
UNIT 6 ENVIRONMENTAL FACTORS

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6.0 OBJECTIVES

After reading this Unit, you will be able to:

- know what are the hazards to library materials in general;
- identify the physical characteristics of library materials and causes of their deterioration;
- understand the different environmental factors responsible for damaging the documents as physical entities; and
- suggest appropriate preventive measures to be taken for the preservation of library materials.

6.1 INTRODUCTION

Essentially the library is a repository of books and other materials to be used by the users. The total collection of library materials is stored and preserved as long as the library exists. Books and other paper-based materials are the major constituents of the library. It is the social responsibility of the Librarian to keep all the books and other library materials physically fit to be used by the readers. In this unit, we are concerned with each library document as a physical entity. The basic materials and constituents of the physical entity of library materials are mostly organic and these are susceptible to natural decay and deterioration. If the environmental condition is adverse, the process of decay and deterioration is accelerated. In this Unit, hazards to library materials, particularly the environmental factors have been discussed.

The environmental factors are mainly temperature, humidity, water, light, air-pollution, smoke dust and such other damaging agents. All these factors exceeding the optimum value continuously, affect the, physical composition of the library materials. It has been problem for the librarians through the centuries to preserve the library materials against these enemies and to take measures against all types of decay and deterioration.

Although the books are read for the intellectual content contained in them, the intellectual, contents usually recorded by impression of type with the help of ink. A book is a physical entity having certain physical properties. The main constituent of a book is paper of any kind and the other constituents may be art paper for printing illustrations, Board for hard binding, cloth pieces for binding, cotton thread for sewing, glue for pasting, and other materials used for the physical construction of a book. Each substance used for the physical composition has its own constituents and these are affected by natural conditions or otherwise in course of time, while kept on the shelves. The environmental factors create the primary conditions for the well-being of the physical entities of the documents and other library materials.

In a modern library there are many printed or non-printed non-book materials which are paper based such as, journals, newspapers, theses, conference and seminar papers, pamphlets, reports, and the like. Special materials are also there in the libraries such as, maps, graphic materials, audio materials, audio-visual materials and various other types. The different types of materials and the characteristics of the substances used for the physical composition of such library materials pose different kinds of preservation problems.

All these materials are acquired and kept in the library for a long time. Although, the climatic condition is not the same in all the regions, our country is basically a tropical country. A tropical country has its own climatic problems particularly the humidity. Industrialisation, especially heavy industries, growth of urban areas, combustion of natural oil for transport, cooking elements in urban areas, and such other situations are continuously affecting the atmospheric condition. These atmospheric and climatic conditions have great impact over the physical condition of the library materials which are kept in the libraries for a long period. Such conditions are hazardous to library materials.

This Unit will make you aware of various environmental factors which are harmful to the library materials, the extent of deterioration they cause, the ideal environmental conditions required to preserve the library materials and the preventive measures to be taken against such harmful and damaging environmental factors.

6.2 PROBLEMS OF PRESERVATION

There is a vast variety of material in various physical formats made of different substances and ingredients. Depending upon the nature and characteristics of a particular type of substance and the mixture of ingredients, different kinds of preservation problems arise under adverse environmental conditions. The problems of preservation were faced by the

librarians ever since recorded documents were created. The art of preservation is as old as human culture. Various substances were used in the ancient world to create the recorded documents. There were attempts to preserve them depending on the kind of materials. Except stone and metals, other materials are vulnerable. Clay tablets were affected by worms and atmospheric condition, papyrus by humidity and insect, birch bark, wood and palm leaf by moisture and insects, paper by humidity, temperature, air pollution, dust and dirt, smoke; ageing and other adverse conditions. It has been found that deterioration of library materials start by the environmental factors. The environmental factors, by way of time, cause decay and deterioration of the library materials and adverse environmental factors cause the damage and destruction. An even more dangerous situation is that adverse environmental conditions not only damage the library materials physically, they also accelerate the damage and destruction being the root cause of chemical factors and biological factors for total damage and destruction.

During the middle ages use of good and durable quality of constituent materials, controlled amount of harmful ingredients in manufacturing, preventive and preservative measures taken during processing of materials, the care and craftsmanship associated with manufacture of materials prevented their decay and deterioration and also built up their resistance against adverse environmental factors. In the pre-modern period adequate preventive measures were taken for the preservation of library materials, During the modern period while paper became the major constituent of the library collection all over the world the problem of preservation became more acute. Paper is non-durable because of two conditions. Firstly because the, basic constituents of paper are organic in nature they are inherently, perishable, and secondly the process of paper making inherits the possibility of self destruction, and the decaying process gets accelerated under adverse environmental conditions.

The problems of preservation have reached an alarming stage in the modern period due to various reasons, the principal being the basic ingredients used for paper making as well as for the manufacturing processes. The main part of the library collection are paper and audio visual materials. The raw materials used for the manufacture of these materials and the processes of manufacture are very important. But unfortunately, in the modern period, low quality ingredients are used and the manufacturing processes are not faultless because of the demand for mass production. But the situation did not draw the attention of the people at large. Even librarians, as a community, were not aware and conscious about all these problems. Previously, it was the affair of some individuals, who were interested in preservation and invented indigenous methods. By the end of the 19th century people became aware of 'the problems of preservation and restoration of library materials and as such, attempts were made to cope with the problems. During the first three decades of the present century many individuals and institutions came forward to identify the causes of damage and deterioration of library materials of various kinds. Attempts were made to take remedial measures against such damage and deterioration as well as restoration of affected materials. Scientific investigations were carried out and notable works were done on causes of deterioration and damage, preventive measures to be taken and curative measures to be applied in USA, UK, Italy, France, Germany, USSR (erstwhile), Sweden and India. Laboratories for research in preservation processes and methods were established in the national libraries, archives and large libraries. Independent research institutions were also established like W.J. Barrow Research Laboratory in USA. The causes and conditions of deterioration and damage to library materials were identified and a good number of methods and techniques for preservation and restoration of library materials were developed.

The physical properties arising from the base materials and the composition in construction of the physical entity of book and other library materials create the problems of preservation. It is a fact that these are inherent. The physical entity of a book is composed of various

types of paper, board, cloth, leather, thread, ink, adhesive, etc. Each of these materials is susceptible to natural decay due to ageing as well as the decay and deterioration which are caused by various physical, chemical and biological factors, mostly created by atmospheric condition and environmental factors.

6.3 NATURE OF THE LIBRARY MATERIALS - PHYSICAL CHARACTERISTICS

The largest single constituent of a library collection is the book. There are also various types of printed non-book materials which are paper based. All these reading materials both in book form and non-book form are composed of paper. Paper itself and other constituents of the book create perpetual problems in preservation. Primarily these problems are caused by environmental factors.

6.3.1 Paper: The Principal Constituent of Book

The main constituent of paper is cellulose fibre. Various types of raw materials of different origin are used to collect the cellulose fibre. The quality of paper depends very much on the particular type of raw materials. The raw materials used for manufacture of paper are usually cotton, flax, hemp, alpha grass, straw, bamboo, rag, linen, chemical wood pulp, mechanical wood pulp and the like. The mechanical strength of paper depends on the length and integration of cellulose fibres. Raw cellulose fibres contain fats, waxes, rosin, lignin and many other impurities causing the deterioration of paper. Some substances and reagents are used to remove the impurities of paper pulp, but the processes taken to do so cause the degradation of cellulose fibre.

Paper is manufactured by grounding of raw materials and digestion of the whole pulp after removal of impurities. While the raw materials are processed under pressure and heat to prepare paper pulp, chemicals like calcium bisulphate, caustic soda and sodium sulphide are added which is required for proper processing. But the residues of the undissolved chemicals or impurities of raw materials cause the deterioration afterwards, particularly under adverse environmental conditions. The bleaching of pulp is done by chlorine. The disproportionate use of chlorine and its residue affect the durability of paper. The beating processes are important in preparation of the pulp if these are not done properly paper will deteriorate. Sizing materials such as glue, gum, rosin, starch, etc. are used to bind the cellulose fibres. Usually this consists of a diluted solution of rosin with an addition of alum. The chlorine used for bleaching and the excess alum combination increase the acidity of paper and decreases the longevity of paper particularly under adverse environmental conditions. The loading materials such as clay chalk, talcum, gypsum etc. are added to the paper pulp for increasing the smoothness of paper. These materials also contribute to the deterioration of paper due to environmental factors. Much water is needed for paper manufacture. If the water is not free from iron and other mineral impurities the paper will deteriorate shortly. The defects at the time of paper manufacture and the inherent causes of deterioration of paper in this process cannot be detected by seeing a book. It can only be detected after the damage has been done to some extent.

6.3.2 Other Constituents of a Book

Board: Boards are used for making the hard cover binding. Boards are used for both new bookbinding and old book binding. Nowadays, the board for book binding is made by machine boards or straw boards. Machine boards are made of wood pulp, waste chips, etc. Straw boards are made of straw and other raw vegetable products. When these boards are exposed to atmospheric conditions they deteriorate quickly. Those particularly with starch glue, are used as food hideouts and breeding places by insects.

Cloth: Cloth for bookbinding is usually made of cotton or silk. The cellulose content in cotton is more than 90%. The cellulose fibres are easily affected by acid and strong oxidising

agents. The fibres become disintegrated under humid condition and moisture. Starch filled cloth cover is tough but it is extremely vulnerable to insects and moulds. Silk is also vulnerable to atmospheric condition.

Leather: Leather is good covering material. But the quality of leather depends on the tanning process and substance used. Low quality substances and improper methods make the leather vulnerable. Badly tanned leather becomes decomposed under humidity and moisture.

Thread: Cotton threads are mostly used as sewing material for book binding. Whatever may be the method of bookbinding, the life of a book depends on the thread and other sewing materials apart from the paper. The gathering of pages in formats are sewn to each other and then to tapes or cords. The tapes and cords hold the gatherings together and these are fastened with the boards on both sides of the book. Low quality sewing materials with starch paste are affected by moisture and weaken the book.

Ink: Ink, dyes and colours play an important role in book making. Ink makes the permanent impression on paper. Dyes and colours make the illustration on various types of paper, particularly coated paper. In humid condition the pigments of ink and colours become wet and behave like adhesive. The pages of the book thus stick together. In case of coated paper the upper layer of paper sometimes sticks to the facing paper causing damage to the colour and illustration. Humidity and moisture affect the ink, dyes and colours.

Adhesive: The widely used adhesives for book binding are glue and starch paste. Glue and gelatin are animal matter. Starch and dextrine are vegetable matter. These are less expensive and widely used. The insecticide added in preparing the starch paste loses their properties after some time and the paste becomes the food of worms and insects. Both glue and starch are vulnerable to moisture and continued humid condition. The binding force thus loosens and damage is caused to books. Binding is a very important factor for the durability, of a book. The environmental factors make the book binding weak and affect the durability of the book.

On the whole, the physical properties of the book depend on the constituent materials and their composition in the construction of the book. The problem of preservation has two aspects. First, the physical conditions of books are vulnerable to deterioration because of inherent physical properties unknown to the librarians. Secondly, books are susceptible to adverse environmental conditions for physical deterioration which also accelerate both chemical deterioration and biological damages.

6.3.3 Audio-Visual Tapes and Discs

The sound recording systems are usually of three patterns, magnetic pattern, photographic pattern and grooved pattern. The audio-video tapes are of magnetic pattern, motion picture sound tracks are of photographic pattern and phonograph discs are of grooved pattern.

The base materials of magnetic tapes are polyvinyl chloride, cellulose acetate, mylar, and the like. The sound tracks of motion picture films are on the same base as the pictures. The plastic substances which are used as base materials are high molecular weight organic compounds capable of bearing heat, pressure, the evaporation of a solvent or to the use of plasticisers. All the materials are thermoplastics and repeatedly soften when heated and harden when chilled. All the substances are soluble in certain liquids.

Phonograph records are made of cellulose nitrate or acetate, polyvinyl chloride, styrene or wax. Sound is recorded by making matrix of grooves. Since these are made for playing purpose, only, emphasis is given on low manufacturing cost. The life span is rather short and cannot be preserved for a long time in high quality sound condition. Because of the groove pattern excessive playing can cause degradation in sound quality.

The quality of audio-video tapes and discs varies greatly according to the substances used

as base materials and the quality of raw materials. It also depends on the quality control in manufacturing the basic materials. A number of actors such as variation in formula, low grade raw material, contamination of elements, variation in heat and pressure, duration of time in processing, manufacturing techniques, etc. have their impact over the finished product and its quality and durability. Obviously low quality materials have shorter storage life and least, resistance to degeneration.

6.3.4 Films and Photographs

Any kind of film, motion picture, film strips and still film consist of thin transparent flexible sheets of cellulose acetate, cellulose nitrate and such other material coated with light-sensitive chemicals in gelatin which after controlled exposure and subsequent processing can retain the image. All kinds of films are very sensitive to extremes of heat, cold moisture and dryness. All the environmental factors affect the film. It can also be damaged by improper storage and handling. Environmental control can increase their longevity.

Photographic papers are high grade paper coated with emulsions which are either dispersions of finely divided silver halide particles in gelatin or colour sensitive chemicals in gelatin. Photographs, if processed properly, are free of active chemicals. If these are stored in tight dust proof containers in an environment of ideal temperature and humidity they may last for a long time. When the photographs are not processed properly and the active chemicals are present, the images turn faint due to continuing chemical action in the gelatin coating in course of time.

Self Check Exercise

- 1) What articles constitute the library materials that need to be preserved?

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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6.4 PROBLEMS RELATING TO AUDIO-VISUAL MATERIALS

The basic elements of the audio-visual materials are susceptible to damage by environmental conditions particularly in the tropical zone. The damage caused by physical and chemical changes, deterioration within the substances cannot be detected ordinarily. It will be evidenced only when the damage has caused the degradation of sound or fading of images. All kinds of base materials used for the composition of audio-visual materials, films and photographs, are sensitive to extreme heat, cold, moisture and dryness. Dust is most harmful to these materials. These materials can deteriorate if proper care is not taken in storage and get damaged in adverse environmental condition. The basic elements of these materials pose problems to librarians. The librarians should be very careful and cautious in selection and acquisition of these materials regarding and quality and durability of the base materials as well as the quality of recording on the base materials.

6.5 AGENTS CAUSING PHYSICAL DETERIORATION

Environmental factors are responsible for decay and deterioration of all kinds of library materials, whatever may be the physical constituents of a particular material, in two ways. First, the environmental factors directly cause the deterioration under extreme conditions

of such factors. Secondly, the environmental factors become indirectly responsible as the root cause and often accelerate the chemical and biological deterioration and damage. If the environmental factors are kept under proper condition and the extreme conditions are controlled by good housekeeping and proper care, all kinds of deterioration and damage can be controlled and the library materials can be preserved for a longer time.

There are various causes of deterioration of library materials as well as various conditions for this. Various agents are there by which the decay and deterioration are accelerated. Broadly speaking, the causes of decay and deterioration of the library materials are the atmospheric conditions, environmental pollution, the effect of acid and other chemical impurities on paper and other materials. The result is discolouring and brittleness of paper due to internal and external causes, fading and decolourisation of films and visual materials and degradation of sound of audio materials. All these are caused by excessive heat, light, humidity and moisture, air pollution and environmental condition detrimental to library materials. There are various other causes working at the same time. So, the causes are more complex and complicated. In such varying situations the causes of decay and deterioration are to be identified and adequate measures should be taken to counteract such conditions.

The following situations are responsible for the decay and deterioration of the library materials because of one or more situations acting simultaneously. Such decay and deterioration are aggravated by the environmental factors directly.

- 1) Natural ageing of paper is an inevitable phenomenon since the major constituents are of organic nature.
- 2) In the manufacturing of paper sometimes fibres are used with low cellulose content or sometimes non-cellulose content of the lignin type by which paper degenerates very soon.
- 3) Mineral and Chemical compounds used for sizing of paper affect the durability of paper.
- 4) Impurities in the ingredients used as basic constituents of paper cause inevitable deterioration.
- 5) Presence of excess acidic sizing materials such as alum, rosin, etc. cause the acidic effect.
- 6) Oxidizing agents present in the constituents of paper make the paper weak by diminishing the mechanical strength as well as by discolouring and disintegrating the paper. Presence of metallic traces accelerates oxidization.
- 7) Alkalis used in manufacture of paper affect the paper if used in a higher quantity. Fungi grow very easily on such paper.
- 8) Films are very sensitive because of the ingredient used for physical composition and the processes of manufacturing as finished products.
- 9) Chemicals present in audio-visual materials, ingredients of base elements and processes of production cannot withstand any adverse condition because these are very delicate.
- 10) Because of the nature and characteristics of basic elements, physical and chemical changes may occur within the material under adverse environmental conditions.

The causes of deterioration of library materials may be grouped broadly under three categories-

- 1) Natural ageing
- 2) Intrinsic or inherent factors, and
- 3) External conditions.

Natural ageing indicates the gradual degradation or deterioration of the material. Obviously it affects the durability of the material. It is inevitable that each material is subject to natural decay. If the ingredients used in a particular material are of good quality, and the processes of manufacture are properly performed and no substance is used for any purpose which may cause deterioration in future under any condition, the material will be durable and long lasting and it will be capable for enduring any adverse condition. In such a case natural ageing will take more time. If the basic ingredients are of poor quality, the substances used are such as may cause deterioration, and the manufacturing processes are not properly performed, the material will be less durable and natural decay or ageing will set in faster. Natural ageing does not refer to any external condition.

