CARE OF MUSEUM OBJECTS

N. Harinarayana
Dr. V. Jeyaraj

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of the
Government Museum, Madras.

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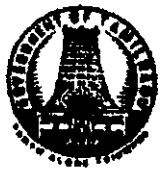

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PREFACE

The Chemical Conservation and Research Laboratory of the Government Museum, Chennai is one of the pioneering conservation laboratories attached to museums in this country. This Laboratory has done a lot of conservation activities pertaining to the museum as well as outside its purview. There were many requests from outside organisations for training the staff in conservation. In order to disseminate its expertise, training was given to those who were working in museums on request. Since there were many requests from outside agencies, it was decided to start the training programme, entitled, Care of Museum Objects in 1974 by Thiru N. Harinarayana, the Curator of the Chemical Conservation Laboratory and the Co-author of the book. The course was well received and is being regularly conducted till date successfully. In order to facilitate learning of the subject during the course, a book on Care of Museum Objects was published by compiling the papers given by the experts who were the resource persons of the course. This book was published in 1995 by Mr. M. Ramu, I.A.S., Commissioner of Museums and the books were exhausted soon. There was a need for the reprinting of the book, as there was a great demand for the same. The Commissioner of Museums, Dr. R. Kannan, Ph. D., I.A.S. took special interest to reprint this book and I thank him for reprinting the book. I thank Mr. K. Lakshminarayanan, Assistant Director of Museums and Dr. C. Maheswaran, Curator for Education for reprinting the book. I also thank the staff members of the Laboratory, Mr. J.D. Jagannathan, Mr. P. Balachandramurugan and Mr. S. Sampth for their cooperation in bringing out this volume. I have revised some of the articles of mine and included photos.

I hope this publication will be of use to those who are engaged in the conservation of art and cultural heritage as well as the students who study conservation besides those who undergo the training in the Chemical Conservation and Research Laboratory of the Government Museum, Chennai.

Chennai-600 008,
14-3-2002.

(V. Jeyaraj)

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FOREWORD

As per the Statues of the General Assembly of the ICOM at Copenhagen, Museum is a non-profit making permanent institution in the services of the society and of its development and open to public, which acquires, conserves, researches, communicates and exhibits for purposes of study, education and enjoyment, material evidence of man and his environment. But, now a days, museums try to create a surplus for making the institutions sustainable. The most important duty of the museums is to preserve the collection they possess. An object qualifies to be a museum object, when it is documented in a museum. Because of lack of information and training on how to take care of the objects, museum objects cannot be cared for by museum personnel at their ideal level. Therefore, the Government Museum, Chennai in order to disseminate knowledge of conservation to the personnel in museums and allied institutions, started a course on Care of Museum Objects in 1974. In order to provide the study materials in the form of a book, the Curator and Co-ordinatior of the Course, Dr. V. Jeyaraj, along with the Retired Director of Museums, Thiru N. Harinarayana compiled papers from experts in the concerned field both in the museum and other institutions and made them available for publication in a book form entitled, "Care of Museum Objects" in 1995. Since the copies are exhausted, there was a demand for the book and therefore the book has been reprinted. This reprint has got photographs pertaining to conservation. I hope this book will be a guidebook for those who are engaged in the great task for conserving our past for posterity.

R Kannan

CHENNAI - 600 008.
15-3-2002 AD

(**Dr. R. Kannan,** Ph.D., I.A.S.)

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HISTORY OF CONSERVATION

N. Harinarayana,
Retd. Director of Museums, Government of Tamil Nadu

Conservation is a word much in vogue today, but it refers generally to environmental conservation, which has become such a crucial issue now. The conservation that we talk of in this Course is much different and refers to conservation of art. Museum objects comprise also of natural history objects and their preservation is looked after in the respective disciplines of geology, botany and zoology. Art objects, which form the other part of the large holdings of a museum like the Government Museum, Chennai have their uniqueness vis-a-vis their up-keep, and a whole discipline has grown round it, called art conservation.

