Game of Bengal and the N. W. Provinces of India* by Captn. J. H. Baldwin. 2nd edition. London, Kegan Paul, Trench & Co., 1 Paternoster Row. 1883.
255. *Natural History of the Mammalia of India and Ceylon* by Robert A. Sterndale. Calcutta, Thacker Spink & Co., 1884.
256. *The Timber trees, Timber woods as also the Forests of India and Eastern and Southern Asia* by Edward Balfour, Surgeon Major Madras Army. 2nd Edtn. Madras, Printed at the Union Press by Cookson & Co., 1862.
257. *Celebrities of the Century* by Lloyd C. Sanders. Cassell & Co. Ltd., London, Paris, New York and Melbourne 1887.
258. *The Fodder grasses of N. India* by J. H. Duthie. Roorkee, Printed at the Thomason C. E. College Press. 1888.
259. *The Cyclopaedia of Home Arts*. Edtd. and Compiled by Montague Marks. London C. Arthur Pearson Ltd. 1899.
260. *Cyclopaedia of English Litearture* Edtd. by Robert Chambers. Two Vols. Edinburgh, Published by Wm. and Robt. Chambers 1844.
261. *The British Encyclopedia or Dictionary of Arts and Science* by Wm. Nicholson Vols. I—VI, 1809. Printed by C. Whittingham, Goswell St. for Longman, Hurst Rees and Orme, Paternoster Row.
262. *A Dictionary, Geographical Statistical and Historical etc.* by J. R. McCulloch. A new and improved edition with a supplement, in 2 Vols. London, Longman, Brown, Green and Longmans 1842.
263. *Classical Foreign Quotations etc.* by Wm. Francis Henry King M. A., Oxford. London Whitaker and Sons. 12 Warwick Lane, Paternoster Row 1887.
264. *A new Greek and English Lexicon* by James Donnegan, M. D. 4th Edtn. London Printed for the Author. Sold by Simkin, Marshall and Co. Stationers Hall Court. 1842.
265. *An Abridgement of Ainsworth's Latin Dictionary* by Thomas Morell D. D. Stereotype Edtn. Carefully revised and corrected from the best authors by James Ross, LL.D. London, Cowie Jolland Etc. 1844.
266. *A Dictionary of the English Language* by Robert Gordon Latham. London, Longmans Green and Co. 1866.
267. *Hobson - Jobson. A Glossary of Anglo Indian Words and Phrases etc.* by Col. Henry Yule and the late Arthur Coke Burnell. London, John Murray. 1886.
268. *A select Glossary of English Words etc.* by Richard Chenevix Trench D. D. 2nd Edtn Revised and improved. London, John W. Parker and Son. 1859.
269. *A manual of gardening for India* by Firmingen, 2nd Edtn. 1869.
270. *The Indian Amateur Gardener etc.*, by Landolcius. Calcutta, W Newman and Co., 3 Dalhousie Sq. 1881.

Of these 270 works comprising 555 Volumes, the following were in a perishing or even brittle condition. 15, 19, 28, 33, 34, 35, 36, 37, 40, 57, 70, 93 (2 only), 95, 109, 121, 129, 132, 138, 143, 148, 162 (advertisement only), 167 (1 Vol. only), 172, 183, 186, 192, 198, 221, 222, 234, 239, 247, 248, 249 (1 Vol. only), 250 (2 Vols.), 251, 270., making a total of 50 volumes or 9 per cent.

In the Library of the Madras Literary Society the following works corresponding with those in the Simla Library were found and examined * 3, 4, 5, 6, 8, 9, 10, 12, 16, 17, 18, 21, 23, 26, 31, 32, 33, 34, 38, 49, 51, 53, 55, 59, 64, 65, 66, 67, 68, 69, 70, 71, 72, 83, 85, 88, 89, 93, (9 Vols.) 94, 98, 107, 108, 110, 115, 116, 117, 119, 122, 125, 126, 134, 135, 136, 140, 141, 144, 146, 147, 148, 164, 167, 168, 170, (1 Vol.) 175, 179, 180, 182, 191, 198, 200, 203, 208, 209, 212, 213, 217, 220, 223, 225, 226, 227, 230, 231, 232, 234, 235, 237, 247, 248, 250, 256.

These works include 165 volumes and only those in italics viz., 24 volumes were in a sound condition, the remainder being more or less perished viz., 122 volumes.

In the Adyar Library Madras the following were found and examined 5, 21, 136, 145, 202, 208, 210, 251, 260. Of 14 volumes 11 showed distinct perishing.

In the Connemara Library, Madras the following were examined 3, 9, 115, 117, 126, 134, 135, 182, 197, 208, 209, 249, 251, 252, 253, 255, and 258. A total of 27 volumes of which 13 were distinctly perished.

Thus in the Three Madras Libraries 206 volumes were examined of which 146 or 71 per cent. were distinctly perished.

In the Nilgiri Library Ootacamund the following were examined 2, 3, 7, 11, 31, 32, 40, 60, 64, 66, 67, 70, 71, 74, 75, 96, 108, 115, 117, 119, 120, 126, 131, 135, 147, 148, 151, 153, 179, 180, 191, 193, 208, 211, 220, 221, 234, 238, 248, 255, 267, 268. The total number of volumes was 60 and of these only 12 were distinctly perished.

In the Bombay branch of the Royal Asiatic Society's Library we examined the following :—

1, 3, 5, 6, 8, 9, 10, 12, 16, 18, 19, 21, 23, 24, 26, 27, 31, 33, 51, 58, 64, 66, 74, 75, 89, 95, 96, 102, 105, 106, 107, 108, 110, 112, 115, 116, 118, 119, 120, 130, 137, 140, 146, 148, 154, 155, 161, 162, 164, 166, 170, 175, 178, 179, 180, 181, 187, 191, 193, 194, 197, 198, 204, 208, 209, 217, 220, 221, 223, 224, 225, 226, 229, 230, 232, 235, 237, 238, 242, 246, 248, 249, 250, 253, 255, 265, 269. Of the 145 volumes examined 96 were more or less seriously perished.

In the Native General Library Bombay, the following were found. 3, 4, 9, 18, 19, 23, 29, 30, 31, 33, 69, 70, 72, 75, 89, 95, 99, 108, 110, 115, 116, 118, 119, 126, 130, 135, 136, 143, 151, 155, 164, 168, 180, 181, 188, 208, 209, 213, 229, 234, 250, 267. Of the 69 volumes 45 were distinctly perished or brittle.

* All numbers in italics indicate sound or only very slightly perished copies.

** Only 10 volumes in the Library 9 were badly perished, one only viz., Vol. XIII was sound, and this was stated to have been added recently to replace a copy completely perished.