Paper is made of vegetable fibres and it is subject to the process of ageing; Paper as a product has mechanical resistance but it decreases with ageing and passage of time. The rate of ageing usually depends on the quality of raw materials from which the particular paper is made as well as on the condition of storage arrangement and environmental conditions. Low grade paper, containing large amount of wood pulp, ages quickly because of the lignin content which results in rapid disintegration. Lignin readily reacts with oxygen in the atmosphere and acids present in the air. The chemical degeneration of lignin is accelerated by humidity and moisture.

Cellulose pulp is also subject to ageing due to oxydising action of atmospheric oxygen, which is intensified in the presence of an alkali. Cellulose hydrolysis is caused by acid in atmosphere mixed with humidity. The acidity of paper has a considerable influence on the ageing of paper and thus on the durability of library materials. The ageing process in paper involves a degradation of cellulose fibres. When the long chain cellulose polymers are degenerated, and broken down to shorter chain molecules, the mechanical strength of paper weakens. Both the physical and chemical factors and atmospheric conditions accelerate the process of ageing. All types of paper, irrespective of their ingredients, must deteriorate in course of time. Even the very good quality paper changes its condition with the passage of time, which makes it yellowish and causes subsequent embrittlement.

Intrinsic or inherent factors refer to the basic ingredients used in the manufacture of physical entity of library materials as well as the manufacturing processes. In case of paper these basic ingredients are low quality raw materials for paper pulp, chemicals used for processing of pulp, sizing and loading substances and processes involved in paper manufacture. These things act as the root cause for physical and chemical effects for which durability of paper becomes affected even if without external cause or condition for deterioration. Since these causes are inherent to the material itself, these are intrinsic or inherent factors.

External conditions are different physical, chemical and biological factors that cause and aggravate deterioration and damage to library materials. The primary external factors responsible for causing hazards to library materials are the environmental factors which cause basically the physical deterioration and act as catalytic agents for both chemical deterioration and biological damage.

The environmental factors causing the physical deterioration are given in the following sections.

6.6 TEMPERATURE

Being a tropical country, India is in the high temperature zone and the relative humidity is also very high. Except for a few months in winter, the longer period of the year experiences high temperature almost all over the country. Extreme variation in temperature such as 5° C in winter and 45° C in summer is experienced in many places in India. Such fluctuation of temperature affects the physical condition of the library materials. Increase in temperature causes an increase in the rate of deterioration.

Temperature is always considered along with relative humidity. High temperature or heat with low humidity causes dehydration of cellulose fibres and the paper becomes brittle and yellowish. On the other hand, high temperature with high humidity, if continued for a considerable time makes the paper soggy and creates the condition for the growth of moulds. In both the conditions paper loses its mechanical strength and the cellulose fibres disintegrate and degenerate. Temperature over 35° C causes brittleness and dryness of paper. It also causes physical deterioration of paper, cloth, linen and leather. The adhesives also lose their binding strength. High temperature or heat accelerates photolysis, hydrolysis and oxidation. It also causes buckling of edges on films and tapes, as well as their embrittlement and curling. If these are kept in such a condition for a long time it will be difficult to use such materials. Usually the source of heat is the high atmospheric temperature. If electric bulbs are used for lighting purpose they increase the room temperature abnormally. High powerful bulbs generate more heat. The natural deterioration of ageing is accelerated by heat and increase of temperature in storage areas.

The mechanical strength of paper depends on the integration of cellulose fibres and the bond in between them. High temperature with high relative humidity disintegrates the cellulose fibres by hydrolysis, a sort of decomposition by chemical reaction with moisture, oxidation and photosynthesis. Each of the processes is accelerated by heat in the presence of minute quantities of iron, copper traces and other impurities which are always found in paper. The films, tapes and records are thermoplastic. They become softer under high temperature or heat. While they are in a soft state there may be physical and chemical changes within the materials affecting image or sound. In extreme cases these may stick together. The handling of such materials in soft state may cause irreparable damage to these materials. The fluctuation of temperature also affect these thermoplastic materials. Very low temperature with low humidity causes embrittlement of the library materials.

6.7 LIGHT AND DARKNESS

Light may be natural or artificial. Natural light is the sun light and artificial light may be fluorescent tube light or electric bulbs. In the natural light several kinds of rays are present. These are visible rays of light, Cosmic rays, gamma rays, X-Rays, far ultra-violet rays, near ultraviolet rays and infra-red rays. All rays are not harmful to library materials. The ultra-violet rays coming directly from the sun are harmful to library materials. Therefore, library materials should never be exposed to direct sun rays. The cellulose fibres of paper lose their mechanical strength and paper becomes brittle and yellowish under direct sun rays.

Both the natural and artificial light cause deterioration to bleaching ink, dyes and colour in illustration and maps. Ordinarily light does not affect cellulose molecules of paper but reacts photo chemically on the other ingredients and impurities in paper content such as lignin, acid, resins, glue, starch, dyes, etc. The effects of these reactions then attack the cellulose by breaking the molecular chain and weakening the paper. Cellulose fibres are bleached by light but lignin and other non-cellulose ingredients in paper become yellowish. Prolonged exposure to light results in photosensitised oxidization of paper which is vulnerable to other forms of deterioration. The presence of rosin, glue, lignin, iron, alum and other sizing and loading substances have a strong bearing on deterioration by light.

Like sunlight; artificial light also contains ultra violet rays. The florescent tube light radiates a high percentage of ultra-violet rays but the light is rather cool. The electric bulbs radiate minimum ultra-violet rays but are sources of much heat. They cause deterioration by yellowing the paper and embrittlement. Heat and light cause deterioration simultaneously, and long exposure to both natural and artificial light is destructive to library materials.

Although excessive light has certain deteriorating affects on library materials, light is required in the storage area. Direct sun rays should not be allowed in storage areas but natural light

should come in a restricted way. Fluorescent tubes should be used in storage areas because they radiate a lower percentage of ultra-violet rays than natural light and also radiate low heat. Darkness or absence of light in storage areas is also very harmful and damaging. Light, because of its heat element, absorbs moisture to some extent. It also hinders the growth of fungi and mould and keeps worms and insects out of their hiding corners. Darkness creates a condition for breeding of biological enemies and makes place for their hide outs. They cause much damage to library materials protected under cover or darkness. Humidity and moisture are increased in dark areas causing physical, chemical and biological deterioration. Therefore, it is desirable that every nook and corner of a library, particularly the storage areas should get the required light.

6.8 HUMIDITY AND MOISTURE

Like heat and light, humidity acts both in favour of and against the preservation of library materials. A certain amount of humidity is necessary for keeping the flexibility of paper. But in prolonged humid condition where humidity is very high, particularly at the period of summer and monsoon, moisture is caused by high humidity. Such climatic conditions with moisture is a most dangerous and destructive factor for all kinds of library materials. Moisture itself causes physical deterioration but the worst situation is that it is the root cause for various types of chemical deterioration and biological damage and destruction.

Moisture makes the paper soggy and thus weakens the tissues of paper. The cellulose fibres lose their strength become disintegrated and make the document unworthy for handling. Moisture weakens the adhesives and makes the book binding loose. It also weakens the sizing elements and loading materials of paper. It causes spreading of ink. It causes stickiness in art paper, glazed paper with the help of sticky ink, dyes, colours and pigments. Moisturised pages of book-often stick together particularly with illustration which may not be restored to their original condition. Moisture causes softening of gelatin on film and sound tape. Rolled films tapes and microfiches can stick together while they are in contact under conditions of moisture.

Moisture accelerates various types of chemical deterioration. Because of chemical reaction paper becomes yellow and stained with coloured spots. The impurities in the ingredients of paper, the contaminants, usually the oxides of carbon, nitrogen and particularly of sulphur, the acidic residue in paper, under condition of moisture cause deterioration to documents. Moisture promotes the growth of micro-organisms like mildew and fungus which cause deterioration and damage to paper and book binding materials. Spores of micro-organisms which are present in the atmosphere in dormant stage, starts growing under favourable conditions of high humidity. They cause enormous damage by destroying the sizing elements, cellulose fibres, adhesives and other binding materials and make the documents unreadable. Dust in contact with moisture causes physical and chemical degradation.

6.9 WATER

Water causing destruction to library materials may come from various sources. These may be due to human negligence, accidents or a natural calamity. Water may get into storage areas from leaking roofs, defective plumbing and clogged drains. If the rainwater pipes are broken, water may come in through open windows. If the windows are not closed rain water may come into rooms freely in the rainy season. Water running on the walls, over the floors, spilling on the shelf ranges, book cases or other furniture and equipment can cause enormous damage to the library materials, furniture, equipment, and even the library building. All these may be caused by human negligence. Water may come by accident if proper caution is not taken in time. It may also come by water-logging of roads under heavy rain and overflowing of water into the basement or ground floor of the library building. Natural calamities may be in the nature, of floods, cyclones and atmospheric depressions for a long time.

6.10 SMOKE

Smoke is another destructive enemy to library materials. Visible or invisible, smoke exists in the air suspended in the lower strata of the atmosphere particularly in urban areas, densely populated habitations and industrial locations. Smoke contains unburnt particles of burning coal, carbon particles, burnt fuel, industrial coal smoke, fibre particles and any other particles suspended in the air. All these suspended particles make the air heavy, so smoke settles at the lower part of the air. When such particles are diffused and distributed in the air, smoke may not be visible, but traces of smoke are there. Atmospheric smoke is visible particularly in the mornings and evenings in winter when smoke mixed with mist or fog hinders even the visibility and looks like a solid object.

Smoke is responsible particularly for chemical degradation and damage to library materials. A large amount of smoke is released in our country combustion of coal and fuel of oil gas. These things are used in urban areas, slum areas and densely populated areas for cooking purposes. A large amount of natural gas particularly diesel is burnt everyday for vehicular transport. The exhausts of transports produce enormous quantities of smoke. Industrial furnaces produce an alarming amount of coal and other types of smoke with chemical impurities. The chemical contents of smoke, as a whole, contain various oxides of carbon nitrogen and particularly sulphur. Sulphur dioxide is absorbed by porous elements of library materials. Sulphur dioxide, a by-product of the combustion of coal and fuel oil, is not in itself harmful to library materials. But under high humidity and moisture it reacts with metallic impurities in paper, particularly iron and copper, and forms sulphuric acid which is highly destructive to paper. The metallic impurities are found in all kinds of modern paper. The oxides of carbon and nitrogen also act for chemical degeneration of cellulose molecules by causing oxidation. The physical deterioration is caused also by smoke while the suspended smoke particles of the air settle down on the surfaces of library materials as dust.

6.11 DUST AND DIRT

Dust is a mass of suspended particles carried over by air coming from any source. It settles down on any surface of library materials which is exposed to air. Since this is airborne it can settle down even in closed files and boxes and closed areas where air can flow freely. Ordinarily dust cannot be seen but one can see it when it has settled down as a mass usually by discolouring the surface. When dust which is hygroscopic in nature is mixed with high humidity and moisture, it is transformed into dirt, a sticky substance over the surface which cannot be eliminated completely.

Dust and dirt substances aggravate the harmful action of sulphur compounds. These are sources of both chemical and physical deterioration. Dust hastens atmospheric acid reaction by attracting moisture to cause chemical degradation. Dust and dirt discolour the pages of books and help to grow micro organisms. Dust and moisture combined loosen the cellulose fibres of paper. The deterioration caused by dust and dirt is visible on the exposed part of the books. Dust is very harmful to audio-visual materials. It is particularly responsible for sound degradation of tapes and discs. Dust and dirt also damage the equipment meant for using the audio-visual materials.

6.12 AIR-POLLUTION

Clean and pure air is essential for any living being, so also for any organic material. Air is a mixture of Nitrogen, Oxygen, Argon, Water Vapour and Carbon Dioxide along with small quantities of Neon, Krypton, Xenon and Hydrogen. Some impurities like oxides of sulphur, carbon, etc. and suspended particulates in the form of soot, smoke and dust also exist in the air. When any of these impurities exceed the permissible level, it results in air

pollution. But it is a fact that even clean air causes deterioration to some extent to organic materials kept in the library. The oxygen mixed with water vapour existing in the air causes hydrolysis and auto oxidation. Library materials cannot be preserved in the library for a longer time without clean air. The real enemy of the library materials is the impurities present in the air and the contamination of the air. All these create air pollution which is more or less a permanent affair in this modern age particularly for urbanisation, industrialisation, increase of slum areas, deforestation etc.

The impurities of air and the sources of air pollution causing damage to library materials are mainly sulphur dioxide, hydrogen sulphide, ammonia, nitrogen dioxide, carbon dioxide, ozone and aerosols.

The hydrogen sulphide in contaminated air is produced by industrial activities, industrial gases and wastage, activities in cities and biological activities. It causes deterioration, though the rate is not high, in comparison to sulphur dioxide. It affects paper, binding materials and metals. Ammonia released into air from many sources is harmful to cellulose fibres. Ozone is generated by the action of ultra-violet rays on oxygen in the upper atmosphere. Most of the nitrogen dioxide, carbon dioxide and carbon monoxide in polluted air come from automobile exhausts. The action of sunlight on nitrogen dioxide generates more ozone and in connection with smoke it causes more damage. Ozone destroys organic materials by breaking the bonds between carbon atoms. Moisturised cellulose is particularly vulnerable to ozone found in polluted air. If it is exposed for a longer time paper and textiles lose their strength, Ozone makes the colours of fabric book covers fade. The book binding materials such as, leather, gelatin, glue, paste are susceptible to deterioration by ozone in humid atmosphere.

The aerosols are the minute solid particles suspended in the air. The main source of their existence is carbon from the incomplete combustion of coal, fuel, diesel, etc. Sometimes these are sticky materials because of the presence of tar. They also include suspended ash, soil dust, fibre fragments, sodium chloride, and other particles. Industrial aerosols contain ash, dirt, sulphur dioxide, hydrogen sulphide, iron and other harmful particles. All these contaminants cause destructive chemical reactions immediately. The polluted air causes decomposition of cellulose fibres of paper and binding materials and no library is safe from the impurities of polluted air.

Self Check Exercise

- 2) What are the disturbing elements responsible for decay and deterioration of all kinds of library materials?

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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6.13 ENVIRONMENTAL CONTROL

Adequate measures should be taken so that the deterioration and decay of the library materials can be checked, retarded and not accelerated. Usually physical and chemical factors cause such deterioration. These causes of deterioration can be controlled to a great extent by the environmental control.

There are two aspects of preservation of library materials: the preventive measures and the curative measures. The preventive measures comprise all the methods of good housekeeping, adequate caretaking, dusting, cleaning, periodical supervision of the storage, prevention of any possibility of damage by physical, chemical, biological and other factors, use of repelling agents, chemicals and insecticides to drive away the biological factors, and, on the whole, the control of deterioration and damage of library materials. The curative measures are taken when it is found that the preventive measures have failed for some reasons and the materials are affected and damaged by the causes of deterioration and the enemies of the materials. The curative measures include mending, repairing, strengthening, rehabilitation, deacidification, fumigation, lamination and other jobs which are required, considering the physical condition of an individual document. The damaged document can be made physically usable after all curative measures have been taken to restore the physical condition of the document.

6.13.1 Building

The environmental control begins partially from the planning and construction of the building. The site of the building, the soil on which it will be constructed, the environmental setting of the building and such other factors have the impact over the environmental control inside the library building. The building should be properly designed and planned to create a congenial atmosphere inside the building for housing the library collection properly. If the library building is an old one the existing building can be suitably modified and restructured to facilitate environmental control. Insecticides should be applied to the floors and corners of the building. Cracks if any, must be repaired. Fine wire mesh should be fitted to the windows. Frequent white washing minimises moisture.

6.13.2 Light

Light should be controlled inside the library building. Coloured glass panes, usually yellow or green, and curtains should be used in the windows to control ultra-violet rays and other harmful rays of direct sunlight, rain water and dust coming from outside. Venetian blinds may also be used in windows. The ultra-violet rays of the fluorescent tubes can be filtered by covers or sleeves slipped over the tubes. Light and darkness are both enemies and friends of library materials. It is better to keep the book storage under lighting condition during working hours and in complete darkness during closed hours.

6.13.3 Temperature

The ideal room temperature in the library is 20° - 25° C with relative humidity of 45 - 55% for preservation of library materials. This condition can be created by air conditioning. But in our country it is not possible. Therefore, temperature and humidity should be controlled as far as practicable by other methods. During the summer months when the temperature is considerably high the windows should be kept closed. The windows should be fitted with coloured glass panes. If the windows are to be kept open wet khas khas or curtains should be used; Floors can be cleaned by wet dusters. Exhaust fans should be fitted to the stack rooms. High speed air circulators may also be used. After the sun sets, the windows may be kept open till the closure of the library hours.

6.13.4 Humidity and Moisture

The percentage of humidity should be measured by a hygrometer. It consists of two thermometers; one dry bulb and one wet bulb. The relative humidity is measured by these two. A thermometer to measure the temperature should also be kept so that the relative humidity with temperature can be recorded and observed. If the humidity is recorded around 70% or more, this should be brought down to about 55% by using dehumidification measures. Dehumidification can be done by using dehydrating agents like silica gel or anhydrous calcium chloride. These give quite satisfactory result in storage areas. On an average 2-3 kg. of silica gel may be used for a room of 20-25 cubic metre area having

70% or beyond humidity. Rain water should not be allowed to enter the building and all water leakage should be sealed off to prevent moisture.