The reasons for conserving art objects carefully are quickly stated: (1) art objects are considered irreproducible, especially great art. Other artists can at best produce a close imitation of a great piece of art, but nobody can entirely make another just like it. That is why it is so important to preserve with intense care an antique object of art, even if only a part of it has come down to us from the past. Ruskin, the great 19th Century thinker and art critic, said, "As long as you can see anything, you can see almost all; so much the hand of the master will suggest his soul". (2) Art objects reflect the social and cultural milieu, which produced them and can be studied to extract from them remarkable facts about the people of their times.

This intensified appreciation of earlier art was the backlash of the Industrial Revolution. Suddenly at the time of this revolution, people found the market flooded with cheap goods which were quite ugly in design and form. Gone was the elegance of the hand-crafted object. Art lovers like John Ruskin and William Morris were horrified. One consequence of this was the quick collection of hand-crafted objects, which could serve as standards and models. This was the *raison d'etre* for founding the Victoria and Albert Museum in London.

This has also led to the quick growth of art conservation as a discipline. Another incentive for the development of this discipline was the advance of archaeology and the digging up of a range of artefacts, which required immediate attention.

Not that there had not been methods of conservation known earlier but they were only traditional rule-of-thumb methods, which did not relate quite often to the object-under treatment. What conservation did as a

discipline is to go about the task of preservation systematically and devise methods accordingly. Even great scientists like Faraday and Davy were involved with finding methods of preserving ancient relics.

In India also, we had our own traditional approach to conservation, but it was not based on the premise of the uniqueness of a work of art. If it becomes damaged, it could be repaired just like any other object. Sometimes, if it appeared to be beyond repair, it would be quickly knocked down and replaced by a new one made to look like the earlier one. An instance of this is the removal of *sudai* or stucco figure of deities of temple *gopurams* and replacing them with newly made ones.

However, at present, we are inclined to follow the tenets of the West through the influence of great administrators like Lord Curzon and John Marshall and art historians like Havell, Coomarasamy and Sivaramamurti.

The application of scientific methods to the study and treatment of objects came about in the late decades of the 19th Century. It was also based on the principle of the least intervention in the material or structure of the object.

The first laboratory - approximating to these principles was opened in Germany. Early in the Twentieth Century, the British Museum asked a scientist, Dr. Alexander Scott, to prepare a reprot of what is to be done for the treatment of its objects. The three reports he gave became the basis of a research laboratory, which was formed in 1921. From 1931, it become an integral part of the British Museum with Dr. Alexander Scott as its head. His successor was Dr. H.J. Plenderleith in 1938.

Other countries also set up laboraties sometimes bigger and more comprehensive such as that of Dr. Paul Coremans in Brussels. The Louvre Museum came up with its laboratory in Paris and the Freer Gallery of Art in New York under R.J. Gettens.

India did not lag behind. Made responsible for a number of monuments all over India, the Archaeological Survey of India had set up a conservation laboratory in Dehra Dun in the mid-twenties of 20th Century. Around this time, the Superintendent of the Government Museum, Madras, Dr. F.H. Gravely sought the advice of the Professor of Chemistry in the Presidency College in Madras, Prof. Erlan Smith. The result of these consultations was the establishement of the Archaeological Chemistry Laboratory in the Government Museum, Madras and the appointment of Dr. S. Paramasivan as the first Chemist in charge of the Laboratory.

The sterling work done in this Laboratory during its first decades, led to Dr. S. Paramasivan being drafted for preservation of paintings at Sittannavasal in the princely state of Pudukottai.

Chemical Conservation and Research Laboratory
Government Museum, Chennai.

The next laboratory of importance was the laboratory of the National Museum, New Delhi which itself came into being in 1951. The Salar Jung Museum set up a laboratory in 1963, which was re-organised in 1965 and shifted to larger accomodation in the new building of the museum in 1968.

While conservation laboratories were growing to attend to the well being of the objects in the museums of the country, the need was felt for carrying out research into several aspects of conservation such as suitable methods for analysis of the composition of objects, methods of preservation and restoration suitable for the conditions in our country, preparation of indigeneous materials of art etc. The result was the founding of the National Research Laboratory for Conservation in 1976 at Lucknow with Dr. O.P. Agarwal as its head.

At this time, in the 60's and 70's the National Archives joined the conservation movement with its specialised interest in the preservation of records, manuscripts and books. Now there has been a proliferation of laboratories in museums and archives in all states.