In the Imperial Library Calcutta Mr. Van Manen found and examined the following. 3, 4, 5, 6, 7, 9, 10, 12, 15, 19, 20, 21, 23, 24, 26, 31, 32, 40, 42, 74, 99, 107, 108, 110, 111, 116, 117, 118, 119, 120, 121, 130, 131, 134, 135, 137, 141, 144, 145, 146, 148, 150, 151, 164, 165, 166, 168, 170, 181, 184, 186, 189, 191, 193, 194, 198, 200, 201, 203, 208, 213, 216, 217, 220, 221, 223, 224, 226, 229, 232, 235, 237, 238, 246, 248, 249 (2 vols.), 250, 252, 255, 256, 257, 258, 267, 268, 270. Of the 140 volumes examined 100 were distinctly perished.

In the Municipal Frere Hall Library, Karachi (founded in 1852 the following were examined:—1, 5, 6, 7, 9, 23, 26, 32, 33, 68 (5 sound), 69, 72, 73, 108, 112, 117, 118, 122, 131, 134, 135, 143, 164, 182, 187, 196, 203, 212, 231, 234, 269. Out of a total of 60 volumes examined 33 were distinctly perished or brittle and 27 sound or only slightly perished.

In the European General Library, Hyderabad (Sind), which was founded in 1871, the following were found:—5, 36, 40, 50, 54, 69, 83, 93, 95, 117, 120, 122, 183, 192, 202, 208, 219, 231, 234, 255, 261. Of the 38 volumes examined 36 were distinctly perished or brittle and only 2 slightly perished.

In the General Library Sukkur, (Sind), founded in 1870, the following were found:—4, 7, 40, 74, 75, 256, a total of 7 volumes all of which were distinctly perished or brittle, and a general examination of books in this Library indicated that the condition of the paper was as bad as in the Hyderabad (Sind) library.

The Sandeman Library Quetta, founded in 1886. An examination of 400 volumes in one case reserved for History and Biography showed 300 in a sound condition, and 100 slightly perished and none badly perished or brittle. Most of those slightly perished were stamped 1914 and had presumably been only a few years in Quetta.

In the whole library two badly perished volumes were found *viz.* The ancient geography of India by Alexander Cunningham, London, 1871, and Narrative of the campaign of the army of the Indus in Sind and Kaubool by R. Hartley Kennedy, Vol II. London 1840, and the dates when these were acquired by the Library were not known.

In all these cases only those volumes which showed distinct perishing, for example the paper broke when folded twice and a moderate or slight pull was applied, were regarded as perished. All which did not break or broke after a severe pull were grouped as sound although slight perishing might have occurred.

APPENDIX II.

Books in the R. A. Mess Library Meerut, the paper of which is in Excellent Condition.

1. Scheuchzer's tr. of Kaempfer's Japan. 2 Vols. London, 1727.
2. Vertot. Hist of the Knights of Malta. London, 1728.
3. John Millner. A compendious Journal [of Marlborough's Campaigns] London, 1733.
4. "Relation of the Battle of Maxen." London, 1785.
5. M. de Folard. Life of Scipio Africanus. [R. Parry's tr.] 2 Vols. London, 1787.
6. R. Percival. An Account of Ceylon, London, 1803.
7. Labaume. A circumstantial narrative of the Camp in Russia. (Tr.) London, 1815.
8. W. James. An inquiry into the principal naval actions between Gt. Britain and U. S., Halifax, 1816.
9. Raffles. History of Java, 2 Vols. London, 1817.
10. "Philalethes." History of Ceylon. [With Knox's "Relation"], London, 1817.
11. R. A. Mc. Naghten. A Memoir of the Military operations of the Nagpore Subsidiary Force, Calcutta, 1820.
12. Batty. Camp in the western Pyrenees. London, 1823.
13. Memoirs of the Hist. of France during the reign of Napoleon. London, 1823.
14. Sir Samuel Romilly's Speeches: London, 1820.
15. Sir Walter Scott. Memoirs of Jonathan Swift. Paris, 1826.
16. E. Osler. Life of Admiral Viscount Exmouth, London, 1835.
17. H. B. Robinson. Memoirs of Sir Thomas Picton. London, 1835.
18. Sir Samuel Romilly's Memoirs, London, 1840.
19. "Memoirs of Mirabeau". London, 1835.
20. William Thorn, Memoirs of the Conquest of Java, London 1815, Plates perished.
21. C. Steadman. The History of the American War. 2 Vols. London, 1794. Plates perished.
22. R. T. Wilson. History of the British Expedition to Egypt, London 1882. One plate perished.
23. Sir R. Wilson. Brief remarks on the character and composition of the Russian Army. London 1810. Plates perished.

APPENDIX III.

List of English Books examined in the Tanjore Maharaja
Serfoji's Sarasvathi Mahal Library.

1. Asiatic Researches or Transactions of the Society Instituted in Bengal for Inquiring into the History.....and Literature of Asia. London 1801. Printed by J. Swan & Co., Jerusalem Court, Gracechurch Street. 2 Vols. Sound except a few pages.
2. Memoirs of the operation of British Army in India by L. Col. Blaker. London, 1821 Printed for Black, Kingsbury, Parbury & Allen Leadenhall Street. (In Tanjore since 1830).
3. The History of Scotland from the earliest accounts of that nation to the reign of King James VI translated from the Latin of George Buchanan in two volumes—Seventh Edition, by Mr. Bond Glasgow. Printed by Chapman and Lang 1799 (In Tanjore since 1818).
4. History of the British expedition to Egypt by Sir R. W. Wilson, London, Printed by C. Roworth, Bell Yard, Fleet Street, 1802, (Tanjore 1827) Sound except maps.
5. History of Calcutta Institutions by Charles Lushington. Calcutta, Printed at the Hindustani Press 1824 (Tanjore 1829) Sound except plates.
6. History of the Reign of the Emperor Charles the Fifth by W. Robertson. Vol. I. London, Published by S. A. and H. Oddy, 1809 (Tanjore 1827).
7. History of England from the earliest times to the Death of George the Second by Oliver Goldsmith, Twelfth Edition in 4 volumes Vol. I & II. London 1815 (Tanjore 1820). Sound except title page.
8. A Chronicle of the conquest of Granada by Washington Irving in two vols. London 1829, John Murray, Albemarle Street (Tanjore 1830).
9. Letters on India by Lieut Col. Taylor. London, Printed by S. Hamilton, Falcon Court, Fleet Street 1800.
10. Sketch of Political History of India by John Malcolm. London, printed by James Moyes, Greville Street, Hatton Garden, 1811 (Tanjore 1827).
11. Notes relative to the Late Transactions in the Maharatta Empire—Fort William December 15—1803, (Tanjore 1827).
12. Part third of Appendix to the notes on the late Transactions of the Maharatta Empire containing copies and extracts and official documents relating to the Military operations against Jeswant Rao Holkar. Fort William 1805 (Tanjore 1827) :—