6.13.5 Housekeeping

Environmental control is the comprehensive measure for good housekeeping. Periodic inspection of the physical condition of all the library materials should be made part by part in a sequential manner. This work will eliminate the possibilities of any damage to library materials and will keep the storage in good condition. Accumulation of dust and dirt accelerate the damage in various ways. A cleaning schedule should be made by considering orders of priority and sequence of operations following daily and weekly routines. Specific instructions should be given to clean remote corners of the book shelves, behind cabinets, under desks and all surfaces accumulating dust and dirt. The dusting schedule should be a routine job in a continuous way. The best way is to use a vacuum cleaner because it sucks the dust and it cannot resettle on the surfaces. If it is not available, routine linen dusting must be done. Floors should be dusted regularly with a damp cloth.

During inspection if it is found that the books are affected in any way, such books should be grouped as dirty, mould or fungi infected and insect infected. Such books should be segregated from library shelves. When these books have been cleaned, treated and disinfected, they will be replaced in the shelves. Not only the books, the book shelves and the stack rooms should be disinfected twice or thrice a year.

Good housekeeping and preventive measures can protect the library materials against all hazards particularly environmental factors.

Self Check Exercise

- 3) What are the measures to be taken to combat various environmental factors responsible for the decay and deterioration of Library Materials.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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6.14 SUMMARY

This Unit discussed some of the hazards which affect Library Materials. As far as environmental factors are concerned, these include temperature, humidity, water, light, air pollution, smoke, dust and other damaging elements. The atmospheric and climatic conditions have a great impact over the physical condition of the library materials. Moreover, the extent of damage they cause, the ideal environment that these materials needed to preserve them for a long period and the preventive measures that need to be taken against each harmful and damaging environmental factors have also been discussed in a detailed manner. The factors that aggravate the decay and deterioration of the library materials caused by excessive heat, light, humidity and moisture, air pollution etc. have been explained. In such cases, adequate measures should immediately be taken to counteract such conditions. Two such measures are discussed in the Unit such as (i) Preventive measures and (ii) Curative measures. Both the measures are intended to restore the damaged physical condition of the document.

6.15 ANSWERS TO SELF CHECK EXERCISES

- 1) Primarily a library constitutes books as well as printed non-book materials which are paper based. Besides these, there are constituents such as audio-visual tapes and discs, films and photographs etc. which need to be preserved.
- 2) The disturbing elements for decay and deterioration of library materials are only environmental conditions. These are temperature, light and darkness, humidity and moisture, water, smoke, dust and dirt, air pollution etc.
- 3) There are two ways for preserving the library materials (i) Preventive measures (ii) Curative measures.

Preventive measures include all kinds of housekeeping, adequate caretaking, dusting, cleaning, periodical supervision of the storage, preventing the possibility of damage by other physical, chemical and biological factors, etc.

Curative measures are applied only when all kinds of preventive measures fail in protecting the library materials. These measure comprise mending, repairing, strengthening, rehabilitation, deacidification, fumigation, lamination and other jobs required for considering the physical condition of individual documents.

6.16 KEY WORDS

Aerosols	:	An air pollutant which refers to the dispersion of solid or liquid particles of microscopic size in gaseous media, such as dust, smoke or mist.
Combustion	:	Act or- process of burning chemically.
Cellulose	:	Highly purified and bleached wood pulp.
Dehydration (chemical)	:	Removal of free or combined water from a compound.
Fumigation	:	Exposure to vapours or fumes for disinfection or destruction of bugs, rats etc.
Fungus	:	Plant of simple structure, lacking chlorophyll; has no root, stem, or leaf and reproduces by spores, e.g. molds, toad-stools, bacteria and yeast.
Hazards	:	Anything which might cause harm or create danger.
Humidity	:	Pounds of water vapour carried by one pound of dry air.
Moisture	:	Something which makes slightly wet, liquid at a given relative humidity and temperature.
Fluorescent	:	The property of some substances of emitting when exposed to radiation, rays of greater wavelength than those received.

7.17 REFERENCES AND FURTHER READING

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UNIT 7 BIOLOGICAL FACTORS

Structure

- 7.0 Objectives
- 7.1 Introduction
- 7.2 Common Book Pests
 - 7.2.1 Micro-Organisms
 - 7.2.2 Insects
 - 7.2.3 Rodents
- 7.3 Identification of Damage
- 7.4 Control Measures
 - 7.4.1 Good House Keeping and General Hygiene
 - 7.4.2 Use of Chemical Repellents
 - 7.4.3 Use of Poisonous Dusts and Liquid Insecticides
 - 7.4.4 Use of Fumigants
- 7.5 Cleaning and Stain Removal
- 7.6 Summary
- 7.7 Answers to Self Check Exercises
- 7.8 Key Words
- 7.8 References and Further Reading

7.0 OBJECTIVES

After reading this Unit, you will be able to:

- recognise the damage caused by micro-organisms and other biological pests viz., insects and rodents;
- adopt precautionary measures to safeguard the library collections from damage;
- apply appropriate control measures well in time; and
- eliminate these biological agents of deterioration.

7.1 INTRODUCTION

Almost all book components, be it paper, pulp or straw board used for binding, textiles and leather of varied colours and varieties used as covering materials are prone to attacks by groups of micro-organisms, insects and rodents. Very often library collections are damaged by pests, and the phenomenon is generally known as bio-deterioration.

A tropical climate which is hot and humid is congenial for the growth and propagation of pests, fungus, insects like silverfish, cockroach, psocid, bookworm, termite etc. They breed in the buildings housing public, institutional or special libraries. There is perhaps no library which at sometime or the other has not suffered the ravages of these agents of bio-deterioration.

This problem has been studied in depth and the species that thrive specifically on book components have been identified. Their breeding cycles have been examined with a view to exterminate them and to apply effective control and remedial measures to check their incidence, thus preventing susceptibility of damage to library collections.

7.2 COMMON BOOK PESTS

Agents of Bio-deterioration include micro-organisms and insects, which are active living organisms found in normal housing environment. They sustain themselves with food derived from paper, board, binding cloth and leather. Sizing material in paper and binding textiles and vegetable tanning material in leather, e.g., starch, glues and gums are their special food.

7.2.1 Micro-organisms

A group of fungi or moulds which include *Alternaria*, *Aspergillus*, *Penicillium*, *Mucor*, *Fusarium* etc. grow in paper. These organisms are present in the environment in every habitat. They remain in a dormant state for long periods. But they appear as brown/ black vegetative growth on paper. This and leather in favourable conditions of climate, high relative humidity (above 65 per cent) and high temperature (in the range of 27°-35° C) are conducive for their growth and propagation. Besides, other conditions which favour their growth are rugged dusty surfaces, stagnant air, damp materials and availability of food for sustaining their life.

The common fungus consists of a reproductive mycelium and a vegetative mycelium. The former extends into the air and is responsible for spore production, while the latter burrows into the substrate digesting and absorbing it.

Besides fungi, bacteria also play a role in decomposing cellulose in paper and binding textiles. These are known as aerobic cellulose decomposing bacteria, e.g., *Cytophaga*, *Cellvibrio*, *Cellfascienla* and *Myscobacteria*. These bring about discoloration and staining of books and other allied materials.



Fig. 7.1: Damage Caused by Fungus

7.2.2 Insects

Common insects that are responsible for attacking and damaging paper and other book components are Silver Fish, Book lice (Psocid), Cockroach, Termite, Book Worm (*Gastrallus Indicus*). These insects are recognised by their characteristic appearance.

Silver Fish (*Lepisma Saccharina*)

It is a wingless, silvery or pearly grey, carrot shaped insect measuring 8 to 10 mm in length. It has two hairy antennae, and its body tapers like a fish from head to tail. The mouth part of this insect is adapted for biting. This insect makes damp walls, dingy corners of a room as its habitat. The female lays 10-50 eggs at a time and hatch in 6-10 days. The young ones closely resemble the adult. A temperature of 18°-25°C and relative humidity above 55 per cent is ideal for their growth. This insect is a surface feeder having an affinity for glue, gelatin, starch and other materials, pastes and other adhesives of vegetable origin.

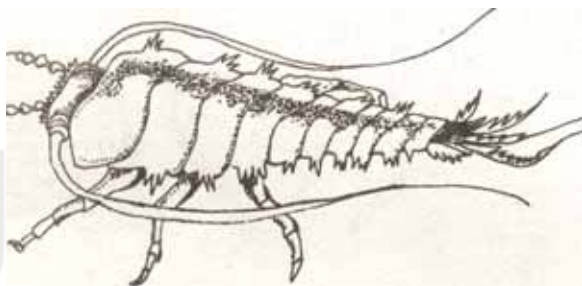


Fig. 7.2: Silver Fish

Cockroach (*Blatta-Orientalis*)

It is a brown or blackish brown, shing flat bodied, foul smelling insect. It has two protruding antennae which help it feel objects. This insect is nocturnal, lives and hides in corners which are damp and dingy, crevices and cleavages in walls and floors, behind and beneath almirahs and shelves in wooden cupboards. It is a very common household insect breeding in kitchen drains and garbage. It is an omnivorous insect feeding on paper, board, binding textiles, leather, especially attracted by binding glues.

The female lays eggs in pouch (cocoon) containing 6 to 10 eggs, mostly in April-May to October. The young ones hatching out from eggs are called nymphs and these mature as fully winged insect adult. Moist air, warmth and darkness form most favourable condition for their breeding and growth.

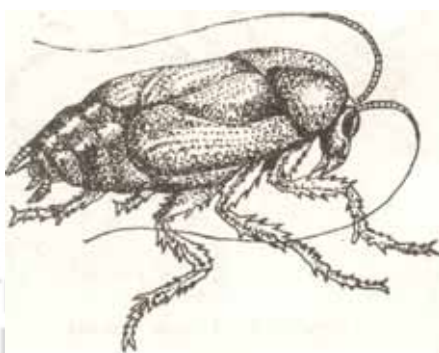


Fig. 7.3: Cockroach

Book-Lice (*Psocids*)

The insect is greyish white to brown in colour as long as the width of a pinhead (1 mm to 2.5mm). It is almost transparent with thread like antennae and mouth part. Its occurrence is noticed in dust laden and fungus infected materials. Dampness and warmth are the essential requirements for its rapid growth.



Fig. 7.4: Book lice

Termite (White-ant)

This insect is most destructive of the wood or cellulose feeding insects. It is a social insect living in a community which includes male, reproductive female (queen) and sterile workers. The workers are soft bodied, white or grey, wingless forms, and devote their energy to nest building and feeding the community. Broadly speaking this insect is of two groups:

- i) Subterranean termites, so called because they maintain their contact with the soil.
- ii) Non-subterranean termites, require no contact with the soil. They can exist in the wood they infest. These are also known as dry wood borers and are found in a tropical climate.

Subterranean termites travel in mud, covered runways, bore into poor masonry structure with bad quality of bricks and cement, reaching their food. They damage paper, board, wooden furniture, textiles and leather.



Fig. 7.5: Termite Worker

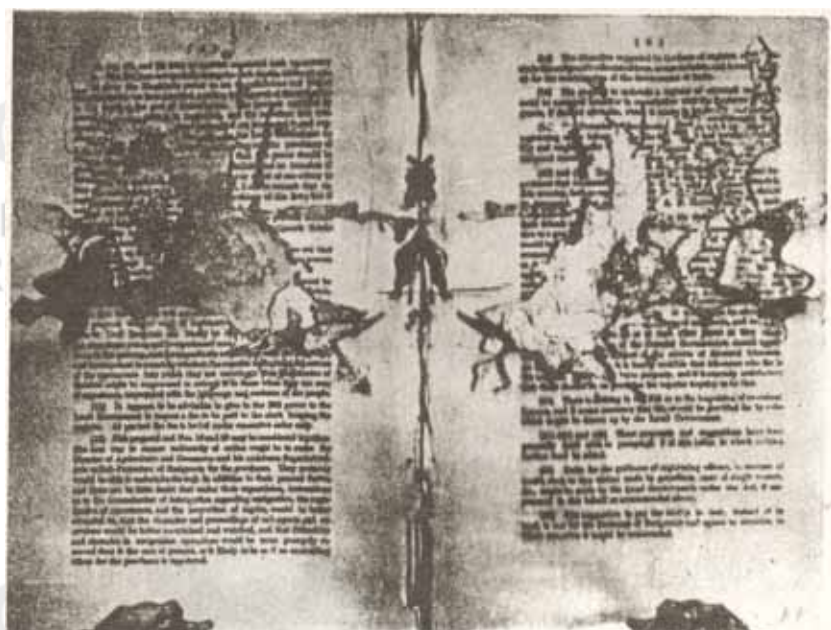


Fig.7.6: Damage Caused by Termite

Book Worm or Book Beetle (Coleoptera)

The Indian book worm has been identified as *Gastrallus Indicuss* Reitter and it has varied stages of growth e.g., egg, larva, pupa and adult beetle. A beetle is small slender and brown in colour and measures 2-3 mm in length and 1 mm in width. It lays eggs in joints of binding boards, and these eggs hatch out in 5-10 days as larva in summer. The larva is white, cylindrical and semicircular in shape, the head being retraced into the front segment of the body when at rest. They remain in pupa stage for 15 days or so at the end of which they emerge as full grown insects. The larvae eat their way into the book and are responsible for major damage. The adult beetle flies out from infested material to build new nests and thus spreads infestation.



Fig. 7.7: Book Worm Beetle

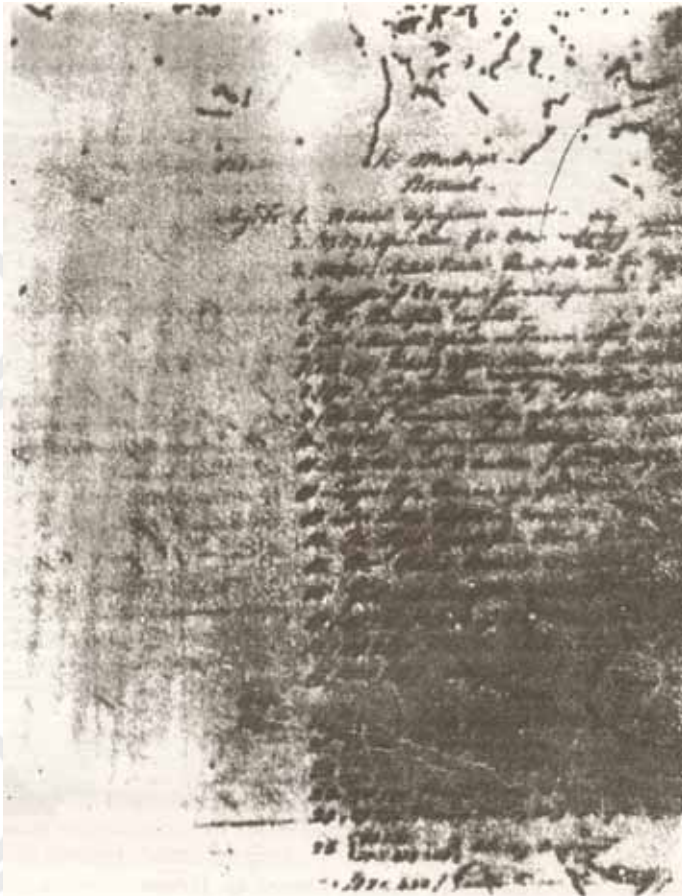


Fig. 7.8 : Books Damaged by Bookworm

7.2.3 Rodents

Mice (*Linnaeus*) and Rats (*Rathus*) find their way into buildings through dry drains and openings in doors and windows. These foraging animals gnaw, eat and soil anything made of paper, board, textiles, leather, glue, gelatin etc. All rodents possess chisel like incisor teeth. These are cunning animals, swift to move, hiding in dark corners weak plastered joints in walls and floors. They move in darkness, and cause damage. Once they enter a room their eradication becomes difficult.

Self Check Exercise

- 1) Why are fungus and book worms considered to be more harmful to books than feeders like cockroach and silver fish?

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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7.3 IDENTIFICATION OF DAMAGE

Damage caused by fungus or bacteria, and that which is caused by insects, is specific with each species. Often, the nature, extent and manifestation of damage make it possible to identify the damaging biological pest, making it convenient to apply appropriate control measures.

Fungus causes the following Damages:

- i) Growth of black/brown patches which eat into the paper, textiles etc.
- ii) Stinking smell.
- iii) Discoloration.
- iv} Staining due to acidic secretion reacting with iron and copper salt present as impurities in paper.

Surface feeders like *Cockroach* and *Silver fish* make their damage manifest in the form of discoloration accompanied by identification scratches appearing as patch work. The damage is mostly at the spine extending on the covers.

Subterranean Termites incise irregular tunnels starting from binding, penetrating deep in the text of the book. The edge of the tunnel are characterised by dusty margin due to dust and soil carried by these species.

Their emergence in a room is visible in the form of mud runways on walls, wooden furniture etc.

Bookworm or Book beetle travels in its larva or pupa stage from top to bottom of the text pages in the form of pinholes or narrow galleries running deep down. The damage usually starts from the back side.