Simultaneously the conservation professionals came together to form the Indian Association for the Study of Conservation of Cultural Property in 1968. The National Museum took the lead in this matter. The idea was to provide a forum for conservators to meet and discuss and publish their work. It has been bringing out a journal, uninterruptedly from the beginning, called "Conservation of Cultural Property in India".

Internationally the professional body is the International Institute of Conservation (IIC). It was started in the 1950's. The International Council of Museums has a Laboratories Committee. The Rome Centre, founded in the 1950's, is important for the training courses in conservation it conducts and for the research it carries out in various aspects of conservation and the publications it brings out. In recent decades, the science of conservation has grown enormously. New techniques like electrolytic restoration of metals, use of iron-exchange resins, and synthetic polymers, the application of x-rays, ultra-violet rays, infra-red rays for examining art objects, solvent lamination for preservation of books and manuscripts have made their appearance.

Still the scope of conservation is enormous and a good deal of work is to be done. Meanwhile museums have expanded their scope to include folk art of important objects with a good variety of problems.

For all that, the history of art conservation is short. But the widening of its scope and the enlargement of its importance is to be noted.

CLASSIFICATION OF MUSEUM OBJECTS AND GENERAL METHODS OF PRESERVATION

N. Harinarayana,
Retd. Director of Museums, Tamil Nadu

Classification of Museum Objects

As the term implies, museum objects are objects found in museum collections. Nowadays the scope of museums has been extended so much that almost anything qualifies for being a museum object. This is because the definition of cultural objects has been widening recently. Apart from this, natural history objects also qualify as museum objects. Still in this course, when we talk of museum objects, it is confined to the objects actually in museum collections.

How are these objects obtained? There are various methods through which they are collected, namely, excavation, field collection, treasure-trove, purchases, gifts and exchanges. Quite often, the way they are obtained influences the manner of the treatment. For instance excavated objects and treasure-trove pieces are different form objects collected from the field. Why it is necessary to classify these objects? This is done so as to grade them according to their vulnerbility to damage. The four groups into which museum objecfs are generally classified are organic materials, metals, inorganic materials and paintings. The first three are grouped according to their susceptibility to damage, organic materials being most susceptible and inorganic materials, the least. Paintings form a class apart because they are made of two or three layers of different materials. There are also certain museum objects, which are made up of two or more of these materials like swords with ivory hilts. Ethnographic objects are generally made up of two or more materials. In subsequent lectures this classification will be kept in mind.

General Methods of Preservation

Conservation methods used at present are of different types; mechanical, chemical, electrochemical. Quite often a combination of any of these methods can be used for conserving any object.

Mechanical

These are the simplest methods used to rid objects of deleterious crusts, which might have formed on them for various reasons. In this method

simple tools such as pins, scalpels and chisels are used. In more difficult cases, dental drills and ultrasonic generators are used. The use of a vacuum cleaner is also a mechanical method.

Chemical

In the chemical method, suitable solvents are employed to remove crusts of the undesirable products on museum objects such as corrosion on metal objects and deposits of clayey materials on bone and ivory. The advantage of this method over the mechanical method is that it removes more effectively the unwanted crusts. But the disadvantage is that it is possible that the chemicals used, however carefully selected, may react still with the metal surface and take away its smoothness.

Electrochemical Method

The electrochemical method is based on the principle that all corrosion is a matter of oxidation and if an effective reducing agent can be used what had happpened earlier can be reversed. According to this corrosion crust on a bronze will be reduced in situ and replaced in its original position. That is why it is called sometimes restoration. There are two types of electrochemical methods depending on the manner of producing nascent hydrogen. (1) the electrochemical method in which hydrogen is generated by the action between a metal and an acid or alkali such as zinc and caustic soda or suphuric acid. (2) In the electrolytic method nascent hydrogen is generated by passing a direct current of low amperage through an electrolytic bath in which the object is made the negative electrode. This is a very refined process in which the hydrogen ions are generated at the object itself and attack the corrosion crusts by combination with oxygen in them and allowing the metal to be back in its place. Though it is highly theoretical, in practice it has been found that there is least loss of weight in this process compared to the other two and the surface after treatment is smooth.