13. History of the reign of the Emperor Charles V by William Robertson, Second Edition, Vol. II, London, Printed at Edinburgh 1772 (Tanjore 1830).
14. Historical sketches of the South of India by Lieut. Col. Wilks. Vol. I. London, Paternoster Row 1820.
15. Transactions of the Royal Asiatic Society Great Britain and Ireland. Vol. I, Part I, London, Printed by Cox and Baylis, 1824 (Tanjore 1829).
16. The History of England, In two volumes by William Robertson, The fourteenth edition, London, 1794, Printed for T. Cadell (Tanjore 1827).
17. Canada or a View of the Importance of the British American Colonies by David Anderson. London, Printed for T. M. Richardson, 23 Cornhill, 1814, (Tanjore 1827).
18. Plutarch's Lives by Longhorne, Sixth Edition, Vol. VI. London 1795, (Tanjore 1818) S.
19. The history of the reign of Emperor Charles V by William Robertson D. D. in four volumes—Edinburgh, Printed by Alex Lawrie & Co., 1813 (Tanjore 1830), Vols. II and III.
20. The History of the reign of Emperor Charles V by W. Robertson, in four volumes, Glasgow, Printed by and for Chapman and Lang 1800 (Tanjore 1827), Vol. I, II, III, IV.
21. History of Scotland by William Robertson in three volumes Glasgow—printed by Chapman and Lang 1800 :—Vols. I, II, III.
22. History of the Thirty Years War in Germany translated by Captain Blaquiére from German, in two volumes, Printed by S. Goswell, Little Queen Street, Holborn, London, 1799 (Tanjore 1827).
23. Experimental History of the Materia Medica by William Lewis, Second edition. London, Ludgate Street, 1768, (Tanjore 1827).
24. Journal of a residence in India by Maria Graham—Edinburgh, Printed by George Ramsay & Co., London 1812, (Tanjore 1827).
25. Lives of the Roman Poets by Crusius. The Third Edition 1753—Vols. I, II.
26. Scarronides or Virgil Travestie by Charles Cotton; the 13th Edition London, Printed by J. Galton, Little Eastcheap :—1804, S.
27. Lectures on Rhetoric and Belles Letters by Hugh Blair, in two volumes, London 1783.
28. Bolingbroke's Political Tracts (Tanjore since 1827).
29. The British magazine—Vol. II, July 1800, (Tanjore 1827).
30. Family Lectures. A Collection of Sermons, in one volume—London 1815 (Tanjore 1820).

31. *The British Cicero* by Thomas Browne. In three volumes. Vol. I, London 1808 (Tanjore 1827) S.
32. *Friendship's Offering—A Literary Album* published by Smith Elder and Co., No. 65 Cornhill, 1828 (Tanjore 1829) S.
33. *The Edinburgh Review or Critical Journal* for September to December 1828 Vol. 48. Edinburgh, printed by Ballantyne & Co., 1828, S.
34. *The Edinburgh Review* for July—October 1819 Vol. 32. Edinburgh Printed by David Wilson London 1819.
35. *The History of Myself and my Friend*. A novel by Anne Plumptre. In 4 Vols. London, 1813, Vols. I. II. S.
36. *Pride and Prejudice*. A novel in two vols by Jane Austin Vol. I, Third Edition, London, Printed for T. Egerton, 1817, (Tanjore 1827). S.
37. *Waverly or The sixty years since—Fourth edition*, 3 vols. Edinburgh, printed by James Ballentyne & Co., London.
38. *Travels* by R. Bakewell. In two vols. London, 1823, S.
39. *Tour through Sicily and Malta in a series of Letters* from P. Brydone in two Vols. A new edition, Vol. I. Perth, Printed by & for R. Morison James 1799 (Tanjore 1827).
40. *The miscellaneous works of Henry Mackenzie*. In three vols. Leith—Printed by and for A Allardice 1815 (Tanjore 1824) Vols. II and III.
41. *Essays of Phsyiognomy* translated by T. Holcroft from German. Vol. I. London 1789. Only plates sound.
42. *The Asiatic Journal and Monthly Register for British India and its Dependencies* Vols. I—V from January 1816 to December 1818, Vols. I—III Sound. (Tanjore 1819).
43. *Journal of the Sieges of the Madras Army in the years 1817, 1818, 1819* by Edward Lake. London, published by Kingsbury, Parbury and Allen, Leadenhall Street, 1825.
44. *A List of the Officers of the Army—Fort St. George*. Printed at the Government Press 25th March 1812. (Tanjore 1812).
45. *Army list October 1813* (Tanjore 1813) Printed at the Government Press.
46. *Army List 1st April 1815* (Tanjore, 1815) S.
47. *Army list 1st April 1817* (Tanjore 1817).
48. *Army list 1st August 1819* (Tanjore 1819).
49. *Observations on the Causes and Progress of the Disturbances in the Madras Army, Part I*. J. Moyes. Printer, Greville Street, Hatton Garden, London. (Tanjore 1832) S.

50. Sermons by Hugh Blair—A new edition, in five volumes, Vol. III London, 1810 (Tanjore 1830).
51. The History of the Decline and Fall of the Roman Empire by Gibbon. Vol. I, A new edition, London 1782; Vol. II, London 1787; Vol. III, 1787; Vol. V, 1787; Vol. VI, 1788.
52. History of Mexico by Charles Cullen. In two vols. Vol. II. London, No. 25, Paternoster Row 1787.
53. Supplement to the Geneological History of the Stewarts by Andrew Stuart. London, 1799. S.
54. Plays of William Shakespeare in ten vols. London 1811 Vols. I, II, III, IV, V, VI, VIII, and IX.
55. Life of Samuel Johnson by James Boswell. A new edition in five volumes, London 1821. Printed by Thomas Daveson Whitefriars.
56. The Life of Samuel Johnson by James Boswell. Fifth edition in four volumes, 1807, C. and R. Baldwin Printers, New Bridge Street, London. S.
57. Life of Samuel Johnson by John Hawkins. Second Edition, 1787.
58. The Works of Adam Smith by Dugald Stewart. In five Vols. London. Strahan and Preston, Printers Street (only Vol. III, S.)
59. Portraits of Illustrious Personages of Great Britain by Edmund Lodge. Vols. I-IX. 1823—1829. All .
60. Julius Caesar, a Tragedy, London, Printed by R. Walker at Shakespeare's Head in Turn-again Lane, by the Ditch side, 1734, S.
61. The works of Shakespeare, Volume the second, Edinburgh, Printed by A. Donaldson 1771.
62. Works of Francis Bacon in ten volumes by C. and R. Baldwin, New Bridge Street, London 1803 :— Vols. III—X.
63. Appendix to Lord Pigot's Arrest, 1766, Vol. II number XX.
64. Do Vol. III number XXVIII and No. XXX 1771.
65. Do Vol. I, 1777 (In Chittore since 1815, in Tanjore since 1827).
66. The History of Persia by Colonel Sir John Malcolm. In two Vols. Printed by James Moyes, Greville Street, 1815, Vols. I and II.
67. Plutarch's Lives in three Vols. London, Pemberton Row, Gough Square, Fleet Street 1813.
68. The Geographical and Historical Dictionary of America and West Indies by G. A. Thompson. In five volumes. London, Harding and Wright, Printers, St. John's Square :—Vol. III 1812, Vol. IV 1814, Vol. V 1815.
69. Asiatic Researches or Transactions of the Society Instituted in Bengal, Vol. III, London Printed by J. Swan and Co., Jerusalem