Rodents leave a good amount of blackish excreta at the site they frequent and leave a good amount of cutting at the site. They leave irregular incision or cutting marks on paper, textiles etc.

Self Check Exercise

- 2) Indicate manifestation in book components by which you would identify damage by
- Termite
 - Cockroach
 - Bookworm

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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7.4 CONTROL MEASURES

Prevention is better than cure. It is a healthy practice to provide for storage environment which checks the growth and propagation of injurious biological pests. Unhygienic or untidy conditions if allowed to prevail for long result in the breeding of biological deteriorative. The propagation and growth of these organisms can be inhibited by maintaining tidy conditions. This in general is termed as observances of optimum storage needs.

7.4.1 Good House Keeping and General Hygiene

Good house keeping or maintenance of optimum storage conditions means avoiding dampness, stagnant air, high temperature, and high relative humidity. Keeping temperature in the range of 20-25°C and the relative humidity between 45-55 per cent is considered ideal for preservation of books and other library materials. This can be attained by a successful air-conditioning system operating for 24 hours throughout the year. For most of the libraries air-conditioning is out of consideration for economic reasons.

While planning of air-conditioning the following points are to be kept in mind:

- Maintenance needs of the plant.
- How long the plant is likely to remain out of commission.
- Running cost of the plant.

Intermittent air-conditioning means more harm than good.

For conserving library materials as also for keeping the biological pests away, a cool and congenial climate, with adequate air flow is required. It is therefore, desirable to use only airy and well lighted rooms for library stacks. For keeping air flowing with positive pressure, the use of air circulators and exhaust fans can be made to maintain unhindered air pressure. Rows of stacks and other storage equipment should run perpendicular to air flow direction.

Dampness on walls can be prevented by painting them in oil distempers or acrylic emulsions, while in damp rooms the floor can be covered with jute matting. These matting can be periodically dried in the sun for removing absorbed moisture. Crevices in floors, joints of

wooden structures with masonry should be well cemented so that there are no hiding places for insects. The windows should be covered with wire net screens. Drain openings in the room should also be covered with iron grills of suitable width. The entry door should be kept closed with a door-spring so that there is no access to rodents.

All library fittings and furniture should conform to specifications issued by the Bureau of Indian Standards on relevant subjects.

Accumulation of dust leads to unhygienic conditions and it is also conducive for breeding of micro-organisms and other injurious pests. Regular dusting of books with an electric vacuum cleaner is helpful. These cleaners make it convenient to dust underneath the shelves and almirahs as well as clean cob-web from walls.

Books should not be kept too tightly packed on shelves.

7.4.2 Use of Chemical Repellents

A variety of chemical insect repellents e.g., naphthalene, camphor, paradichlorobenzene, and electronic or ultrasonic wall mounted type insect repellents or trappers are available. While naphthalene is a safe domestic preservative paradichlorobenzene leaves a pungent smell. Commercially available pellets are admixed with paradichlorobenzene and fragrances, and are good for library environment. The concentration of naphthalene should not be more than 400/ 500 gms. per 1.5-2 cu.m. space.,

A suitable repellent can be prepared by mixing paradichlorobenzene, and creosote in benzene (1: 1: 1). This liquid can be kept in chinaware or enameled cups in the corners of the stack room.

Tissue paper impregnated in 10 per cent solution of naphthalene in benzene can also be used among books to keep the pests away.

Many librarians prefer the use of neem Leaves tied in muslin bags for keeping the pests away. Since the properties of leaves to have active chemical for long periods are not evaluated, it is not safe to use them.

7.4.3 Use of Poisonous Chemical Dusts and Liquid Insecticidal Emulsions

Normally it is not advisable to use poisonous dusting powders like D.D.T., Gammexane etc. in the library stacks. However, use of liquid insecticidal sprays e.g. Pip, Baygon, Lindane etc., may be necessary if an incidence of silver fish or cockroach is observed in the room. The spray of these chemicals is restricted to places where the insects hide, e.g. walls, corners, behind and below almirahs and shelves. In no case should these sprays be directed towards the books. If rat baits are used, which may be necessary if these are observed in the room; these should be used in rat traps.

In case white ant or termite infestation is observed the problem of treatment etc. should be done by experts in the field. In such a case also large-scale treatment of the books is not necessary. The treatment is applied at the site of entry of these species which can be identified —by examining the mud covered runways on walls ceiling and floor etc. Extermination of termites from an infested building calls for a collaborative approach between the Chief Librarian and Civil Engineer responsible for the building maintenance.

7.4.4 Use of Chemical Fumigants

Use of chemical fumigants or smoke generating chemicals for general sterilisation of environment of library stacks is neither necessary nor desirable.

Fumigation is a process which is adopted to kill active infestation of biological pests, in materials. Books having active fungus infestation or infestation of Bookworm need fumigation. In this process the infested books are subjected to the fumes of a toxic chemical in an enclosed vault out of contact with air. However, the first step to control these infestations is to segregate the infested materials so that it does not spread- further.

Only those chemicals are recommended which do not have any effect on book materials, and do not cause any staining or colour change.

A few safe fumigants are:

- a) Thymol; 100-150 gms per Cu m. space.
- b) Mixture of carbon tetrachloride and Ethylene dichloride (1:3), 225 ml per Cu. m. space.
- c) Paradichlorobenzene, 400-500 gm per Cu m. space.

Though fumigation chambers of varied designs, including vacuum fumigation vault etc. are available, yet considering the need of libraries and their resources, a small chamber design has been developed by the National Archives of India. This chamber makes use of solid, liquid and gaseous fumigants, since all pests cannot be killed by the same toxic fumigant. Thymol is suitable for fungus, while paradichlorobenzene kills Bookworms. This chamber, could be got fabricated within Rs.35,000 - Rs.40,000, it is portable and the chemical exhausted can be thrown out of the room/or washed out with water.

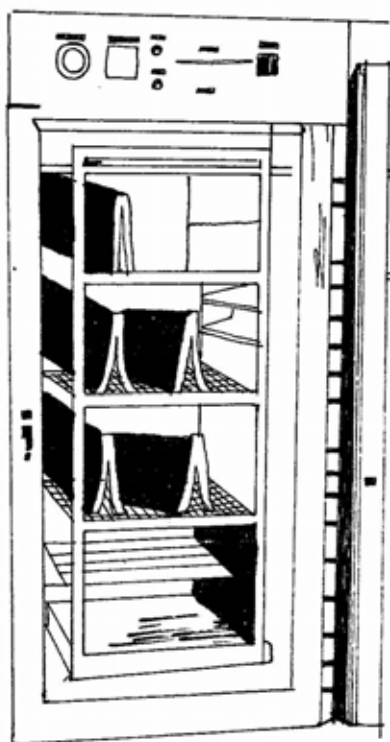


Fig. 7.9: Fumigation Chamber

Books subjected to fumigation should be exposed to fresh air for 24 hours before replacing on the shelf. The technique of fumigation needs -skilled trained staff.

Insecticidal formulations and fumigants advertised in commercially should not be used, since some of the toxic chemicals may discolour, stain or weaken the paper materials.

Similarly, no chemical formulation should be directly applied on book covers, since these may have an adverse effect on the users of these books or servicing staff in the library.

Only in case of an acute fungus attack, a general sterilisation of library stacks may become necessary. For such a purpose use of 10 per cent solution of thymol in methylated spirit is recommended. This spray could be done by any electrically operating fogging machine. Spray of these chemicals in air-conditioned enclosures is not desirable. After such fogging, the rooms must be sealed for 24 hours, and staff allowed entry after the fumes are exhausted by air circulation.

Self Check Exercise

- 3) Describe the general requirements which help safeguard library collections from damage by biological pests.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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7.5 CLEANING AND STAIN REMOVAL

Books and other library collections get soiled or develop stains due to bio-deterioration e.g. fungus growth and foxing. Cleaning of these materials is necessary after the infested materials have been fumigated. At times localised bleaching of the stain is necessary.

7.5.1 Cleaning

A few simple techniques of cleaning are:

- i) Removal of mud or hard crust of dust mechanically with brush or blunt knife.
- ii) Removal of foreign deposits with cotton moistened with water.
- iii) Removal of fungus spores with cotton dipped in ethanol.
- iv) Use of mild steam jet to soften hardened crust.
- v) Drying damp materials under air current in shade (direct sunlight not to be used).

Chamber described in 7.4.4 can also be used for drying at mild heat (40°-45°C) with circulating fans in the chamber.

These cleaning operations are carried in a separate room, and not in library stacks.

The staff handling these operations should be skilled in such work. Training to sub professional library staff can be imparted for undertaking these jobs. The School of Archival Studies of the National Archives of India imparts 8 weeks training in “Care and Servicing of Books”, free of charge to in-service personnel. Help of this school should be sought for the purpose. Bleaching of stains etc. should not be undertaken without a conservation laboratory. For such tasks the help of specialised conservation laboratories e.g. National Archives of India, National Museum, National Library etc. should be taken.

7.6 SUMMARY

Biological infestation and subsequent damage to library collections can be kept in check by providing a clean, neat and tidy storage environment. As soon as any manifestation or damage is noticed, which can be easily recognised by a few symptoms, curative steps should be undertaken. A stitch in time saves nine.

Fumigation is necessary only for infested materials and this is done in an appropriate vault with selective and specific chemicals in a separate well-ventilated room.

7.7 ANSWERS TO SELF CHECK EXERCISE

- 1) Fungus and book worm are more harmful for books since these species make their nests inside the book, where they reproduce and grow causing damage. The feeders like Cockroach or Silver fish hide outside the book and cause damage from the surface.
- 2) Termites make tunnels which run parallel with mud covered edges, while Bookworm make pinhole galleries deep down into the pages of the text.
- 3)
 - i) Maintaining air circulation to avoid stagnant air pocket.
 - ii) Avoiding dampness on walls and floors.
 - iii) Maintaining dust free, neat and clean storage.
 - iv) Using repellent chemicals.

7.8 KEY WORDS

Cellulose	:	Organic substance that forms the main part of all plants and trees and is used in making plastics, papers etc.
Fumigation	:	Process of destroying infectious germs, insects etc. with the fumes of certain chemicals.
Fungus	:	A type of plant without leaves, flowers, or green colouring matter, growing on other plants or decaying matter.
Mould	:	Fine furry growth of fungi that forms on old food or on objects left in moist warm air.

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UNIT 8 CHEMICAL FACTORS

Structure

8.0 Objectives

8.1 Introduction

8.2 Components of Books and Documents

8.2.1 Material used for Text or Informational Unit

8.2.2 Protective Coverings for Text or Informational Unit

8.3 Preventive Conservation

8.3.1 Chemical used for Establishing Paper

8.3.2 Chemicals used for Protecting Water Washable Writings

8.3.3 Chemicals used for Preventing Damage by Biological Pests Care of Weak and Damaged

8.4 Books and Documents

8.4.1 Repair and Reinforcement Materials and Chemicals

8.4.2 Chemicals Used for Stain Removal and Bleaching

8.4.3 Chemicals Used for Glazing and Varnishing Covering Materials

8.5 Summary

8.6 Answers to Self Check Exercises

8.7 Key Words

8.8 References and Further Reading

8.0 OBJECTIVES

After reading this Unit, you will be able to:

- have an acquaintance with the various components that combine to form a book or document;
- have an understanding of the chemical nature and behaviour of these components during use, storage, transit and display of books and documents; and
- obtain an insight into the techniques and chemicals deployed for stabilising, rehabilitating and reinforcing weak and damaged books and documents.

8.1 INTRODUCTION

Books and documents are created and produced to disseminate information and knowledge to man for developing his/ her intellect, and thus increase his/ her capacity to work and achieve desired goals, objectives or life pursuits.

With the diversification, and multiplication of knowledge in many directions, books and documents have been and are being produced in very large numbers. These materials are amassed in our libraries, manuscript repositories, archives and museums, and represent our cultural and library heritage. From loose handwritten or printed paper sheets loosely kept in a bundle to the shape of a book as we see today as a well stitched and bound physical unit, it has taken a long way.

8.2 COMPONENTS OF BOOKS AND DOCUMENTS

Primarily speaking the format of a book or manuscript comprises two parts:

- i) Text or informational content.
- ii) Covering and encasing of the text to protect it during use, storage or display.

A variety of constituents combine to form these two units. The performance, which in other words mean usability, capability to resist wear and tear (termed as durability) depend on the physical properties of the constituents, whereas the keeping or lasting qualities are determined by chemical properties of these constituents. A systematic study of these documentary or book components helps not only to maintain these collections physically safe and sound, but also help to conserve them for use by posterity.

8.2.1 Material used for Text and Informational Unit

Advancement in science and technology has given man a wide choice of writing and printing media. However, since man first started expressing himself, he used materials inorganic and organic available in nature for drawing and inscribing characters to communicate his feelings, and thoughts. These were stone, clay tables and bricks, parchment and leather, bark and leaves of trees. A very large number of manuscripts on birch bark and palm leaves are available in our repositories. However, among all these materials, paper has found use on a very wide scale for creating manuscripts and books. Collections in our libraries and manuscript repositories have chiefly paper materials in bulk. Manufactured by hand in earlier stages of its preparation, its use in bulk subsequent to the advent of printing (1450 AD) resulted in the establishment of paper manufacturing mills all over the world.

Besides paper, a variety of inks and colours have been used for writing, printing or drawing characters on paper. These contain many pigments and dyes. Among the many pigments known e.g. Zinc white, Antimony oxide, Chrome Yellow, Vermillion, Ultramarine etc; none has been used on such a wide scale as carbon (lamp black or graphite). Many vegetable or synthetic dyes have been used and are in use for giving a shine and tint to inks. Admixed with water or drying oil, or in inert organic solvents like alcohols glycols etc., these pigments and dyes gave birth to many varieties of inks. After the advent of printing manufacturing of inks became an industry.

Paper

Paper is composed of cellulose fibres which are interlaced and interwoven in an irregular manner to form a web like structure. As these fibres possess the properties of absorption of liquid/semi liquid media, and capillary action (flow of liquids through the fibres), the surface has to be specifically prepared to contain writing or printing on paper. These properties of absorption or capillarity are controlled by filling or loading chemicals and sizing chemicals, which is an essential paper making operation. Added to these are finishing operations which add smoothness, compactness, and capacity to the paper surface to improve upon its reflectance properties. These operations include calendering, coating, adding dyes etc.

Cellulose for paper making is derived from a variety of plant materials e.g. cotton and linen (textile rags - new or old), wood, bagasse, bamboo, straw, grasses etc.

While cellulose in cotton rags is available in its pure form, in other materials it is admixed with lignin (group of carbohydrates), gum and resins. Presence of lignin with cellulose

makes it prone to yellowing with light, while high content of resinous material also reduces mechanical strength. To obtain cellulose in pure form, raw materials like bamboo, wood etc. are treated with alkaline or acidic chemical solution at high heat and under pressure and the resultant pulp is then bleached to get white colour. This is the first stage of paper manufacture termed as digestion or cooking. The chemicals in pulping are: Sodium Hydroxide, Sodium Carbonate, Sodium Sulphate and Sulphite, Magnesium and Calcium bisulphites. While chemicals used for bleaching are Sulphide liquors, Hypochlorites of Calcium, Hydrogen peroxide or Sodium peroxide.

The pulp is then washed to make it free from residual chemicals. With these operations pulp of different stages of chemical purity is prepared. Cellulosic/purity in pulp determines the strength and stability of paper. Pure cellulose is known as Alpha Cellulose. High percentage of Alpha Cellulose is an essential- requirement for the stable composition of paper.

Since in a particular pulp impure cellulose may also be present (known as Beta or Gamma Cellulose), it is desirable to have an idea of their presence in paper pulp. These degradable forms are evaluated as copper number. Presence of a high Copper Number of a pulp indicates its poor quality.

Alpha Cellulose is defined as that part of cellulose which remains unaffected when pulp is treated with a solution of Caustic Soda (NaOH) of 17.5 per cent strength. Copper Number is defined as number of grams of metallic Copper in Cuprous Oxide made available by reduction of alkaline Copper Sulphate by 100 gm of pulp. High Alpha Cellulosic purity indicates its stability.

Mechanical wood pulp which has low chemical stability is prepared by grinding dry wood in specially designed mills and macerating it with water. This pulp is primarily used for newsprint and other cheap grade printing material.

Cellulose fibre loses its tenacity and is damaged by acids. Presence of acid liquors in digesting and bleaching operation makes the pulp acidic. Though washing of pulp reduces its acid content, yet acid is retained in pulp to some extent. For a good quality stable paper pH value (indicative of acidity or alkalinity) not less than 5.5 is desirable.

For improving upon the writing and printing qualities, of paper chemical additives, termed as fillers and sizing materials are added to pulp. Fillers are inorganic chemicals e.g. China clay or Kaolin, Calcium and Magnesium Carbonate, Talc (hydrated Magnesium Silicate), Asbestos, Gypsum (Calcium Sulphate) or Barium Sulphate and Titanium dioxide.

Sizing materials are both inorganic and organic e.g. Starch, Casein, Gelatin, Rosin, Waxes and Sodium Silicate.

If loading or filling, and sizing chemicals are not correctly and properly balanced, the paper suffers from the following defects:

Loading

Decrease in bonding properties

Loss of Rigidity

Amount of loading in paper is determined by its ash content.

Sizing

Properties of paper to resist penetration of fluids (inks) is affected.