These three methods are used for all objects though the electrochemical methods are confined to metal objects. In subsequent lecturers the necessary details of treatment for various types of materials would be given.

General Principles of Conservation

There are some important principles, which have to be observed while carrying out the treatment of museum materials.

(1) The simplest method should be tried out first, namely mechanical. Then only the chemical method ought to be resorted to. Even then the less drastic chemical is to be tried first.

(2) The pace of treatment should be controlled carefully. The concentration of chemicals has to be kept to the minimum.

(3) After treatment it is essential that all the chemicals used are thoroughly removed. This is absolutely necessary. Intensive washing techniques have been devised for such purposes.

(4) No crust of corossive products may be removed unless necesasry. For instance, the patina (which is also a corrosion crust) should not be removed from a bronze, because it enhances the artistic merit of the object.

(5) A programme of treatment should be drawn up in the beginning itself and followed with any changes as may be required.

(6) Careful records of all work done should be maintained.

FACTORS AFFECTING MUSEUM OBJECTS AND THEIR CONTROL MEASURES

S. Thangavelu,
Retd. Deputy Director of Museums,
Government Museum, Chennai

Art and antiquities are affected by light, biodeterioration, air pollution, soluble salts, climate and neglect.

Light

Unlike inorganic objects, organic objects are easily affected by light. Natural as well as artificial light falling on objects should be avoided. Direct light on organic objects causes damage. Due to light, fading and discolouration of paintings and textiles take place. U.V. radiation present in the light causes the deterioration. Therefore we should not allow direct light falling on organic objects. We can arrange the light source in such a way that the light is reflected on the object. Otherwise we can use filters to prevent U.V. radiation so that it may not cause any damage on the object.

Biodeterioration

Biodeterioration is caused by biological agents, that is, insects and microorgnaism. Silverfish, cockroach, book lice, wood borer, clothes moth and termite are the common insects causing damage to organic objects. The microorganisms, which cause damages are bacteria, fungi, algae, moss, liverworts etc.

Organic materials contain ample nutrients required for the survival of insects and microorganisms. Hence the biological agents cause damage.

Silverfish causes damage to glue, paper, textiles and photographic materials. Cockroach causes damage to wood, leather, paper, textiles etc., and has a special liking for glue used in book binding. Book lice causes damages to paper, books, photographic prints, textiles, leather, parchment, glue and gum used in book binding. Wood borer beetle causes damage in

Biodeterioration

wood and wood is disintegrated into powder. Clothes moth causes damage in clothing, carpets, furs, feathers and woollen fabrics.

Among the insects, termites are the most dangerous. They cause damage to wood, paper, textiles, leather etc. But teakwood and rosewood are not affected by termitees because of their oil content. Micro organisms cause staining and erosion on organic objects. 5% thymol in rectified spirit could be applied on objects affected by micro-organisms. If the R.H. of the place is above 65%, biological agents will grow.

Cleanliness and proper ventilation are necessary in order to avoid the presence of biological agents. Periodical fumigation of organic objects is necessary. If we do not have fumingation chamber, we can keep the chemicals inside the show case where the organic objects are exhibited. Incase, chemicals are not available, we can keep the objects in mild sunlight for half an hour.

Soil treatment with chloropyriphos is necessary in order to ward away the termites. A channel is dug all around the building one foot away from the wall. Chloropyriophos diluted 50 times with water is poured into the channel and then covered with stand. Inside the building, holes are drilled all along the wall at an interval of two feet. The diluted chemical is poured and then the hole is filled with cement. Even if it is a multistoried building, it is enough, if the ground floor is treated.

Air Pollution

It is the contamiants present in the air, which are harmful to the environment.

Air pollution corrodes metals, erodes stones, causes paint to discolour or peel off, leather and rubber to crack and cloth to became stained and weakened.

Natural pollution is caused by forest fire, cyclone, volcanic eruptions, dust particles and respiration of plants.

Man made pollution is the result of the exhausts of chimneys, exhausts from automobiles, aeroplanes, locomotives and from activities such as laying road, construction of buildings etc.