Court, Graecchurch Street London 1801; Vol. IV, London, Printed by G. Auld Greville Street 1801; Vol. V. Printed by T. Maiden, Sherbourn Lane, Lombard Street; Vol. VI. Printed by Buncy and Gold, Shoe lane 1801; Vol. VII, Printed by T. Maiden, Sherbourn Lane 1807; Vol. VIII, London at the Union Printing Office St. John's Square by W. Wilson 1808; Vol. XI Printed verbatim from the Calcutta Edition, London 1812 by W. Wilson 4, Greville Street, Hatton Garden and T. Maiden, Sherbourn Lane, Lombard Street, London; Vol. XII London, John Murray, Albermale Street, 1818. Vols. IV, V, VIII and XII. S.

70. The Edinburgh Magazine or Literary Miscellany, 1785.
71. Conversations of Lord Byron at Pisa by Thomas Meduri. Second edition. London, Printed by S. and R. Bentley, Dorset Street, 1824.

This list comprises 144 volumes and of these 40 are in a sound condition or show only trace of perishing, the remaining 104 are distinctly or completely perished. The volumes which are sound are denoted by the letter. S.

APPENDIX No. IV.

Report on Old Books in the Madras Literary Society's Library
from 1554—1770.

1. The Dictionary Historical and Critical of Mr. Peter Sayle, the Second Edition. Vol. I London, 1734. S
2. Dem. Cantemir. The History of the Growth and Decay of the Ottoman Empire. Translated, by U. Tindal, London, 1756. S
3. "Things Divine and Supernatural" London, 1733. S
4. "A New General Collection of Voyages and Travels." Vol. I London, 1645. S
5. F. Baconi Scripta in Naturali et Uuiversali Philosophia. Amstlodami, 1653. S
6. Catalogus Plantarum circa Cantabrigiam. 1660. S
7. Notitia Orbis Antiqui. C. Cellarius Collegit Cantabrigiae. 1703. S
8. Edin. Castello. Lexicon Heptaglotton. Londini, 1669. S
9. Dom. Beshovra. The life of St. Ignatius. London, 1686. S
10. Boileau. Oeuvres. La Haye, 1722. S.
11. Aristotelis Opera Omnia quae extant. Tome I. Lutetiae Parisiorum, 1619. Mostly Sound.
12. Joseph Baretti. A Journey from London to Genoa. Vol. I London, 1770. Part brittle. Some strong.
13. W. Burkitt. Expository Notes on the new Testament 15th ed. London, 1760. Edges brittle.
14. Dictionnaire Universel de Commerce. Tome I, Paris, 1723. Edges brittle.
15. Memoires de Condé, Tome I, Londres, 1743. Edges brittle.
16. L. Chambaud. Dictionnaire Francois et Anglois. Londres, 1761. Part brittle.
17. Le Chou-King traduit par Le P. Gaubil...revu... par M. de Guignes. Paris, 1770. Mostly brittle.
18. J. Bryant. Observations and Inquiries relating to various parts of Ancient History. Cambridge, 1767. Mostly brittle
19. R. O. Cambridge. An Account of the War in India. London, 1762. Mostly brittle.
20. J. Bingham. Origines Ecclesiasticae Vol. II London, 1710. Brittle.
21. Novum Testamentum Syriacum . . . cura et studio J. Lensden et C. Schaaf editum. Lugduni Batavorum, 1708. Mostly brittle.

22. Tomus Tertius Operum M. Tullii Ciceronis. Lutetiae, 1554. Mostly brittle.
23. "Coke upon Littleton." London, 1684. Brittle.
24. Biblia Sacra Polyglotta ed. B. Waltonus. Vol. I. Londini, 1657. Part Sound and Part Brittle.
25. Abulfedace Tabula Syriae. Lipsiae, 1766. Brittle.
26. A Voyage Round the World by George Anson compiled by Richard Walter. 5th ed. London, 1749. Paper weak and plates brittle.
27. Sir, Richard Baker. A Chronicle of the Kings of England. London 1730. Perished and very brittle.
28. Basnage, Histoire des Juifs. Tome I. La Haye, 1716. Mostly brittle.
29. The Works of Mr. Abraham Cowley. Vol: I. London, 1710. do:
30. A collection of Poems in Six Volumes. By Several Hands. Vol. II. 5th. ed. London, 1758. Brittle.
31. An Historical and Political Discourse of the Laws of England collected from notes of Selden by U. Bacon. 5th. ed. London, 1760. Brittle.
32. Abbè Banier. The Mythology and Fables of the Ancients. Vol. I. London, 1739. Very brittle.
33. R. Cudworth. The True Intellectual System of the Universe; London 1743. Brittle.
34. J. Boswell, An Account of Corsica. London, 1769. Very brittle.
35. H. Boerhaave. Index Alter Plantarum. Lugduni Batavorum, 1720. Brittle.

The books were not selected examples of good and perished books, but were all the old books catalogued in pp. 1-117 of the *Library's Catalogue*. They may fairly be taken as representative of the condition of the whole Library so far as it consists of books of the same dates of publication.

APPENDIX V.

Table of Books with fibre, sizing material, condition and date.

No.	Date	Book	Fibre	Bosin	Gelatine	Condition
1	1690	400 year old paper (Rough hand made)	Cotton	Absent.	Excess	Excellent.
2	1635	Principles of Christian practice (8 years in Ban- galore, India.)	"	"	"	"
3	1704	Arrianni : cutting A, p. 103.	Flax with very little cotton.	"	Trace	Good.
4		Cutting B, p. 117.	"	"	"	Not so good as A.
5		Cutting C, p. 145.	"	"	Excess	Slightly perished.
6		Cutting D, end of the book.	"	"	"	More perished than C.
7	1719	Dewan Shamsh Works. Persian book No. 305.	Cotton with majority of flax	"	Trace	Very slightly perished.
8	1720	Commentarius in Jes- aiam, Vitringa p. 345-	Flax	"	Absent	Good.
9	1720	Persian Mss book.	Flax	"	Trace	Good.
10	1720	Dewan Shadi Works (Im- perial Library No. 311).	"	"	"	Good but yel- lowish.
11	1746	The doctrine of projec- tiles by W. Starraf. Dub- lin (a) Sample A, p. 53.	Flax with very little cotton	"	Absent	Good.
12		(b) Sample B, p. 157.	"	"	"	Slightly perished
13	1757	Old soft, not very coarse paper.	"	"	Excess	Good.
14	1772	Books of Virgil by Dry- den (In India for 8 years)	"	"	Present	Excellent.
15	1775	Sermons by A m o r y (Only 8 years in Banga- lore, India).	"	"	Excess	"
	1793	A sketch of the war with Tippee Sultan by R. Mackenzie. Vol. I. Calcutta.				
16		A, page 19.	Flax with some cotton.	Present.	Present	Good.
17		B, page 113.	"	"	Excess	Slightly perished.
	1800	History of the reign of Charles V. Vol. I. (Bom- bay.)				
18		(a) Frontispiece Robert- sons' Portrait.	Flax	Absent.	Absent	Good.
19		(b) Page 133.	"	"	Present	Slightly perished and brown.