Compactness of paper sheet is adversely affected during finishing operations, Application of high pressure, and high temperature (Calendering and Coating), may also affect the chemical and physical properties of paper.

Quality of a paper is evaluated by a series of chemical and physical tests. These determine its durability or mechanical strength to resist wear and tear as also stability or permanence and life span.

Physical tests include: Tensile strength, Folding endurance, Bursting endurance, Internal tearing resistance, Opacity, Reflectance, Porosity etc.

Chemical Tests include: Alpha cellulose content, Copper number, pH value

For evaluating the extent of physical and chemical degradation, an accelerated aging test has been devised for paper. Heating paper for 72 hours at $103 \pm 2^\circ \text{C}$ is known as accelerated aging. For helpful guidance the Bureau of Indian Standards has specified methods of sampling and test for paper; IS: 1060 (1950) revised.

Writing and Printing Inks

Inks or fluids for writing and printing are suspension of a pigment or dye (a coloured substance) in a medium which is usually water (writing ink) or drying oil (printing ink). The chief characteristics of an ink are:

- 1) Colour to yield characters which are lustrous and dense.
- 2) Flow to get registered on paper as desired characters.
- 3) Capacity to retain its composition as liquid suspension without scum formation or mould growth.
- 4) To give writing or printing characters which dry up quickly.
- 5) With no corrosive action on writing and printing instrument (pH not less than 4.5).

The colour of writing or printing inks is a matter of choice, but its legibility, sharpness of characters, colour fastness, and permanence are essential qualities.

Printing Inks

Pigment used for manufacturing printing inks include:

Lamp black, graphite, Charcoal:- Black, Baryta white, Zinc-white;

Titanium - Oxide, Antimony oxide :- White;

Chrome yellow, Zinc Chromate :- Yellow;

Vermilion, Scarlet Chrome, Madder (Alizarin), Oxide of iron :- Red;

Ultramarine, Prussian blue:- Blue;

Basic acetate of Copper (Verdigris):- Green

Medium used is dried linseed oil admixed with terpenes (Fatty acids and essential oils)

Silicates of soda and glycerin are added to have raised characters, while shellac and borax find use of lining etc.

For obtaining desired hue or tint organic dyes (known as aniline dyes) are also used.

Writing Inks

Pigments used for writing inks are carbon or lamp black; iron galls (mixture of Ferrous sulphate, Gallic acid and Tannic acid).

Acids (Hydrochloric or Sulphuric) used for keeping the pigment in suspension for desired flow.

Various aniline dyes mixed with pigments or alone are used for obtaining inks of desired hue and tint. Some of these dyes are:

Colour	Dye
Black – blue	Phenol blue
Violet black	Phenol blue and Poncean red R
Red black	Poncean Red R.
Green	Anilair green

In printing as well as in writing inks phenols and formalin are used as preservatives to avoid scum or mould formation.

A new class of coloured fluids are now available as ball point pen refills. These are prepared using dyes incorporated in Phthalic anhydride or glycols ad medium.

Fixing action of an ink on paper depends on the liquid medium and its viscosity, its penetration in the paper fibre. Polymerisation of oil also determines fixing properties. With age some pigments get tarnished affecting the tint of the ink. Behaviour or-an ink on paper is an important aspect. There are a few varieties of inks which develop acidity in paper and gradually cut into the paper structure. Such inks mostly contain black or green acidic dyes or pigments.

The appearance of writing and printing on a paper is thus a twin phenomena depending upon the quality of an ink as well as that of paper. Though the constituents that make these two components of books and documents have varied properties yet their relationship and interaction is an important aspect. An understanding of the same helps in preserving and conserving these materials.

8.2.2 Protective Coverings for Text or Informational Unit

Text or informational content being on paper represents a delicate entity likely to get creased, folded, degraded or torn during use, keeping, transit and display of the material. In order to provide adequate physical safety against such wear and tear text papers are encased in protective covers popularly called ‘Docketing and Bindings’. These covers are prepared with hard boards composed of straw pulp or pulp prepared with mill waste (textiles waste). The composition of the boards is similar to paper with the exception that the cellulosic materials are not of good grade.

Colours and impurities being transmigratory are likely to flow to the text material by contact. The impure Docketing or Binding constituents are likely to spoil the text material.

Materials Used for Docket Covers

During docketing sections of sheets are stitched with a hard pressed stiff paper cover. If

the sheets of the text are single sheets, these are joined together on a guard to form sections (2, 4, 6, 8 sheets).

The constituents for docketing are:

- Paper for preparing guard.
- Adhesive paste used for guarding.
- Stiff cover paper for docketing.
- Thread for stitching.

Constituents of guard paper are the same as discussed for paper.

Adhesive used for guarding is a paste prepared with starch admixed with small quantity of preservative chemicals e.g., Oil of cloves, Saffrol, Formalin, Sodium salt of pentachlorophenol etc. These materials do not have any deleterious effect on text paper.

Glues, gums and other synthetic adhesives which give bonding quality with polymerisation or change in structure during drying are not safe to use for guarding. These adhesives bring about physical distortion in paper surface (glue, gum etc.). There are some synthetic emulsions and pressure sensitive formulations which become yellow with age and thus impart impurity to the text material (polyvinyl chloride, collodion etc.).

Paper for docketing is thick and stiff (hard pressed pulp board). It has the same basic composition as described for paper, with the exception that it is glazed, coloured and has moisture repellent properties. A mixture of waxes (natural and synthetic) and resins are used for glazing. Besides strength and durability this paper should have a pH not less than 6.0. Its colour should not bleed with water. Thread used for stitching is either of cotton, nylon or linen. Though toughness and mechanical strength of nylon thread is more than that of cotton, yet once stretched it shows sagging quickly and the stitched sections become loose. Thus damaging the sewn structure. Cotton and linen thread does not show such a change.

Materials and Adhesives used for Binding

More than a dozen operations and a wide variety of materials are used to produce a bound, book. These comprise two major steps.

Forwarding: Comprising all operations such as collating, sewing, attaching papers, spine or back formation, back lining, and case in covers.

Finishing: Putting title and other decoration on covers.

In book production trade many mechanical innovations are used for binding techniques, but the formats in common are:

Paper Back: Text sheets are collated and joined by an adhesive to hold them together as a unit. This unit is case-in with a cover of stiff pulp board. This cover paper is similar to that used for Docketing.

The adhesive used are either water based animal glue emulsions or hotmelt synthetic adhesives (polyvinyl chloride or polyamide emulsions).

Paper Bound: Loose text Sections are stitched with thread or wire on the text margin and the Unit case-in stiff paper cover pasted at the back with adhesives similar to that used for paper back.

Hard Board Bindings: Loose text sheets stitched in sections with thread and casein hard pressed board prepared from straw on textile mill waste. These boards are then covered with binding textiles or leather natural or synthetic (plastic clothes). These are called edition bindings.

Besides the above, most library collections are available in reinforced library bindings, mostly done by hand.

Materials used for binding and their properties are as under:

- a) Sewing thread, tape and bands: Thread used for reinforced binding is unsized soft, made of cotton.
- b) Tapes used for reinforced binding are of unbleached cotton, unsized, free from loose threads and other mechanical defects.
- c) Bands: These are used to strengthen the binding at tail or head and their composition is similar to that of tapes.
- d) Boards: Hard pressed straw or mill waste board is used. These are of single ply, and neutral to acid reaction.
- e) Covering Materials: Leather, art Canvas and Calico cloth are used as covering materials. Good quality leather is vegetable tanned, though chrome tanned leather is also used.

Art canvas and calico cloth is evenly woven, free from pin holes and other mechanical defects. This Cloth should not show sticking when folded upon itself. The colour and surface of the covering material should be capable of taking designs and prints. Coated fabrics and PVC cloth, Rexine etc. are treated with lacquers and varnishes which decompose on keeping and are not satisfactory.

f) Adhesives

Qualities of a satisfactory adhesive are:

- i) Maximum bonding in thin films with no loss in bonding strength on ageing.
- ii) Reversibility with easy means without damaging the bonded surfaces.
- iii) pH range between 5.5 - 8.5 .
- iv) Release of no chemical vapours during setting and application so as to injure the text.
- v) Quick setting with low hygroscopic action with no strain on bonded surface.
- vi) Good keeping without change in colour, scum or mould growth (use of safe preservatives).

g) Embossing foils

Gold and silver foils which were used earlier have been replaced with plastic coloured foils for embossing and tooling. The colouring medium of the foil should be non acidic and fast. It should not tarnish or fade on ageing.

Self Check Exercise

- 1) Discuss the requirements of a stable paper, good quality ink and adhesive for binding.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

8.3 PREVENTIVE CONSERVATION

Life and durability of books and documents depend on the chemical composition of constituents e.g., paper, ink or protective covering materials. The chief cause of decay of paper, textiles, leather etc. used in text and covering materials is acidity introduced during their manufacture or storage.

Preventive conservation which includes neutralising acidity imparts stability to these materials.

8.3.1 Chemicals used for Stabilising Paper

Deacidification or Neutralising acidity of text paper and ink.

The techniques used for paper deacidification are:

- i) Use of dry powders (alkaline chemical salts).
- ii) Use of aqueous or non aqueous alkaline solutions.
- iii) Use of alkaline vapours or gases.

The selection of a deacidification process depends on the physical condition of the document, and the quality of the ink e.g., water washable/resistant. Chemicals used are mild alkaline chemicals e.g. Calcium hydroxide and Methyl magnesium, Morpholine, Magnesium methoxide, Barium hydroxide, Ammonia (Dilute), Cyclohexylamines carbonate, Diethylzinc.

These chemicals do not effect the chemical properties of paper. However, if left as excessive reserve in paper, they destabilise paper showing colour change and fragility.

A satisfactory deacidification, or neutralisation process takes into consideration:

- i) Whether the chemical has successfully removed acid content and what is the resultant pH. A pH between 5.5 to 9.5 is desirable lower-and higher pH than these are injurious to paper.
- ii) What quantities of the chemicals are left as residual reactants and what effect these are likely to produce on subsequent aging.

8.3.2 Chemicals used for Protecting Water Washable Writing

It may be necessary to treat and protect water colours and inks in documents before these are subjected to deacidification. A variety of plastic emulsions are used in inert organic solvents for this purpose. A thin protective film is formed on the writing, drawing, painting etc. Some of these are: Soluble nylon, Polyvinyl acetate, Polyvinyl chloride, Polyamides and Acrylic esters.

Inert solvents used are: Acetone, Xylene, tri and dichloroethylene, Chloroform etc.

These emulsions do not react with paper or its constituents, yet modify surface properties such as smoothness, bonding, glare, opacity etc.

8.3.3 Chemicals used for Preventing Damage by Biological Pests

Numerous fungicides, poisonous dusts, fumigants and liquid emulsions are available for controlling insect pests.

For use in libraries and manuscript repositories only those preparations are safe which do not stain, damage or weaken paper and its components. Chemicals which liberate free sulphur, free chlorine is harmful to paper. Similarly, chemical formulations which contain mercury or arsenic are not safe. These preparations should in no case be used in contact with paper. Chemicals which can be used safely are:

Fungicides: Thymol, Formalin, Orthophenyl phenol, Salicylanilide.

Fumigants: Thymol, Paradichlorobenzene, Formaldehyde, Ethylene dichloride, carbon tetrachloride, carbondioxide; Ethylene oxide, Methyl bromide.

Insect Repellent: Camphor, Naphthalene, Paradichlorobenzene.

Use of chemical emulsions making use of Pyrethrum, D.D.T., Lindane, Dieldrin, Gammaxene should be avoided in direct contact with paper. These emulsions contain mineral oil or some terpenes which may stain or affect paper adversely.

Self Check Exercise

- 2) Describe a few chemicals which deacidify documents without impairing the quality of paper.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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8.4 CARE OF WEAK AND DAMAGED BOOKS AND DOCUMENTS

Repair and reinforcement of weak, fragile and damaged paper or repairing of old, loose, and damaged bindings is an essential task in libraries which have rare books and out of print publications. These materials are irreplaceable and are of intrinsic value. Many chemicals for repair and mending materials are used for repair and restoration of such materials.

8.4.1 Repair and Reinforcement Chemicals and Materials

Repair and reinforcement techniques make use of Tissue paper, Handmade or High grade Bond paper, Chiffon, Plastic foils (Cellulose acetate or Polyester). Desirable properties of these materials are:

Tissue Paper: White tissue paper with a substance of 9-12 gsm, and pH not less than 6.0 is suitable. It should be free from oily and waxy additives and its ash content should not be more than 0.5 per cent. Its alpha cellulose content should not be less than 88 per cent.

Waxed/ Oiled/ Butter Paper: It is used as a support for handling documents when wet during their treatment. This paper should be resistant to water penetration, and should not contain any oily/waxy constituent which would harm or stain paper.

Chiffon: Pure and white silk gauze which does not have any sizing or filling material.

Handmade Paper or High Grade Bond Paper: pH of this paper should not be less than 6.0 and it should have alpha cellulose content of over 88 per cent. It should not show any colour change during accelerated aging test.'

Cellulose Acetate or Polyester Film: These plastic films have been used for repair and mending. The coatings or adhesives used in these materials turn yellow and mar the appearance of paper and stains it also. Use of such materials is to be avoided.

8.4.2 Chemicals Used for Stain Removal and Bleaching

Stain removal from paper is possible by using inert organic solvents, which are also known as Drycleaning agents. These are Acetone, Benzene, Petroleum ether, Trichloroethylene, etc. However, inks and colours should be tested for their bleeding in such solvents before use. These chemicals are used with sponge or cotton swab. Each stain dissolves in a specific solvent.

Bleaching chemicals are used for removing localised stains. Most of these chemicals liberate free oxygen, sulphur or chlorine and react with the stain.

Some of these chemicals used with paper are- Calcium hypochlorite, Chloramine- T, Chlorine dioxide, citric acid, Oxalic acid, Hydrogen and Sodium peroxides, Formaldehyde, Potassium bioxalate, Sodium sulphite, Potassium Perborate and permanganate.

If not used under controlled conditions, these chemicals are likely to damage paper. Coupled with anti bleach chemical, these operations are carried by trained chemist with adequate care and caution.

8.4.3 Chemicals Used for Glazing and Varnishing Covering Materials

Many chemical varnishes and glazing solutions are now available for decoration and protective purpose.

Book Binding Textiles are treated with lacquers and plastic emulsions. Most of these chemicals are unstable and show cracking or aging. Some of these contain: Polyvinyl chloride, Nitrocellulose, Polyurethane, Polyacrylates and Polyamides.

A few varnishes are also available in the market which are described as insect repellents. These contain compounds of mercury/arsenic/sulphur etc. Use of these preparations is not advisable as they can contaminate the users' hands.

Leather used for book binding needs restorative treatment when it becomes dry, shows cracking or rotting due to acidity.

Waxes and oils which can be safely used are: Lanoline, Beeswax, Castor oil mixed in Hexane or Benzene.

Petroleum wax or mineral oils are avoided as these materials may prove harmful in the long run. Due to defective tanning (Vegetable or Chrome) leather develops acidity. For removal of acidity in leather 1 per cent Buffer solutions of Sodium benzoate or potassium lactate is satisfactory. Use of alkaline chemicals is likely to make leather dull, and damage its grain. Imitation leather is prepared by treating textile materials with polyamide emulsions and grain is embossed on these to give an appearance of leather. These materials can be treated like natural leather.

Self Check Exercise

- 3) Describe the requirements of Tissue paper and Handmade paper satisfactory for use in repair and reinforcement of damaged documents.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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8.5 SUMMARY

The performance or durability which in other words means resistance to wear and tear, as also longevity or lasting quality of books and documents depends to a great extent on the stability of constituents that make their basic form. Because of poor grade paper and ink used in many books and documents these materials have shown rapid decay, and age has wrought deleterious effect. Besides such damage many books and documents are spoiled and damaged by injudicious use of chemicals for controlling biological pests or ill devised preventive and restorative conservation techniques. Further use of poor grade binding materials, adhesives, etc, adds to this damage.

An understanding of the components and constituents that make the physical form of a book or document helps in selecting materials that are stable, have a lasting quality, at the very creation or production stage.

Further, adoption of selective preservative chemicals and restorative materials help conserving these materials on a long term basis.

8.6 ANSWERS TO SELF CHECK EXERCISES

- 1) Paper: High cellulosic purity; Alpha Cellulose Content High, Copper Number low, pH not less than 5.5
- Ink: Fast colour which gives lustrous and dense characters on paper.
- Satisfactory flow to get released on paper to form sharp characters.
- With no corrosive action on paper/pen/printing instrument.
- 2) Calcium hydroxide and Calcium bicarbonate in Water/Magnesium Carbonate in water. Barium hydroxide in Methanol Dilute ammonia and Cyclohexylamine carbonate.

3) **Tissue Paper:**

Substance 9-12 gsm

Free from oily and waxy constituents

Ash content 0.5 per cent (maximum)

Alpha cellulose not less than 88 per cent

pH not less than 6.0

Handmade paper:

pH not less than 6.0

Alpha cellulose content over 88 per cent

Should show no colour change during accelerated aging test.

8.7 KEY WORDS

Embossing : Decorate with raised design.

Fumigate : Destroy infectious germs, insects etc. with the fumes of certain chemicals.

Fungicides : Substance that kills fungus.