For example when we burn coal, coke, sulphur present in the fuel as impurity is oxidised to sulphur dioxide and on further oxidation sulphur trioxide is formed. Sulphur trioxide on taking up the moisture from the atmosphere, forms sulphuric acid which is a most dangerous acid causing damage in all kinds of objects.

In order to avoid environmental damage, museum should be established away from city. Plants and trees should be planted around the building. Windows should be provided with screens. Senstive organic objects should be displayed inside cases or could be framed. Protective coating should be applied on objects.

Soluble Salts

Lot of salts are present in the atmosphere when the museum is near the sea-coast. The salts in the atmosphere settle on objects if there is favourable environment. Thus a salt layer is formed, which causes damage to objects.

If salts are present, paper pulp treatment is given to objects like stone sculptures to remove the salts. A 5% solution of P.V.A. in toluene may be applied after treatment as a protective coating.

Change of Climate

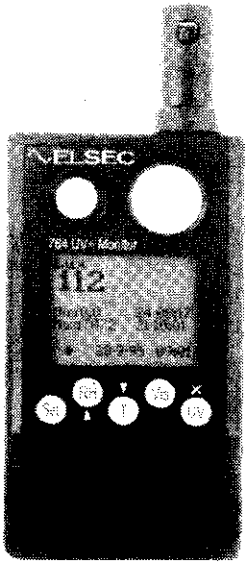
Change of climate refers to the change of temparature and R.H. When we say 0% R.H., that means absence of moisture in the atmosphere and when we say 100% R.H., it means the atmosphere is fully saturated with moisture and the atmosphere cannot take up more moisture. For example, 15% R.H. indicates dry condition and 75% R.H. moist condition.

Paper, parchment, wood, ivory, bone are hygroscopic in nature and therefore swell with increase in the humidity of the atmosphere and shrink with its decrease. Under dry condition, wood shrinks, palmleaf and leather become very dry.

Very low or very high conditions of humidity produce servere strain in wood because it is continuously changing the dimensions. Flaking and cleavage occur in paintings.

To maintain ideal condition, the museum could be air-conditioned and run through out the day. Not only the initial cost but also the maintanence cost are high.

We can also bring out the optimum conditions by the other means. 40 to 60% R.H. and temparature of 20 to 24°C are optimum conditions.



Environmental Monitor

We can control the factors by proper design of the building. The building could be constructed in such a way that the lengthwise wall are facing north-south instead of east-west so that less area is exposed to the sun. Proper materials and thickness of wall should be decided so that we may reduce heat conductivity. If high ceiling is provided, there will be more ventilation and circulation of air. Weathering course could be provided on the roof so that less heat is transmitted inside the building. White paint should be applied to the walls and roof so that less heat is absorbed. Sun shades should be provided for the doors and windows. Trees and plants should be grown around the building not only to control the R.H. and temparature but also to reduce the pollution. It is preferable to have vegetable fibre screens for the windows.

We can also control the climatic conditions of individual show cases by the use of chemicals.

Neglect

Periodical dusting and fumigation are necessary. Proper handling is necessary, while transporting the objects. Storage area should be kept clean. Proper ventilation should also be provided for the storage area. The objects should not be dumped. They should be arranged properly as in display. Accidents should be avoided and proper care should be taken, while handling the objects.

BIODETERIORATION

V. Jeyaraj,
Curator, Chemical Conservation and Research Laboratory,
Government Museum, Chennai

There are various agencies like light, heat, humidity, pollution, microorganisms, which have deteriorating effects on the materials of museum objects. Of these agencies, biological agencies like microorganisms and insects of various kinds are the most devastating. Almost all classes of museum objects such as stone sculptures, metal objects, cellulosic and proteinaceous objects, paintings are damaged by these agencies.

Biodeterioration is any undesirable change in the properties of the materials affected by the activities of the living organisms. Tropical climate favours biodeterioration. Temparature between 25°C to 35°C and relative humidity above 70% favour biodeterioration.

Symptoms of Biodeterioration

The activity of the biological agencies can be noticed only by a close examination of the objects regularly. As soon as changes are noticed on the objects, they should be investigated seriously.