Table of Books with fibre, sizing material, condition and date—(Contd).

No.	Date	Book	Fibre	Rosin	Gelatine	Condition
	1800	History of the reign of Charles V by Robertson, (Bombay) Vol. II.				
20		(a) Front piece Charles V's portrait.	Flax	Absent	Absent	Good.
21		(b) Page 147.	"	"	Present	Slightly perished and brown.
22	1800	130 year old paper.	Cotton.	"	Absent	Excellent.
23	1801	Asiatic Researches. Vol. VII.	Flax with very little cotton.	"	"	Good.
	1801	General Orders from A. G. Office Madras Vol. III.				
24		(a) Page 181.	Flax.	"	"	Excellent.
25		(b) Page 41.	"	"	"	Slightly perished
26	1803	General orders issued from the office of Adjutant General Fort St. George Vol. VII.	"	"	Trace	Very good.
27	1805	General orders from A. G. Office Vol. XI Madras page 88.	Flax with some very little cotton.	"	Excess	Badly perished and blotchy.
28	1805	Old coarse paper Indian letter paper.	Cotton.	"	Present	Good.
29	1806	Brown's Travels in Africa, Egypt and Syria.	Flax	Excess.	Absent	Completely perished.
	1806	General Orders from A. G. Office Vol. XII.				
30		(a) Page 103.	Flax with very little cotton.	Absent.	Present	Very good
31		(b) Page 37.	"	"	Excess.	Very brittle.
32	1807	Buchanan Vol. I, Introduction.	Flax with some cotton.	Absent	Absent.	Good.
33	1807	Buchanan Vol. I, Chapter.	Cotton with some flax.	Trace	Trace.	Moderately perished.
34	1807	"	Cotton with some flax.	"	Trace.	Completely perished.
35	"	Buchanan Vol. III, Margin from appendix.	Cotton.	Absent	Absent.	Excellent.
36	1807	Margin p. 310.	Cotton.	Trace	Trace.	Perished Moderately.
		Dr. Johnson's Dictionary by W Mavor-Glasgow [In India since 1828].				
37	1807	a] Vol. I, p. 167.	2/3 Cotton and 1/3 flax.	Absent	Present.	Slightly perished and decolourised.
38	1809	b] Vol. II.	"	"	"	Good.

Table of Books with fibre, sizing material, condition and date—Contd).

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
39	1810	Historical sketches of the South of India.	Cotton with very little flax.	Absent.	Present	Spotted slightly perished.
	1810	Brief remarks on the character and composition of Russian Army by Sir R. Wilson. London.				
40		a) Sample A, p. 183.	Flax with very little cotton.			Good.
41		b) Plates.	$\frac{1}{2}$ Cotton and $\frac{1}{2}$ flax.			Slightly perished.
42	1811	Select letters of Tipoo Sultan to various public functionaries translated by W. Kirkpatrick. London.	Flax with some cotton.	„	Excess	Good.
43	1812	Bland's Algebraical problem. (Bombay).	$\frac{1}{3}$ Cotton with $\frac{2}{3}$ Flax.	„	Absent	Excellent.
	1812	Tracts in controversy with Dr. Priestley. Dundee (Bombay).				
44		a) Page 531.	Flax with some cotton.	„	„	Moderately perished.
45		b) Page 295.	„	„	„	Fairly good.
	1818	Simpson's plea 9th edition (Bombay).				
46		a) Frontispiece Rev. Simson's portrait.	Flax with very little cotton.	„	„	Very slightly perished.
47		b) Page 1.	Flax with very little cotton.	„	„	Good.
	1820	The History of the Decline and Fall of the Roman Empire by Gibbon (Bombay).				
48		(a) Vol. VIII.	$\frac{1}{3}$ Cotton and $\frac{2}{3}$ flax.	Trace	Trace	Moderately perished.
49		(b) Vol. XI.	„	„	„	„
50		Sample of paper in Mr. Chapman's letter No. 446.	Flax	Absent.	Present	Spotted and slightly perished.
	1821	Memoir of the operations of British Army in India 1817—1819.				
51		(a) Dedication.	Flax with some cotton.	„	Excess	Slightly perished
52		(b) Title page.	„	„	„	Fairly good.
53		(c) Chapter.	„	Present	„	Badly perished.
54		(d) Map.	„	Absent	Absent	Good.

Table of Books with fibre, sizing material, condition and date—Contd).