8.8 REFERENCES AND FURTHER READING

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UNIT 9 DISASTER MANAGEMENT

Structure

- 9.0 Objectives
- 9.1 Introduction
- 9.2 Disasters and their types
- 9.3 Preparedness for Disasters
- 9.4 Salvage and Recovery Procedures
- 9.5 Resurrection of the Library of Alexandria
- 9.6 Disasters Due to Armed Conflict
- 9.7 Recent Disasters Due to Natural Calamities
- 9.8 The International Committee of the Blue Shield(ICBS)
- 9.9 Summary
- 9.10 Answers to Self Check Exercises
- 9.11 Keywords
- 9.12 References and Further Reading

9.0 OBJECTIVES

After reading this Unit, you will be able to:

- understand about disasters and various types of disasters;
- discuss how to prepare and plan for disasters;
- learn the various salvage and recovery procedures for different materials like paper, books, microforms, magnetic discs, optical discs, and photographic materials;
- understand different recovery methods that can be employed for salvage of water damaged materials; and
- describe some of the major initiatives in this direction.

9.1 INTRODUCTION

The increasing occurrence of natural and human-caused disasters, including armed conflicts, is causing extensive loss of life, damage to property, and harm to the environment. Natural disasters like floods, earthquakes, hurricanes, landslides, volcanic eruptions and drought also cause tremendous devastation. There is an increase in the frequency of these disasters and the damage caused by them. Libraries and archival collections are not unaffected by their devastating impact. The countries are gradually shifting from disaster response to a more proactive approach to disaster management. A proactive stance to reduce the toll of disasters in the region requires a more comprehensive approach that encompasses both pre-disaster risk reduction and post-disaster recovery. And this is evident in case of documentary and cultural heritage also. This Unit discusses the various disasters and their impact on library and archival collections. A proper disaster management strategy should be formulated in order to avoid disasters and to mitigate the impact of any disasters that do occur.

9.2 TYPES OF DISASTERS

The term disaster may be defined as any occurrence that threatens human safety and/ or causes damage to library facilities and materials. Disasters can be natural or man-made depending on their origin. Disasters related to extreme weather events (floods, cyclones, tornadoes, blizzards, droughts) occur regularly. Disasters cannot be predicted and there is little that can be done to prevent these disasters as most of the disasters occur suddenly and perhaps unexpectedly. Disasters can be minor or major, and range from roof and plumbing leaks which can be repaired by in-house personnel; to broken water mains, power disruptions which require large effort and money for repairs; to major catastrophes, such as earthquakes, floods, tornadoes etc. in which all the organisation's operations are disrupted, all utilities are out of order, and destruction occurs on a massive scale. These disasters include fires, floods, earthquakes, hurricanes, tornadoes, and workplace violence. Any of these disasters, large or small, natural or man-made, has the potential to harm the library's collections, the building, the library employees, and the library users. In addition to potential damage, the disaster may disrupt the services that the library offers to its users. As Henson has put it "A library disaster is a threat that might cause harm to the library collection, building, staff, or users, or it is an unscheduled disruption of normal library services". Having a disaster response plan in place before a disaster strikes can help the library minimise the impact of a disaster and restore collections and services in an optimum time. Let us first understand the various kinds of disasters that library and information centres face.

Fire

Fire-related disasters are often even more destructive than those caused by water alone. Fires produce enormous amounts of heat, smoke, and toxic gases, and the process of extinguishing the fire sometimes causes as much or more damage than the fire itself. Causes of fire include natural phenomena such as lightning and earthquakes, as well as old or defective wiring or heating equipment, accumulations of combustible materials, and arson.

Water

Violent floods and storms that cause wind or water-related damage are typical natural disasters for libraries and information centres. The floods that may result from such events can be devastating. Besides natural occurrences such as hurricanes, tornadoes, and floods, water damage can come from malfunctioning plumbing, sprinkler, and air-conditioning systems. Floods, rain, sprinkler pipe breaks and other disasters can leave paper records, microfilm and other library materials soaked with water. Once water has entered the collection areas, a danger of a mold problem arises, especially if the humidity is high.

Earthquake

Earthquake is a natural catastrophe that may effect the collections in a library or museum. During an earthquake walls, ceilings, and shelves may collapse causing structural damage. The library buildings may be destroyed and the collections buried underneath covered in debris and mud. The damage to archival collections due to earthquake could be irreplaceable.

Theft and Vandalism

Library collections are also effected by theft and vandalism. Other man-made disasters are war, terrorism, rioting. All these lead to the destruction of collections of libraries and museums. During war a number of factors which affect libraries apart from the shelling are phenomena like the movement of people from the affected areas. Recent conflicts in Africa,

in the former Yugoslavia, Iraq and Afghanistan have shown the risks to the archival heritage from the devastating effects of armed conflict.

Chemicals

Plaster dust, sawdust, and other particulates filter into the atmosphere and then into the collections. They abrade the paper and act as a catalyst for chemical damage. Various chemicals present in the atmosphere, are spread from one area to another by air-handling systems, normal air currents, and traffic.

When structural damage occurs, the person in charge of the over-all building maintenance should assess the structural damage and determine when it is safe to enter the building. After this preliminary assessment, damage to the affected materials needs to be assessed. In addition to the “traditional” disasters caused by wind, water, and fire, libraries and archives should be well prepared to face threats of terrorism in all forms. Bombings, and other terrorist acts are also capable of causing mass destruction. Disaster planning for these types of extreme events presents an enormous challenge for librarians.

9.3 PREPAREDNESS FOR DISASTERS

Often it is found that the advantages of emergency preparedness are learned through hard experience when an emergency becomes a full-fledged disaster. However, the affects of disasters can often be mitigated or avoided altogether by a comprehensive, systematic, disaster-preparedness programme. A disaster management plan provides a means for recognizing and preventing risks, and for responding effectively to emergencies and disasters. It is increasingly being realised by the information professionals now that small-scale emergencies can be contained and in the case of a large-scale disaster, damage can be limited, if staff members are prepared to react quickly.

The basic principle of disaster preparedness is “to plan for a disaster that one hopes will never occur”. A disaster plan is a document that describes the procedures devised to prevent and prepare for disasters, and those proposed to respond to and recover from disasters when they occur. The responsibility for performing these tasks is allocated to various staff members who comprise ‘the disaster team’ (Lyall, 1993). The basic elements of a disaster management programme are a written document, both in paper and on the library’s website, and a well-trained Library staff. The document should be reviewed and updated at least annually. The various disaster management strategies should be discussed at any new staff orientation programme as well as in periodic refresher sessions for long-term staff. A well-documented disaster management programme enables to keep the staff members well prepared in the face of any emergency. Thus, formulating a written plan is a basic step towards preparing for disasters.

Disaster planning is a complex process. The entire process must be supported at the highest level of the organisation if it is to be effective. Various guidelines for the **Disaster Planning Process** are mentioned below. The disaster plan should include, but not necessarily be limited to, the following steps.

- 1) **Assigning responsibility.** A proper disaster team must be formed with one staff member having the main responsibility for organising and updating the plan. The disaster team must comprise participants from different library backgrounds. Other personnel in the organisation—such as building maintenance staff, engineers, and security experts—should also be members of the team.
- 2) **Conducting preliminary research.** The disaster team should review literature on disaster planning and recovery, examine disaster plans from similar types of institutions,

and attend relevant workshops thus conducting preliminary research before formulating a disaster plan.

- 3) **Identification and Assessment of potential hazards.** The team should make a survey to identify the type of disasters that may occur and determine the probability of their occurrence. Various geographic and climatic hazards and other risks that could jeopardise the building and collections should be identified. These might include the institution's susceptibility to hurricanes, tornadoes, flash flooding, earthquakes etc. and also to man-made disasters such as power outages, sprinkler discharges, fuel or water supply failures, chemical spills, arson, bomb threats, or other such problems. Within the building, fire protection systems, electrical systems, plumbing, and environmental systems should also be examined. The condition of the electrical wiring, if it is old or overloaded, whether electrical appliances are unplugged at night or not, the condition of water/ drainage pipes, problems if any with the climate control system, installation of sufficient number of fire extinguishers in the building, whether they inspected regularly or not, existence of fire alarms and fire suppression system, if they are well maintained or not, provision for fire exits, is any fire exit blocked — all these questions should be taken into account. Then an assessment should be made regarding the extent of danger each of the identified disaster poses to the institution and its continued operation. Based on this assessment, a list of the required preemptive measure to protect the institution's facilities should be prepared and finalised.
- 4) **Identification of resources.** Sources of assistance in a disaster should be identified. The various supplies required in the event of a crisis for disaster response and salvage efforts should be identified. Basic supplies like sponges, flashlights, plastic sheeting, small plastic buckets, paper towels and sponges, masking tape and duct tape, scissors, latex or rubber gloves, dust masks, cleaning products and disinfectants, etc. should be procured and kept in an easy to locate place. A list of required supplies and a list of suppliers' names, addresses, and phone numbers should also be prepared and maintained.
- 5) **Setting up liaisons with local emergency agencies.** The team should make an assessment of the area's potential hazards, such as fire, floods, earthquakes etc. The team should also consult fire fighting personnel and see that the building is in conformity with the fire norms. Local service like fire service providers should be asked to visit your institution to become familiar with your site plan and collections in advance of an emergency. All appropriate disaster-response and recovery services, ranging from police, fire, and ambulance services to maintenance workers, insurance adjustors, and utility companies, should be identified. Several companies provide disaster-recovery services such as dehumidification and vacuum freeze drying. Liaisons should be maintained with local emergency services so that they can respond appropriately in case of disaster.
- 6) **Establishment of goals and tasks for team members.** In addition to their primary responsibilities the various team members should be assigned other tasks as well. These tasks should be well-defined and prepare them to take needed action in case of any disaster. The list of tasks should be updated regularly. Proper deadlines should be set for the completion of the various stages of the disaster planning process.
- 7) **Conduct a collection survey and determine salvage priorities.** An assessment should be made of entire collection of the library and also about the contents of the collection. It is also important to determine the vulnerability of the objects within the collections. The security and housekeeping procedures should also be analysed to

check if they expose collections to the dangers of theft, vandalism, or insect infestation. Then the treatment priorities must be established based on factors such as the intrinsic and monetary value of the items, their importance to scholars and researchers, and any legal obligations of the institution. Highest priority should be given to items that are unique, and therefore, difficult or impossible to replace. The items that are essential for the ongoing operation of the institution, or have significant research importance or monetary value can also be included in this category. These items must be given maximum protection and in the event of a disaster their salvage must be the foremost priority. Items that are rare, difficult to replace or that can be replicated only at high cost should rank second in the priority listing. These items should be given special protection within the limits of available personnel, time, and funds, once the high priority items have been dealt with. Then come the items that can be replaced without much effort. Current periodicals, commercially produced audio-visual material, and use copy microforms fall into this category. These items should be dealt with only after the items in the earlier two categories have been treated adequately.

- 8) **Financial Assessment.** The team should also make an analysis of the financial implications of a disaster and also how to make up for those financial requirements. The institution's insurance policy should also be examined to determine the adequacy of the levels of coverage.
- 9) **Documentation of the plan.** After formulation and finalisation the plan must be documented. A sample outline of the plan (Patkus, 1999) is given below:
 - i) Introduction, stating the lines of authority and the possible events covered by the plan.
 - ii) Actions to be taken if advance warning is available.
 - iii) First response procedures, including who should be contacted first in each type of emergency, what immediate steps should be taken, and how staff or teams will be notified.
 - iv) Emergency procedures with sections devoted to each emergency event covered by the plan. This will include what is to be done during the event, and the appropriate salvage procedures to be followed once the first excitement is over. Floor plans for the various areas covered in the plan should also be included in the final plan. These floor plans should show the location of fire extinguishers, smoke alarm systems, air conditioning systems, sewage and drainage systems, and emergency exits.
 - v) Rehabilitation plans for getting the institution back to normal.
 - vi) Appendices, which may include evacuation/floor plans; listing of emergency services; listing of emergency response team members and responsibilities; telephone numbers of the emergency response team members; location of keys; fire/intrusion alarm procedures; listing of collection priorities; arrangements for relocation of the collections; listing of in-house supplies; listing of outside suppliers and services; insurance information; listing of volunteers; prevention checklist; record-keeping forms for objects moved in salvage efforts; detailed salvage procedures.
- 10) **Ease of Implementation.** The written disaster plan should be easy to implement during a crisis. Instructions must be concise, clear, and comprehensive and flexible enough to allow for adjustments and improvisation. Staff must be given adequate

training in emergency procedures and regular drills should be conducted if possible. After formulation the plan should be sent for the approval and support of the institution's top-level management. All members of the disaster recovery team should be given two copies of the plan, one to be kept at work and one at home. Copies of the plan should also be kept in various locations in the institution itself. Essential supplies for quick response to the kind of disaster that is most likely to occur (for example water damage) should be stockpiled in various easily accessible locations throughout the institution.

- 11) **Maintaining the plan.** The plan should be updated regularly, whether or not a disaster has occurred. This becomes all the more essential as names and contact information for pertinent staff, vendors, and suppliers may change frequently; new collections may be added; buildings may be modified; and new equipment may be installed. In order to be effective in case of a disaster, the plan must be updated and modified regularly.

Disaster planning is becoming an important part of the overall management plan for a library or archive. For effectiveness disaster planning must be integrated into the routine operating procedures of the institution. Survey of an institution's collections and creation of an inventory for disaster planning enables better access to the collections for researchers and staff. The disaster plan should address all types of emergencies and disasters that the institution is likely to face. It should include plans for both immediate response and long-term salvage and recovery efforts. An effective disaster plan is characterised by comprehensiveness, simplicity, and flexibility. Last but not the least the plan must be easy to follow. In situation of a crisis people often have trouble thinking clearly, so the plan must have concise, easy to follow instructions in a clear and simple language and style. Adequate training is also essential for the success of plan.

Response to disaster

In case of crisis the first response should be contacting the Library's Security office. Library's security staff will then contact Public Safety if required. Meanwhile they should take the required steps to limit potential damage. These steps involve making sure that the library users and staff members are not in danger, and locating and eliminating the source of the problem. In case of minor fire, fire extinguishers should be used to put out fire. In case of water damage, efforts should be made to cut off the water supply to the effected area. This should be followed by efforts to remove the materials out of danger. However, any clean up or salvage work should not be undertaken till the situation is stable and a proper damage assessment has been made. Once the situation is brought under control, the members of the disaster maintenance team should then make an assessment of the overall damage caused. Types of materials have been damaged, the nature of damage, the extent of damage - all these factors should be considered while making damage assessment. On the basis of the assessment made by the disaster management team important decisions, as whether to withdraw, replace, or attempt salvage of damaged materials, should be taken. Materials that are to be withdrawn should be set aside and not discarded immediately. Water-damaged materials can usually be salvaged, but the process is expensive, labour-intensive, and time-consuming. However, in case of severe fire, damage is generally irreversible and salvage is not possible. In the event of major disasters, salvage should be done according to the set salvage priorities. However, if the extent of damage is small all damaged items can receive treatment.

Self Check Exercise

- 1) Mention in brief the various steps in preparation of a Disaster Plan.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

9.4 SALVAGE AND RECOVERY PROCEDURES

Salvage is an important part of the overall disaster planning process, comprising steps like prevention, preparedness, response, and recovery. Recovery of wet documents and records is one of the most daunting tasks as apart from floods, rains, leakages and other disasters even fire suppression can leave paper records, microfilm and microfiche soaked with water. Immediately after becoming wet, paper-based collections begin to distort physically — books swell and distort, paper cockles, inks and pigments run and coated papers begin to adhere to one another. For an effective recovery/ salvage effort what is most important is immediate response. A quick and rapid response can enable a hundred percent recovery. The main strategy should be to keep photographic media from drying and blocking, and to freeze paper documents to prevent further damage. The immediate environmental conditions must be given attention — water must be removed, temperature and humidity controlled, and dry collections protected. Materials that could be dried easily and relatively inexpensively, if attended to quickly, should be separated for rebinding or expert conservation. Wet paper, books and photographic records should be packed and shipped to cold storage for stabilising the wet materials by freezing. Freezing is not a treatment method in itself, but a way of arresting damage until treatment can proceed. Freezing halts mold growth, prevents inks from running and pages from sticking together, reduces smoke odour, and initiates the drying process. Books may be frozen indefinitely with no further damage, and all further treatment options still remain possible.

Any salvage operation must be aimed at preservation of the overall collection. Proper techniques and care handling must be practiced in order to avoid causing further damage during the salvage process. In case of water damage immediate action needs to be taken to lower the temperature and humidity in order to inhibit mold growth. Target temperature should be 65° Fahrenheit and humidity of 45%. The thermostat must be turned down, heat or air-conditioning system turned on, and dehumidifiers and fans should be set up. Immediate efforts should be taken to remove standing water with wet-dry vacuums if this can be done without further damage to materials. The success of any salvage effort depends on the availability of adequate number of staff and their ability to work without distraction.

In case of fire, the fuel consumed in the fire has a direct bearing on the restoration effort. Soot produced from wood and paper is not as greasy or oily as the soot from plastic, carpet, insulation around electrical wires etc. Soot left on equipment and other materials is potentially harmful to metal components and damage continues long after the fire is out. Smoke contains hydrochloric, hydrofluoric, and/or hydrobromic acid fumes in varying amounts as well as other reactive agents that are corrosive in nature. Paper, photographs, micrographics, magnetic media, and some building materials must be handled very carefully when wet. These items may be knocked to the floor during the firefighting efforts.

Salvage of paper

One should be extremely careful when handling wet materials as they are rendered very fragile, and can be easily damaged during packing and transport. Files must be packed carefully in proper order, and sufficient documentary information should be maintained. If some time is available, different materials should be packed separately. The materials can be packed in the following categories: by media, moldy from uncontaminated and wet from partially wet and damp (Waters, 1993). Coated papers will stick together unless frozen or dried immediately. Keep them wet in cold water until they can be air dried or packed for freezing (Walsh, 1997). Maps and plans should not be blotted, especially if the inks are water soluble and quickly frozen or air dried.

Salvage of Books

Separate soaked books from books with light water damage. If any books are actually submerged in water, do not remove them until they can be dealt with immediately. Mold grows faster in air than in water. Unless it is possible to work within the damage area, wet books must be moved to a space where they can be treated. Do not attempt to open or close wet books or remove book covers. If the water is very dirty, books should be washed before freezing. Closed books should be washed in tubs of cold running water and then dabbed (not rubbed) with a sponge to remove the mud. Then they should be packed spine down or lying flat in single layers, in a milk crate or cardboard carton (pack only 1 layer deep, to prevent crushing of bindings). Books with coated papers stick together unless frozen or dried promptly. Therefore, they should be kept wet in cold water until they can be air dried or frozen.

Books that have been soaked need to be individually wrapped in wax paper or freezer paper and immediately frozen. Any commercial freezer is adequate. After the books have been frozen they will need to be dried at freezing temperatures in a vacuum chamber. Following treatment in the vacuum chamber the books will have a humidity of about two percent. At this point the books will be very fragile and will need to be stored undisturbed for two to four weeks until they have regained their normal humidity (about seven percent).

Books with minimal water damage may be air dried. The following procedures should be followed:

- 1) Select a cool, dry, well-ventilated area for drying.
- 2) Cover worktables with paper towels or clean newsprint.
- 3) Stand books upside down with covers slightly open; do not fan pages. Place toothpicks under covers so that books stand tilted slightly backwards.
- 4) Place clean newsprint or paper towels between covers and end papers; change frequently.
- 5) When books begin to dry, use paper towels or clean newsprint to interleave at intervals of 50 pages. Keep books upright during this process.

Leather, parchment, and vellum bindings distort and disintegrate in water and are highly susceptible to mold growth. They should be air dried; if there are large quantities, freeze them.

Fire leads to damage by burning of books etc. and in addition to this it can cause indirect damage through heat, smoke, soot, and water thus affecting materials far removed from the actual flames. Books with charred edges can be trimmed and rebound. Heavy or light soot can be gently removed by brush. Some soot stains can be removed with the help of a rubber sponge. And if the stains are water-soluble they can be cleaned with a damp

cloth. Books should be carefully opened and cleaned to remove the soot especially from the area between the cover's spine and the text block. Books with sooty covers should be rebound. Exposure to rapidly circulating air can help in lessening the smoke odour.

Salvage Procedures for Microforms

First step in the salvage of microforms and microfiche is to determine whether they are replaceable or not. If available, replacement is the most cost effective solution. Then examine the microfilm rolls to determine how wet they are. If microfilm or microfiche is contaminated by mud or other debris, it may be rinsed in cool, clean water. Never attempt to unroll or separate water damaged microfilm or microfiche when wet. Microfilm that is thoroughly wet will fuse together as it dries therefore, it should be kept wet and sent to a lab to be reprocessed as soon as possible. To keep it wet the reels should be placed in a large plastic container and covered with cold clean water. Cold water at low temperature helps to keep the emulsion from separating. If reprocessing is not an option microfilm may be unwound and air-dried on clothesline however this might result in scratches and water spots. Similarly, microfiche to be reprocessed should also be kept wet in cold water. Microfiche may also be removed from storage envelopes, separated, and air-dried. Water damaged microfiche and water damaged microfilm, should be frozen as quickly as possible in order to inhibit mold growth.

Salvage Procedures for Photographic Materials

A photograph conservator should be consulted for salvage of photographic materials. All photographic materials are very vulnerable to water damage and immediate action should be taken to salvage them. Collodion wet plate negatives, ambrotypes, pannotypes, and tintypes should receive first attention. Beyond these categories, prints in general should be treated before negatives, and colour material before black-and-white, assuming all are of equal research value (Albright, 1999). Dirty items may be rinsed in clean, cool water and dabbed off with blotting paper or soft cloth. Do not rinse or dry off any item showing signs of emulsion deterioration such as bubbling, separation, or image loss.

Air-drying is the preferred salvage method for all photographic materials. Items should be separated and placed emulsion side up on clean lint-free cloth or blotting paper. Do not touch wet emulsions. Photographs and negatives of any type should never be allowed to dry with their emulsion in contact with any other surface, including other photographs, because it will adhere to that surface and be impossible to remove without irreparable damage. Cased photographs should be carefully separated from frame and mat and laid flat to dry. Small weights may be placed at the corners of drying items to limit curling, and photographs that do curl up can often be flattened again after they dry.

Photographs waiting to be separated and air-dried should be kept damp by sealing them in plastic bags and immersing the bags in cold water. If all items cannot be treated within 48 hours, they should be frozen and kept for air-drying later. Any items that have already stuck together should be frozen as is before they have a chance to dry. Do not attempt to separate them at this point. Freeze-drying should be undertaken only as a last resort because it can cause further damage. Vacuum drying should not be considered at all. Vacuum drying can cause reversible damage to the surface of the photograph. Do not freeze wet collodion processes, photographs in cases, i.e, daguerreotypes, ambrotypes, tintypes, magnetic media photo, glass negatives, and glass positives.

In case of photographic materials exposed to fire, heat will again cause the emulsion to become sticky and it may adhere to adjacent surfaces and possibly shrink and crack. The base of the film or print may also burn, shrink or distort. The emulsion will swell and become sticky if it is exposed to water (used for fire extinguishing) and will stick firmly to

adjacent surfaces. Smoke and dirt may get adhered to the surface of the emulsion and base. There may also be chemical reactions between smoke/dust and components of the photographic material causing fading of colour dyes and decomposition. The physical effects can be diminished; however it is not possible to recover the actual image.

Salvage Procedures for Electronic Resources

Hard drives are housed in cabinets that are less susceptible to water and soot contamination. However, they may be affected by heat. If due to fire or water damage the hard disk is not accessible, it should be removed and placed in another compatible unit. If this does not work it may need to be opened and cleaned and therefore, in order to recover data from such a hard drive, any firm or expert specialising in data recovery may be contacted. If optical discs like CDs etc. have been exposed to dirty water they should be rinsed in clean water and dried with a soft, lint-free cloth. During the recovery care must be taken to avoid physical damage due poor handling. Care must be taken so as to not to scratch the surface of discs. Fire may cause distortion of the optical discs resulting in total loss of content. Even if the CD appears intact the dyes used for recording data might be affected by fire and heat, and the disc may not work. CDs may also be affected by water used for fire suppression if they are physically scratched or damaged especially on the label side. Smoke and dirt caused due to fire damage may adhere to the surface of the tape, disc or CD and cause problems in playback or physical damage to the object or machine. In case of fire damaged CD's if the disc appears not to be distorted, then dust or dirt may be gently brushed from the surface of the disc taking care not to scratch the label side. The laser side may be rinsed with clean or de-ionised water. Brushing or drying should be done only from the centre towards the edge and not in a circular motion around the disc using soft brushes or cloth. Once the information has been retrieved it should be copied on a new CD.

If possible, tapes (audio, video, and computer) and floppy discs etc. should be replaced rather than salvaged. Wet floppy discs should be dried immediately. They can also be dried with a hair-dryer set on air only. For drying, wet floppy discs must be carefully cut out of their enclosures, washed in distilled water, air-dried, placed in replacement enclosures, and then copied. If treatment is delayed the damaged discs should be kept wet in cold, clean water. A wet or dirty audio or video tape should not be played as it can be harmful to the playing equipment as well as to the tape itself. If the tape is still wet and dirty, submerge the entire cassette in running water to clean it. A slightly wet tape may be cleaned by fast-forwarding and rewinding it through a tape cleaner. This will remove any debris that might have deposited on the tape. The lint cleaners will pick up the water as the tape passes across them. The lint cleaners will need to be replaced as they become wet. The wet tapes can also be air-dried by setting fans to blow constantly but indirectly over it. After treatment the data from the damaged tape should be transferred/ copied to a new tape.

In case of fire the magnetic signal in audio tapes and cassettes may be affected either over a part or all of the tape. This may lead to a faint or distorted sound or an increase in the background noise. In case of fire damaged audio tapes and cassettes, if the cassette shell is in good condition the tape may be cleaned and replayed, if the shell is distorted or damaged the tape may be transferred to a new shell. Do not touch magnetic media with bare hands. Handle open reel tapes by hubs or reels.

A vinyl disk may get distorted as a result of exposure to fire and heat. A distorted vinyl disc may be flattened again by placing it between two sheets of glass and then leaving it in a warm place for some time till the disc appears completely flat. The disc should then be left to cool down. However, this treatment may not completely recover the full quality of the

original recording and there might be some loss of the quality of audio content. Dirt and dust can be rinsed off using clean or preferably deionised water and gently patting the surface with a very soft brush or cloth.

Different Recovery Methods

Some of the recovery methods that can be employed for the salvage of water damaged materials are:

Air Drying

Air drying is the oldest and most commonly used method for treatment of wet books and records. It is an inexpensive method of drying as no special equipment is required in this method. However, a great deal of space is generally required. In this method, documents records are dried at room temperature with relative humidity below 60% and fans to keep the air circulating. Materials are spread out on or interleaved with absorbent papers.

Freeze Drying

This method is used for treating books and records that are only damp or moderately wet. By freeze drying water-damaged library and archival materials are stabilised by freezing and storing at low temperatures, before being dried. This buys time in which to plan and organise the steps needed to dry the material, and to prepare a rehabilitation site and the building for storing the collections after drying (Waters, 1993). Freezing stops mold growth, prevents inks from running and pages from sticking together, reduces smoke odour, and initiates the drying process. Books may be frozen indefinitely with no further damage, and all further treatment options still remain possible. This enables to store the water-damaged materials safely preventing further deterioration by water and mold till final treatment and restoration. Freezing also stabilises water-soluble materials such as inks, dyes, and water stains etc. Freeze drying can be carried out by placing the wet records in a self-defrosting blast freezer with temperature below 0° C. For faster drying, documents may be placed in the freezer in stacks or spread out. Leather and vellum bindings can also be dried in this way. By this method wet materials can be kept several weeks to many months, depending upon the temperature of the freezer and the extent of water damage.

Vacuum Freeze Drying

In this process frozen records are dried in a vacuum chamber at temperatures below 0° C. The process is suitable for large number of wet books and records as well as for water-soluble inks and for coated paper. It prevents additional wetting, bleeding, feathering or distortion, and sticking together of materials. In vacuum freeze drying sophisticated equipment is used. Frozen books and records are placed in a vacuum chamber. The vacuum is pulled, a source of heat introduced, and the collections, dried at temperatures below 32° F, remain frozen. In this process sublimation takes place i.e. water passes from ice to vapour without melting or becoming liquid. It is necessary to monitor the temperature of the records inside the chamber otherwise once the wet materials have dried, they will heat up. Vacuum freeze drying is most suitable for rare and unique materials but not for leathers and vellums. The method is a little expensive however it saves the funds and effort required for rebinding and cleaning as mud, dirt and/or soot are lifted to the surface. The process is appropriate for large numbers of very wet books as well as for coated paper.

Vacuum Thermal Drying

This process is generally used for slightly to extensively wet materials. In this process materials are placed in a vacuum drying chamber, the vacuum is drawn, heat is introduced, and the

materials are dried at temperatures above 0° C. As it is a process that changes a liquid to a vapour, it results in a much greater risk of expansion, distortion, sticking, and staining. It often produces extreme distortion in books and papers, and causes adhesion or blocking of coated paper and photographic materials. Water-soluble inks or pigments are also affected. However, the process is suitable for un-coated papers, vacuum thermal drying is often cited as a cost-effective option for materials of low intrinsic value. For large collections, vacuum thermal drying is easier than air drying and also more cost-effective. However, it leads to extensive rebinding or recasing of books and expanded shelf or storage space is also needed.

Dehumidification

Dehumidification is also known as desiccant-drying. In this process large, commercial dehumidifiers are used for drying the records which are still on their shelves with all the collections, equipment, and furnishings left in place. Temperature and humidity are carefully controlled. Dried (dehumidified) air is introduced at very low relative humidity, often below 15%, and circulated with fans in and around the drying chamber. Air temperatures vary throughout the drying process, but usually are in the range of 26-37° C (79-99° F). This method is not suitable for drying most collections, because it affects water-soluble inks or pigments thus causing the water soluble media to further bleed, and blocking of coated materials. This process provides the ease of drying the collections in place thus eliminating the cost and effort of removal to a freezer or vacuum chamber and is suitable for library or archives buildings that have suffered extensive water damage to the structure itself.

Air drying is suitable for drying small quantities of damp and partially wet papers and books from minor disasters. Freeze drying is suitable for large quantities of wet materials especially water soluble media, coated paper, and drafting linens. Vacuum drying will dry large quantities of wet records without intrinsic value. However, it is not suitable for many archival materials because they have water-soluble inks that could bleed. Never vacuum dry coated papers and drafting linens because they will stick together. Parchment and vellum manuscripts may be freeze dried. Air drying or vacuum drying without heat can be done in case of magnetic tapes.

Self Check Exercise

- 2) Write about the salvage procedures for damaged microforms.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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9.5 RESURRECTION OF THE LIBRARY OF ALEXANDRIA

The Great Library of Alexandria, which was probably established by Ptolemy I, around 300 BC, was the most important centre of learning in ancient times. The initial organisation

is attributed to Demetrius, and is estimated to have stored at its peak about 400,000 to 700,000 parchment scrolls. The ancient library had an unsurpassed collection of important original manuscripts and, in many cases, unique volumes by the classical Greats. At its height, the library was said to contain copies of “all the books in the world”. It held documents from Assyria, Greece, Persia, Egypt, India and many other nations. Over the periods the library was repeatedly rebuilt, modified, and burned. The historians are divided on when and how the library was destroyed though they are certain that the library was destroyed by fire. The library is said to have been first destroyed in a fire during Caesar’s reign. It is widely held that fires and depredations during the Roman period gradually destroyed the Library. Some historians attribute the destruction of the library to a period of civil war in the late 3rd century AD.

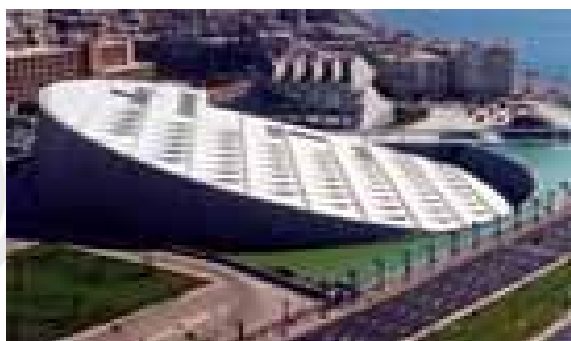


Fig. 9.1: The Bibliotheca Alexandria
(Source: <http://www.bibalex.org/>)

In 1974, the University of Alexandria began a campaign for the rebuilding of the ancient library and allocated the land, which is believed to be close to the original location. An organisation was founded in 1988 to carry on with that project, and on 25 June 1990, the president laid its first stone. Detailed archaeological excavations of the site were carried out before construction began in 1995. The construction was executed in 1995, with a total cost of US\$ 176 million, by Egyptian, British and Italian companies. The new Great Library of Alexandria, the Bibliotheca Alexandrina, finally reopened, if only for a trial run, after 11 years of planning and construction and 1500 years or so of cross-accusations about who burned down the original. The library was conceived, funded, designed and implemented in a spirit of international cooperation with active support from UNESCO. The New Bibliotheca Alexandrina takes the shape of a circular diaphragm wall – 160 meters in diameter and 33 meters high - representing the sun. It consists of 11 floors with a total area of 85,405 square meters. The circular form of the library, facing the sea, also has strong symbolic significance and an iconic presence. Its exterior wall is clad with four thousand granite blocks carved with letters from the alphabets of the world. The whole complex includes two other libraries (Library for the Blind and Young Peoples’ Library), a large convention center, planetarium, four museums (science, calligraphy, manuscripts and archeological) as well as the International School of Information Studies, Center for the Preservation of Rare Books and Documents, as well as research center and exhibition areas. The library is planned to contain 8 million books, 4000 periodicals, 50,000 manuscripts and rare books, 50,000 maps as well as audio-visual and multimedia materials and computer databases.