No.	Date.	Book.	Fibre.	Rosin.	Gelatine	Condition.
	1823	Asia Polyglotta by Kalapraht. Paris.				
55		(a) Sample A, p. 301.	Cotton with some flax.	Absent	Excess	Good and white.
56		(b) Sample B, p. 293.	2/3 cotton and 1/3 flax.	"	Absent	Slightly perished and discoloured.
	1824	Blackwood's Edinburgh Magazine, Vol. XV. London.				
57		(a) Sample A, p. 703.	Cotton with some flax.	"	Present	Good
58		(b) Sample B, p. 447.	2/3 cotton and 1/3 flax.	"	"	Brown and moderately perished.
59	1824	Considerations on the Hindu Law by Sir F. Macnaghten (Serampore.)	Cotton with few flax.			
60	1825	Journal of the Sieges of the Madras army by Lake. London.	1/2 cotton and 1/2 flax.	Present	Absent	Slightly perished.
	1825	Lectures on Electricity by James Ferguson. London (Bombay).				
61		(a) Chapters	Flax.	Trace	"	Slightly perished.
62		(b) Plates	Flax with very little cotton.	"	"	More perished.
		Further continuation of G. Orders of Fort St. George Vol. VI.				
63	1826	(e) "E. Wise." P. 33.	1/2 flax and 1/2 cotton.	"	Excess	Good.
	1827	Quarterly journal of Science Literature and Arts. Vol. 22.				
64		(a) Page 57.	Flax with some cotton.	"	Absent	Very badly perished.
65		(b) Page 400.	1/2 cotton with 1/2 flax.	"	"	Not so badly perished.
66		(c) Plate.	Cotton.	Absent	"	Excellent.
		Further continuation of G. O. VI.				
67	1828	(a) Whatman and Balston and Co., page 203.	Cotton with flax rarely seen.	Trace	Excess	Good.
68	1828	(b) " " page 121.	Cotton with very little flax.	"	"	Slightly perished
69		(c) " " page 161.	Cotton with very little flax.	"	"	Slightly perished
70		(d) " " page 257.	Cotton with some flax.	"	"	Moderately perished.
71		(e) " " page 49.	Cotton with flax in majority.	"	Present	Moderately perished.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
	1839	Illustrations of the Botany of the Himalayan mountains by Royle. London.				
72		(a) Balston and Co., p. 346.	Cotton	Trace	Excess	Very good.
73	1830	(b) Balston and Co. page 432.	Cotton	Present	Excess	Slightly perished.
74		(c) Without water mark page XXIV.	"	Excess	Absent	More perished.
75	1831	Letter from Maharaja Natch Parkus to Lord William Bentinck.	Cotton with flax rarely seen.	Absent	Slight trace	Perished.
76	1838	Old coarse paper.	"	Absent	"	Slightly perished.
77	1840	Old rough Eastern paper, gloss on surface.	"	"	Excess	"
78		Old note paper-	"	Excess	Trace	Moderately perished.
79	1841	Old rough paper.	"	Absent	Excess	Slightly perished
80	1842	Ring Cakutala.	Flax with some cotton.	"	Absent	Badly perished.
81	1844	Cover of Mss. letter from King of Oudh to Lord Ellenborough (Eastern paper).	Cotton.	"	Trace	Strong.
82	1849	Bill from Collector's Office.	Cotton with very few flax.	"	Excess	Good.
83		Letter from Collector to H. A. Corne.	About 2/3 flax and 1/3 cotton.	"	"	Very slightly perished.
84	1850	Letter to Secretary of Board of Administration Punjab.	Cotton.	"	"	Good.
85	1850	Revenue Department Punjab Government.	Cotton.	"	"	Good.
86		List of unanswered returned reference.	Cotton with very few flax.	"	"	Good.
87	1852	Calcutta Review Vol. XVIII.	Flax.	Present	Absent	Badly perished.
	1859	Shakespeare's Legal Acquirements by Campbell.				
88		(a) Chapter.	Cotton with some flax.	"	"	Moderately perished.
89		(b) List of works.	Cotton with very few flax.	Absent	"	Good.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
	1859	Book of the Church by Robert Southy London.				
90		(a) Contents.	Cotton with flax in majority.	Present	Absent	Moderately perished.
91		(b) Chapters.	"	"	"	More perished.
92	1860	Letter to Secretary of Govt. of Panjab from P. M- General	Cotton with very little flax.	Trace	Excess	Good
93	1861	Natural Philosophy by W. R. Chambers London.	Cotton with little flax.	Excess	Absent	Moderately perished
94	1865	Vishnu Purana by H. Wilson. London (Mysore).	Esparto.	"	"	Slightly perished.
95	1868	Wayside Thoughts by Thompson.	Straw with some cotton.	"	"	Badly perished.
96	1868	Proceedings of the Madras Government Judicial department (Ootacamund).	Cotton with flax in majority.	Present	Present	Fairly good.
	1869	Memoirs of the Geological Survey of India Vol. VII				
97		(a) Beginning, page 21.	Esparto with little cotton.	Absent	Absent	Fairly good.
98		(b) End part, page 327.	Esparto with little flax.	"	"	Moderately perished.
99	1870	History of war between France and Germany.	Esparto	Excess	Absent	"
100		Do.	"	"	"	Completely perished.
101	1870	Letter from Lt. Col. Blair Punjab Govt.	Esparto with very little cotton and flax.	Absent	Excess	Moderately perished.
102	1870	Proceedings of the Hon'ble Mr. L. C. in the Political department.	Flax with little cotton	"	Present	Sightly perished.
103		Old Coarse paper.	Cotton	Excess	Trace	Good.
104	1871	Friendship's garland.	Esparto	Trace	Absent	Fairly good. (fresh from England)
105	1871	"	"	"	"	Completely perished. (In India for a long time)
	1872	Morley's Voltaire.				
106		(a) Advertisement.	Esparto with some cotton.	Absent	"	Moderately perished.
107		(b) Chapter.	Flax with very little cotton.	"	"	Little worse than advertisement.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
108		History of Japan.	Esparto	Present	Absent	Badly perished.
	1875	Beame's Comparative Grammar				
109		(a) Table of contents.	"	Trace (Starch trace)	"	Slightly perished
110		(b) Chapters	"	"	"	Little better than contents.
111	1880	Proceedings of L. C. in Home Dept.	½ esparto with ½ cotton	Absent	Excess	Moderately perished.
112	1830	Collin's Series Illustrated Dictionary (Bombay).	Esparto	Excess	Absent	Completely perished.
113	1882	Guizot's History of England (Bombay).	"	"	Trace	Moderately perished.
114	...	" "	"	"	Absent	Badly perished.
	1903	Imperial Institute Technical Reports and Scientific papers.				
115		(a) Imperial Library Copy	Esparto.	Trace	Absent	Moderately perished.
116		(b) I. I. S. copy.	"	"	"	Fairly good.
117	1907	Record of meetings of Board of Revenue Fort William.	Flax with very few cotton.	"	Excess	Good.
118	1918	Cross and Bevan's Cellulose.	Cotton with very few flax.	Present	Absent	Good.
119		Chinese Repository (Bombay).	Birch wood cellulose.	"	Excess	Completely perished.
120		Waverley novels (Bombay).	Straw.	Excess	Absent	Badly perished.
121		Persian Arabic Mss. Book No. 201.	Flax with majority of cotton.	Trace	Excess	Very badly perished.
		Iyar Danish Works. Persian Mss No. 445.				
122		(a) Pages at the end of the book.	Flax with some hemp.	Absent	Present	Badly perished.
123		(b) Pages at the beginning.	"	"	Absent	Good.
	1831	The Quarterly Review Vol. XLV.				
124		Page 281	Flax, cotton rarely seen	Trace	Present	Good.
125		Page 101	"	Absent	Absent	Badly perished.
126	1847	Madras Catholic Expositor. Vol. VI	Cotton	Excess	"	Slightly perished.
127	1849	Vol. VIII	Cotton	"	"	Fairly good.
128	1851	Vol. X	"	"	"	"

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
129	1757	L'entiquites' expri- quee et represente en Figure	Cotton	Absent	Excess	Spotted and moderately peri- shed.
	1877	General Orders by the Honorable the Governor in Council 3rd January 1877.				
130		Page V (index)	Cotton	Present	"	Excellent.
131		Page 57	Esparto with very little flax and cotton.	"	"	Distinctly peri- shed.
132		Page 17	$\frac{1}{2}$ cotton and $\frac{1}{2}$ flax	"	"	Fairly good.
		Index to Orders of General Import by His Grace the Governor in Council for:—				
133	1874	1874-P. III	Esparto	"	Absent	Slightly perish- ed.
134	1875	1875-Page VII	Esparto	"	"	Fairly good.
135	1876	1876 page IX	Esparto	"	"	Good.
136	1877	1877 ,, III	Cotton with very little flax	"	Present	Fairly good.
137	1877	1877 ,, VII	Esparto	"	Absent	Moderately peri- shed.
138	1878	1878 ,, III	$\frac{1}{2}$ flax and $\frac{1}{2}$ cotton	"	Present	Fairly good.
139	1879	1879 ,, XI	Esparto	"	Absent	Moderately peri- shed.
140	1880	1880 ,, IX	Esparto	"	"	Slightly perished.
141	1881	1881 ,, V	"	"	"	"
	1825	General Orders—By L. G. Bowser. Head Quarters—Choultry Plain, 29th Decr. 1824—Receiv- ed 20th Jany. 1825:—				
142		Page 7144	Cotton with little flax	"	Excess	Fairly good.
143		" 7148	Flax with very little cotton	"	"	Slightly peri- shed and spotted.
144		" 7291	Flax with little cotton	"	"	Good.
	1866	General Orders—Mili- tary Department—2nd Jany. 1866:—				
145		Page 9	Esparto	"	Absent	Fairly good.
146		" 31	Esparto with some flax and cotton	"	"	Slightly perished.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
147		Page 77	Some flax and cotton	Present	Absent	Moderately perished.
148		" 101	Cotton with little flax	"	Excess	Slightly perished
	1825	General Orders—by L. G. Boer—December 1825.				
149		Page 7438	Cotton with very little flax	Present	"	Slightly perished
150		" 7440	"	"	"	Moderately perished and spotted
151		" 7492	"	"	"	Good.
152		" 7624	"	"	"	Slightly perished
	1791	Compendium of Ancient Geography by D'Anville London—Part I				
153		Page 69	Flax	Absent	Present	Slightly perished
154		Map	$\frac{1}{2}$ flax and $\frac{1}{2}$ cotton	"	"	Good.
	1805	Transactions of the Royal Society of Edinburgh.				
155		Vol. V—page 361	$\frac{1}{2}$ flax and $\frac{1}{2}$ cotton	Present	Excess	Good.
156		" " 298	"	"	"	Slightly perished
157	1812	Vol. VI—Part I—P. 21	Cotton with very little flax	Absent	Trace	Slightly perished.
158		" " Page 145	"	Present	Excess	Moderately perished.
159		" " " 173	Cotton, flax rarely seen	Trace	Absent	Good.
160	1814	Vol. VII—Part I—Page 501	Flax with some cotton	Absent	Present	Slightly perished
161		" " 327	All flax	"	Absent	Badly perished.
162		" " 385	Cotton with little flax	"	Present	Very good.
163	1818	Vol. VIII—page 29	Flax with little cotton	"	Present	Slightly perished
164		" page 51	$\frac{1}{2}$ flax and $\frac{1}{2}$ cotton	"	Trace	Distinctly perished.
165	1538	Aristotelis Opera—Basileae.	Cotton	"	Excess	Good.

Table of Books with fibre, sizing material, condition and date--(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
	1803— 1807	Proceedings of the Board of Revenue at Fort William 1803--1807.				
166	1806	(a) "S Wise and Patch 1806"	Flax with very little cotton	Present	Excess	Good.
167	1805	(b) "S Wise and Patch 1805"	"	"	"	Slightly perished.
168	1805	(c) "S Wise and Patch 1805"	"	"	"	Distinctly perished.
		File from the Empress Mills, Nagpur :—				
169	1876	"A. Pirie & Sons" Water Mark.	$\frac{3}{4}$ flax and $\frac{1}{4}$ cotton	"	"	Distinctly perished.
170	1886	"Smith & Meynier Fume"	Straw with some flax and cotton	"	Trace	Badly perished.
171	1878	"G. I. P. Railway Company, Waterlow & Sons, London."	Cotton	"	Excess	Fairly good.
172	1879	"G. I. P. Railway J. Spicer & Sons, London"	Cotton	"	"	Completely perished.
173	1878	"G. I. P. Railway"	Cotton	"	"	Moderately perished.
174	1877	"T. H. Saunder"	Cotton	Trace	"	Good.
175	1886	"Malcolm & Henry"	Esparto	Excess	Absent	Fairly good.
176	1888	"Robert & Leese, Asiatic, London."	Cotton	"	Excess	Good.
177	1886	"Byramji Shapoorji."	Esparto	Trace	Absent	Distinctly perished.
178	1881	"Superfine Kent."	Cotton	Excess	Excess	Good.
179	1879	"G. I. P. Railway, Waterloo & Sons."	Esparto	"	Trace	Brittle.
180		"Darling & Co., London" Map.	Cotton	"	Excess	Good.
181	1881	"G. I. P. Railway, Waterlow & Sons."	Esparto	"	Trace	Badly perished.
182	1880	"G. I. P. Railway"	Esparto	"	Trace	Moderately perished.
183	1890	"St. Neots' Mill"	Cotton	Trace	Excess	Distinctly perished.
184	1881	"Government of India"	Esparto with wood-pulp	Present	"	Badly perished.
185	1888	"Howard & Jones, London."	$\frac{1}{2}$ cotton and $\frac{1}{2}$ flax	"	"	Slightly perished.
186	1889	"Extra Strong"	Cotton	"	"	"