9.6 DISASTERS DUE TO ARMED CONFLICTS

Armed conflicts in the form of wars between nations, civil wars and terrorism pose grave threats to libraries and other cultural institutions. The various cultural institutions represent a nation’s identity and common history. During conflicts and wars large scale destruction of library collections and other cultural institutions takes place. This leads to permanent destruction of the precious documentary and cultural heritage. It is not possible to mention

the list of all the libraries and archival collections which have been damaged due to war, bombardment and other acts of terrorism. During the two world wars considerable damage was caused to library and archival collections. One example is of the Library of the University of Louvain, Belgium which was destroyed because of German invasion during World War I. The entire collection of about 300,000 books was destroyed. After the war the library was rebuilt with the aid of funds and books received from many countries. However, the library was again destroyed in World War II. Similar, damage was caused in other countries like, France, Italy, Germany, Poland, United Kingdom, Czechoslovakia, Netherlands, former Soviet Union where a large number of libraries, archives and museums were destroyed due to fires caused by bombings, air raids, artillery fire during war and invasion. In the 1990s events in Cambodia, the Gulf war and the war in former Yugoslavia, caused untold destruction to libraries and archives.

During the 1992-96 conflict in Bosnia-Herzegovina also there was widespread destruction of cultural and religious heritage. Shelling of the National and University Library of Bosnia and Herzegovina led to a fire that burned down the building and destroyed most of the collections. A large number of books in the library had been salvaged from collections in libraries that were damaged during World War II.

Large scale destruction was caused to archives, libraries and other cultural institutions during the war in Iraq. Because of armed conflict there was the looting and burning of Iraq's National Library and National Archives and the destruction of most of the contents of the National Museum. An assessment of the damage to libraries and archives in Iraq was made. The different libraries situated in different cities and the collections originally held by them and the number of collections destroyed or burnt.



Fig. 9.2 Basra University Central library- scene of a looted reading room.

(Source: <http://ifla.org/>)

The initial assessment just after the war was based on different inputs- like reports by researchers who spent time working in Iraqi libraries (e.g. verbal report by Dr Donny George, Director of Research, Iraqi museum and written report by Edouard Méténier, a French researcher who spent six months working in Iraqi libraries), information posted on various subgroups (H-ISLAM, H-LEVANT, etc.), etc. Later on UNESCO sent its expert teams to Iraq. It was found that few libraries, like Library of the Iraqi Museum which had one of the finest collections on history and archaeology of the Middle East, had most of their collections evacuated before the war started – completely protected. Preliminary investigations by the historians revealed that between 30%-60% of the National Library's collection is safe and held in three separate locations. However, In Baghdad, Mosul, Basra and other cities almost all university libraries were looted and/or burned, even the ones left untouched have little in them. In Kurdistan, there are hardly any books or journals after 1980. Most of the major collections at Baghdad's Academy of Sciences library - which held 65,000 volumes, 8000 manuscripts, and microforms – were reported as missing.



Fig. 9.3: Burnt National Archives (Iraq)
(Source: <http://ifla.org/>)

IFLA made a call to all countries to commit to contribute to the restoration of the physical, professional and technological infrastructure of Iraq's libraries. Responding to the devastating effects of war on Iraqi libraries, the Simmons Graduate School of Library and Information Science (GSLIS) and the Harvard University library system have launched a joint program to provide training for Iraqi librarians and archivists, to help modernise Iraqi libraries and address the country's serious shortage of librarians. The Library of Congress (LOC) has also stepped in to help rebuild and restructure Baghdad's National Library after it was devastated by arson and looting. The Cultural Emergency Response (CER), a joint initiative of the Prince Claus Fund of the Netherlands and the International Committee of the Blue Shield, allocated funds to help refurbish the reading room, of the Central Library of the University of Baghdad, damaged during war in Iraq. The money from this fund was used to buy tables, chairs and computer equipments for the library. Universities, publishers and businesses in United Nations donated ten tons of educational books and journals for universities in Iraq. The British Library offered to provide conservation training to the Iraqi personnel. It also offered to participate in an internationally co-ordinated and funded programme to produce surrogate copies of cultural heritage items of significance held in the British Library's collections as a contribution to the reconstruction of the collections of Iraqi libraries and archives.

In Afghanistan also massive destruction of library and archival collections took place due to long period of armed conflict. The magnificent remains of this past and the treasures that survived looting and war until the invasion of the country by Soviet troops in December 1979 were destroyed in the later period of conflict that continued till 1996. Many monuments were damaged and documents disappeared. The illicit traffic of cultural artifacts was rampant. The National Museum was destroyed by war and rocket fire and much of its collection was later stolen or looted. Apart from the Kabul museum a large number of other monuments were destroyed due to shelling. Many people, organisations and countries pledged assistance for the reconstruction of the national heritage. The National Museum, various other monuments, sites libraries and archives need to be reconstructed. UNESCO has taken up projects to rehabilitate Afghanistan's information institutions and infrastructures. This includes assistance to the libraries (National Library, Public Libraries, School Libraries, University Libraries, etc.) and the records and archives management system (National Archives, Regional Archives, Communal Archives, Archives of Public Administrations, etc.).

In order to combat the threat to cultural heritage during armed conflicts UNESCO commissioned the International Council on Archives in 1997 to develop guidelines to help

archives to protect their vital or essential holdings. Protection during armed conflict should cover two elements. First is the use of protective techniques in the archive building, in situ protection, to increase the insulation of the archive material from attack. Second is the evacuation and sheltering of collections or parts of collections, or re-formatted copies of documents, which involves criteria of selection for protection, identification of shelter sites, physical arrangements for moving, together with consideration of the circumstances in which the procedure will be initiated. Some of the recommendations provided by this study are:

- All archive institutions should establish written emergency policies.
- Emergency programmes for protection of archives in armed conflict should be developed in close conjunction with general disaster preparedness plans. Where no disaster preparedness plan exists, one should be developed along with the armed conflict protection programme.
- The development of the plan must be undertaken at a senior level and fully supported by the Director of the institution.
- Part of the plan must be to stockpile materials and equipment appropriate to the needs of the institution and its vital records.
- Plans must be regularly reviewed and tested and staff must receive regular training.

9.7 RECENT DISASTERS DUE TO NATURAL CALAMITIES

Natural calamities like floods, tornados, hurricanes and earthquakes etc. are some of the natural disasters that cause enormous devastation of library and archival collections. A deadly Earthquake struck Gujarat in January 26, 2001. The earthquake flattened hundreds of towns and villages in Gujarat. More than 20,000 people were killed, 166,000 injured and 1.1 million homes destroyed. The damage to historic buildings, and sites of cultural heritage significance was both severe, and widespread. Many libraries and their collections were damaged in the devastating earthquake.

Invaluable cultural heritage was damaged and destroyed by the floods in Europe in August, 2002. Cultural monuments and institutions such as museums, galleries, theatres, libraries, and churches buildings in Austria, Germany, Hungary, Slovakia and the Czech Republic were affected. Archives and library collections in the Czech Republic suffered extensive damage due to floods though libraries and archives in the German cities of Dresden, Dessau and Wittenberg are suffered less damage. Affected public libraries in Czech Republic reported an initial loss of approximately 280,000 volumes. The floods caused extensive damage to the archives in Prague, especially to the National Technical Museum, Military Historical Archive, the Academy of Science, the Municipal Library of Prague, the Czech Philharmonic Orchestra, and the Czech Statistics Office. Many precious books and manuscripts at Charles University were damaged. About one million volumes from various library collections, among them several early prints and printed books up to the 1800, and some rare collections have been damaged. Museums and archives also suffered considerable loss. Thousands of irreplaceable works of art — including old masters such as Rubenses, Rembrandts and van Dycks and Raphael's famous Sistine Madonna — were rescued at Dresden's baroque Zwinger Palace from the floodwaters. A large portion of the cultural artifacts in Prague and Dresden were evacuated prior to the flooding. The collections of the National Library of the Czech Republic in the capital city of Prague did not suffer any damage. A consultancy and support centre was established in the Czech Republic for various libraries and cultural institutions whose collections were inundated by floods. Libraries, museums, and archives in the country used vacuum sublimation chambers for freeze-drying. Condensation and heat drying equipment was also used. Most of the

archival materials in National Technical Museum were secured by deep-freezing. The Museum prepared a special building with large utility space (2 x 300 m²) in which the frozen records could be defrosted, washed, disinfected, stabilised, dried and then registered, restored and put in a suitable storage. Provision was also made for a depository of the rescued items. Special equipment like portable freezers, spraying tubs, drying chambers and boxes, drying tables, pressing tables, acid-free cardboards, record folders and boxes were acquired for conservation/renovation works. Suitable germicide and stabilisation solutions were also used for the treatment of the records not directly damaged by water, but inflicted by mildew in humid environment.

The terrible tsunami that hit coastal areas of the Indian Ocean in December 2004 caused considerable damage to human life and property. It damaged library buildings, collections, furniture, and mobile libraries. In Sri Lanka the National Library has identified 177 school libraries, 53 public libraries, and 68 religious libraries that were either destroyed or damaged. The purpose was to assess the damage to libraries and information services of all types and to begin to plan programmes of rehabilitation. With the assistance of the National Library and Documentation Centre, Unesco, IFLA and a number of Sri Lankan organisations have established the Sri Lanka Disaster Management Committee for Libraries, Information Services and Archives [SL DMC for LISA]. IFLA has issued an appeal to its members to contribute through national or international relief efforts, and the Sri Lanka National Library and Documentation Services Board is seeking assistance for the country's damaged libraries and collections.



Fig. 9.4: Library in Hikkaduwa, Sri Lanka
(Source: <http://ifla.org/>)

As all libraries in Maldives were not registered the exact level of damage caused to the libraries is not clear. According to the estimates, the damage to building and resources are huge. Some libraries have lost all of their material including the building itself, while other libraries have major damages. The National Library is making efforts to rebuild the libraries in Aceh and preserve the collection. It is also coordinating with foreign and domestic institutions to reconstruct library, documentation and information centers. In Chennai, India, water damage was reported at Madras University Library. In Bangladesh, the Chittagong Public Library, which had already sustained cracks from past earthquakes, suffered further damage from the initial tremor, and the staff removed equipment and collections for fear that the building would collapse.

A devastating hurricane, Hurricane Katrina that hit the Gulf of Mexico and various Southern regions of the United States at the end of August 2005, also caused considerable damage to libraries. The hurricane caused enormous flooding and caused associated damage. A large number of public libraries, academic libraries and university libraries were affected. In case of New Orleans Public Library the main library was intact however eight out of it twelve branches suffered moderate to severe flooding damage. In most of the libraries books and computers were destroyed because of wind-driven rain. Mose Hudson Tapia

Public Library in Alabama, with a collection of about 14,000 was completely destroyed. The library had at least 6 feet of standing water and later when the waters receded the library resources were affected by black mold. In most of the public libraries books, furnishings and computers were damaged because of flooding. Soon after Katrina, hurricane Rita, almost as powerful, struck the Southern States. It affected public and parish libraries. Most of the libraries were affected by moisture and mold problems. The main library in Cameron was totally destroyed. Only a bookmobile and electronic equipment was left which had been evacuated before the storm. A number of public libraries and their branches suffered water damage. Various associations like the American Library Association have come forward to help in the reconstruction work. ALA has also set up a relief fund to help raise funds to rebuild the libraries.

In the event of such natural disasters the international associations like UNESCO etc. do help in the reconstruction and salvage operations in the affected regions. ICOMOS (international Council on Monuments and Sites), ICOM (International Council of Museums), IFLA (Int'l Federation of Library Associations) and ICA (International Council on Archives), who are the participants in the UNESCO Blue Shield advisory group do keep an eye on the cultural aspects of the crisis brought about by such natural disasters (details provided in the next section on International Committee on Blue Shield). UNESCO, for instance, sent expert teams in the aftermath of the Gujarat, India and Bam, Iran, earthquakes, and also after the Indian Ocean tsunami.

9.8 THE INTERNATIONAL COMMITTEE OF THE BLUE SHIELD (ICBS)

The ICBS (International Committee of the Blue Shield) was created in 1996 to collect and disseminate information and to co-ordinate action in emergency situations. It is constituted by the following non-governmental organisations, ICA (International Council on Archives), ICOM (International Council of Museums), ICOMOS (International Council on Monuments and Sites), IFLA (International Federation of Library Associations and Institutions). Its mission is to protect and safeguard cultural heritage according to The Hague Convention of 1954 for the Protection of Cultural Property in the Event of Armed Conflict. The International Committee of the Blue Shield (ICBS) covers museums and archives, historic sites and libraries. It brings together the knowledge, experience and international networks of the four expert organisations dealing with cultural heritage: an unrivalled body of expertise which is now available to advise and assist in responding to events such as war in former Yugoslavia and hurricane damage in Central America. ICBS is international, independent and professional.

The main objectives of ICBS are:

- to facilitate international responses to threats or emergencies threatening cultural property
- to encourage safeguarding and respect for cultural property especially by promoting risk preparedness
- to train experts at national and regional level to prevent, control and recover from disasters
- to act in an advisory capacity for the protection of endangered heritage
- to consult and co-operate with other bodies including UNESCO, ICCROM and the International Committee of the Red Cross (ICRC).

The activities and functions undertaken to fulfill these objectives are:

- collecting and sharing information on threats to cultural property world-wide

- raising public awareness about damage to cultural heritage
- promoting good standards of risk management among those responsible for cultural heritage at all levels, from institutions to national governments
- working to make decision makers and professional staffs aware of the need to develop prevention, preparedness, response and recovery measures
- providing professional expertise to help meet emergencies
- identifying resources for disaster prevention and for rapid intervention in emergencies
- encouraging the establishment of national Blue Shield committees

Blue Shield Committees are being formed in a number of countries. They bring together the different professions, local and national government, the emergency services and the armed forces, thus providing them a single forum to improve emergency preparedness by sharing experiences and exchanging information. They provide a focus for raising national awareness of the threats to cultural heritage.

Self Check Exercise

- 3) What are the main objectives of ICBS.

Note: i) Write your answer in the space given below.

ii) Check your answer with the answers given at the end of this Unit.

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9.9 SUMMARY

In this unit we discussed about the basic concept of disaster management and various strategies, which can be adopted for effective disaster management. We learnt about the various salvage procedures that can be adopted for recovery of different materials like paper, books, microforms, photographic materials, hard disks, optical disks, audio/ video tapes, etc. The reconstruction of the library of Alexandria, which was destroyed several times during the course of history, is an example of a major reconstruction programme undertaken in recent times. We also discussed the International committee of the Blue Shield and its activities for protection of cultural heritage in the event of emergency situations. During the past few decades a number of disasters both natural and man-made like armed conflicts, bombardments and other such terrorist activities have taken place. Such disasters cause huge loss of human lives and invaluable cultural property. Libraries and other such cultural and archival collections are not unaffected by the impact of these devastating disasters. We discussed some of the recent disasters due to armed conflict and natural calamities and also how they have devastated library and archival collections. In event of such disasters international organisations like UNESCO for instance send their expert missions for the assessment of the devastation and the detailed study of the needed reconstruction and recovery efforts. International committee of Blue Shield (ICBS) is an

international agency which was created to collect and disseminate information and to co-ordinate action in emergency situations.

9.10 ANSWERS TO SELF CHECK EXERCISES

- 1) The various steps involved in preparation of a disaster plan are:
 - assigning the responsibility by forming a proper disaster team.
 - conducting preliminary research by reviewing literature on disaster planning and recovery.
 - Identification and assessment of potential hazards.
 - Identification of resources required in the event of crisis.
 - setting up liaisons with local emergency agencies.
 - Establishment of goals and tasks for team members.
 - Conduct a collection survey and determine salvage priorities.
 - Financial assessment.
 - Documentation of the plan
 - Maintaining the plan
- 2) First step in the salvage of microforms and microfiche is to determine whether they are replaceable or not. If available, replacement is the most cost effective solution. Then examine the microfilm rolls to determine how wet they are. If microfilm or microfiche is contaminated by mud or other debris it may be rinsed in cool, clean water. Never attempt to unroll or separate water damaged microfilm or microfiche when wet. Microfilm that is thoroughly wet will fuse together as it dries therefore, it should be kept wet and sent to a lab to be reprocessed as soon as possible. To keep it wet the reels should be placed in a large plastic container and covered with cold clean water. Cold water at low temperature helps to keep the emulsion from separating. If reprocessing is not an option microfilm may be unwound and air-dried on clothesline however this might result in scratches and water spots. Similarly, microfiche to be reprocessed should also be kept wet in cold water. Microfiche may also be removed from storage envelopes, separated, and air-dried. Water damaged microfiche and water damaged microfilm, should be frozen as quickly as possible in order to inhibit mold growth.
- 3) The main objectives of ICBS are:
 - to facilitate international responses to threats or emergencies threatening cultural property
 - to encourage safeguarding and respect for cultural property especially by promoting risk preparedness
 - to train experts at national and regional level to prevent, control and recover from disasters
 - to act in an advisory capacity for the protection of endangered heritage
 - to consult and co-operate with other bodies including UNESCO, ICCROM and the International Committee of the Red Cross (ICRC)

9.11 KEYWORDS

Disaster Plan : A disaster plan is a document that describes the procedures devised to prevent and prepare for disasters, and those proposed to respond to and recover from disasters when they occur.

- Air Drying** : In this method, documents records are dried at room temperature with relative humidity below 60%.
- Vacuum Freeze Drying** : In this process the frozen records are dried in a vacuum chamber dried at temperatures below 0° C.
- Dehumidification** : In this process large, commercial dehumidifiers are used for drying the records which are still on their shelves with all the collections, equipment, and furnishings left in place.
- Tornadoes** : A rotating, funnel-shaped, column of air ranging in width from a few yards to more than a mile and whirling at destructively high speeds.

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