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
187	1891— 1895	Times of India	$\frac{1}{2}$ chemical wood pulp and $\frac{1}{2}$ Esparto			Slightly perished.
188	1896	do.	Chemical woodpulp			Fairly good.
189		do.	"			Slightly perished.
190	1897 } 1899 } 1901 } 1916 }	do.	$\frac{1}{2}$ chemical and $\frac{1}{2}$ mechanical woodpulp			Slightly perished
191	1811	Bombay Courier.	Flax.	Present.	Present	Good.
192	1812	" "	"	"	"	"
193	1815	" "	"	"	"	"
194	1816	" "	"	"	"	"
195	1817	" "	Mainly straw.	"	"	Badly brittle.
196	1819	" "	"	"	"	" "
197	1820	" "	"	"	"	" "
198	1821	" "	"	"	"	" "
199	1822	" "	"	"	"	" "
200	1823	" "	"	"	"	" "
201	1824	" "	"	"	"	" "
202	1826	" "	"	"	"	" "
203	1826	" "	Cotton.	"	"	Fairly good.
204	1836	" "	$\frac{1}{2}$ cotton and $\frac{1}{2}$ flax.	"	"	Slightly perished and spotted.
205	1837	" "	$\frac{1}{2}$ cotton and $\frac{1}{2}$ flax.	"	"	"
206	1839	" "	"	"	"	Slightly perished.
English books at Tanjore Library (appendix III):—						
207	1801	No. I Vol I.	Flax with little cotton.	Absent	Absent	Fairly good.
208	1801	Do (pages in foreign language).	"	"	Present	Slightly perished.
209	1799	No. 3.	Flax.	"	Absent	Brittle.
210	1802	No. 4.	Cotton with little flax.	"	Present	Very Good.
211	1824	No. 5.	Cotton.	Trace	Absent	"
212	1815	No. 7.	Cotton.	Absent	Present	Good.
213	1829	No. 8.	$\frac{2}{3}$ flax and $\frac{1}{3}$ cotton.	Present	Absent	Distinctly perished.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
214	1800	No. 9.	Cotton with very little flax.	Absent	Present	Badly perished.
215	1803	No. 11 p. 6. with water mark "J. Wharmham 1801".	Cotton with some flax.	Trace	Excess	Fairly good.
216	1803	No. 11 page 83 without water mark.	Do	Absent	"	Distinctly perished and spotted.
217	1803	No. 11 page 96 water mark "S. A. D. 1801".	Flax with very little cotton.	Trace	"	Moderately perished.
218	1803	No. 11 page 15 water mark "Budeen 1802".	Cotton with some flax.	Present	"	Good.
219	1803	No. 11 Page 33 water mark "A Blackwell".	Do	Trace	"	Distinctly perished.
220	1805	No. 12.—Page 6 without water mark.	Do	"	"	Badly perished.
221		Page 204—water mark "Thomas Edmonds"	Do	Absent	Absent	Do
222		Page 242—water mark "C. Jones 1803."	Cotton,	Present	Excess	Brittle.
223		Page 20—water mark "Curties and Sons."	$\frac{1}{2}$ flax and $\frac{1}{2}$ cotton.	"	"	Good.
224		Page 180—water mark "T. Stains."	Cotton with little flax.	"	"	Very slightly perished.
225		Page 259—water mark "W. Sharp."	Do	Absent	"	Badly perished.
226	1810	No. 14	Cotton flax rarely seen.	Trace	Present	Do
227	1824	No. 15	Do	Excess	Excess	Brittle.
228	1814	No. 17	Do	Absent	Trace	Distinctly perished.
229	1795	No. 18	Cotton with little flax.	"	"	Fairly good.
230	1800	No. 21 Vol. 1	Flax with some cotton.	Present	Present	Brittle.
231		No. 28	Do	Absent	Absent	Do
232	1808	No. 31	Cotton with some flax.	"	Trace	Very good.
233	1828	No. 32	Cotton, flax rarely seen.	"	"	Shows signs of perishing.
234	1819	No. 34, p. 280	Do	Present	Present	Distinctly perished.
235	1819	" p. 264	Do	"	"	Good.
236	1813	No. 35, Vol. 2	Do	"	Absent	Fairly good.

Table of Books with fibre, sizing material, condition and date—(Contd.)

No.	Date	Book.	Fibre.	Rosin.	Gelatine.	Condition.
237	1817	No. 35	Cotton with very little flax.	Trace	Absent	Fairly good.
238	1814	No. 37, Vol 2, p. 7	Cotton, flax rarely seen.	"	"	Moderately perished.
239	1814	No. 37, p. 74	Cotton with very little flax.	Present	Trace	More perished.
240	1814	No. 37, Vol. 3	Do	Trace	Absent	Moderately perished.
241	1814	No. 37, Vol. 1	Cotton and flax.	"	"	Do
242	1799	No. 39	Flax with some cotton.	"	Trace	Distinctly perished.
243	1815	No. 40, Vol. 1	Cotton.	"	"	Do
244	1818	No. 42, Vol. I, list of works	Flax with some cotton.	Present	Absent	Good.
245		No. 42, Vol. 5, p. 5	Do	Trace	"	Distinctly perished.
246	1817	No. 47	Cotton.	Excess	Excess	Moderately perished.
247		No. 49	Cotton with some flax.	Trace	Absent	Fairly good.
248	1810	No. 50	Flax with some cotton.	"	"	Badly perished.
249	1811	No. 53	Flax, cotton rarely seen.	Excess	Excess	Brittle.
250	1803	No. 61	Flax	"	"	Brittle.
251	1812	No. 67	Flax with very little cotton.	"	"	Brittle.
252	1787	No. 51, Vol. 5, page 170.	Flax with majority of cotton.	Absent	Absent	Fairly good.
253		" page 354	About $\frac{1}{2}$ flax and $\frac{1}{2}$ cotton.	"	Excess	Distinctly perished.
254	1821	No. 55	Cotton	Present	Trace	"
255	1807	No. 56	Cotton	Absent	Absent	Fairly good.
256	1787	No. 57	Flax, cotton rarely seen.	Present	Present	Moderately perished.
257	1812	No. 58, Vol. 1	Cotton	"	"	Distinctly perished.
258	1811	" Vol. 3	Cotton	Slight trace	Absent	Fairly good.
259	1812	" Vol. 2	Cotton	Present	"	Do
260	1811	" Vol. 4	Cotton	"	"	Badly perished.

Table of Books with fibre, sizing material, condition and date—(Contd.),

No.	Date.	Book.	Fibre.	Rosin.	Gelatine.	Condition.
261	1829	No. 59, Vol. 9	Cotton	Excess	Excess	Moderately perished.
262	1827	„ Vol. 7	Cotton	„	„	„
263	1827	„ „	Cotton	„	Absent	Very slightly perished.
264	1827	No. 59, Vol. 6	Cotton	„	„	Good.
265	1823	„ Vol. 1	Cotton	Trace	Excess	Good.
266	1766	No. 63, page 1298	Flax, cotton rarely seen.	„	Trace	Good.
267		„ page 586	„	„	„	Fairly good.
268		„ page 890	„	„	Excess	Distinctly perished.
269	1815	No. 66 Vol. I.	About $\frac{1}{2}$ cotton and $\frac{1}{2}$ flax.	„	Absent	Slightly perished.
270	1813	No. 67 Vol. I.	Flax with little cotton.	„	Excess	Distinctly perished.
271	1812	No. 67 Vol. III. Page 450.	Cotton with little flax.	„	„	Moderately perished.
272		No. 67 Vol. III Page 363.	Flax with some cotton.	Excess	„	Brittle.
273	1812	No 69 Vol. XI.	Flax.	Trace	Absent	Brittle.
274	1801	No. 69 Vol. VI.	About $\frac{1}{2}$ cotton and $\frac{1}{2}$ flax.	„	Present	Distinctly perished.
275	1807	No. 69 Vol. VII.	About $\frac{1}{2}$ cotton and $\frac{2}{3}$ flax.	Absent	„	Fairly good.

For detailed summary of 214 samples see p. 157.