Stains and Discolouration

Because of the biological activities, stains are formed in the objects. Foxing, a brown spot formation, in paper is due to microorganisms and iron impurities etc. Excreta of the insects, dead insects create strain on the objects. Because of the excreta of insects, the pigments are dissolved and discolouration takes place.

Insect Attacked Paper Painting

Erosion

Because of the frequent passage of certain insects erosion occurs on the object.

Disfigurement

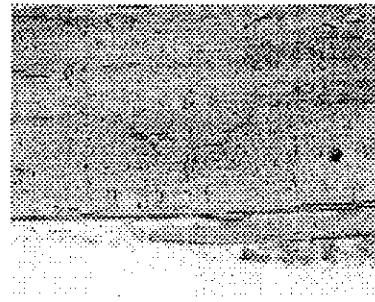
Insects eat away portions of the objects and permanent disfigurement is created in the objects e.g. photographs are eaten by silverfish, wooden objects are eaten by termites.

Pitting

The surface of objects are pitted and become rough. Metals by corrosion; stone by sulphate reducing bacteria.

Tunnelling

Insects eat the materials and tunnel through them leaving holes. The lavial stage of the insects is dangerous.



Tunnelled Palm-Leaves

Firbilization

Because of the action of the biological agencies, organic materials like palmleaves, barks etc., become fibrous.

Powder Formation

Eventhough the insects are not visible, their action will be revealed by the powder falling from the objects.

Development of Odour

Distinct smell will emanate when fungal growth is active. The death of rodents etc., will be inferred from the bad smell.

Changes in Properties

Mechanical and chemical properties are lost, for example, materials become weak.

Insects

Organic objects like wooden objects, leather, textiles, books, biological specimens etc., are worst affected by insects. Insects bore holes into the materials and eat voraciously. The insect mence is high due to high temparature and humidity.

Some of the most common insects attacking materials are silverfish, cockroaches, termites, moths, beetles, booklice and crickets.

Silverfish

Both the young ones and adults cause surface damages to paper, eat away glue, paste etc., from books and documents, herbarium specimens, photographic plates, paintings of the Tanjore style as they

involve paper, textile and paste. In order to eradicate them, 5% D.D.T., B.H.C. or pyrethrum in kerosene is sprayed.

Cockroach

Both the adults and young ones damage wool, leather, paper, herbaria, ethnographic and natural history materials, palmleaves. 5% D.D.T., chlordane, B.H.C. or pyrethrum in kerosene as a spray, sodium fluoride, gypsum (1:1) as poison powder, Baygon Bait are the effective insecticides.

Termite

There are two main categories of termites. They are dry-wood termites and subterranean termites. The sub-terranean termites maintain a link with the earth, whereas the dry-wood termites live in wood. Adults bring about irrepairable loss or damage to wooden objects, furniture, showcases, panels, books, textiles and other cellulosic materials. Structural timbers may be coated with cresote, zinc chloride, sodium fluoride, As Cu (Potassium dichromate-4 parts, copper sulphate -1 part, arsenic pentoxide -1 part and water 100 parts). Sprays of dieldrin, aldrin, Dursban TC, D.D.T., B.H.C., chlordane eradicate termites. Subterranean termites may be eradicated by treating the soil of the affected area by drilling pits and filling them with the solution of insectides. Fumingation with ethyl bromide or carbondisulphide is good for small wooden artefacts.

Booklice

Adults of booklice cause surface damages to paper, herbaria, leather, gelatine of photographic plates, Tanjore panel painting, water colour painting etc. Such materials are fumigated with paradichlorobenzene. Napththalene balls are also used. A spray of 5% D.D.T. in kerosene may be given to the objects.

Clothes Moth

The active stage of insect pest, clothes moth, is the larval stage. It destroys woollen fabrics, hair, fur, feather, stuffed mammals and birds. Fumingation may be done with 1% penta chlorophenol in alcohol. Arsenical paste (arsenic trioxide, alum and soap) is used in case of birds. Fumingation may be done with paradichlorobenzene. Napththalene balls may be used.

Beetle

The larval stage of the beetles are active in damaging objects. Carpet beetles feed on hair, wool, feather, leather etc. The hide beetle damages

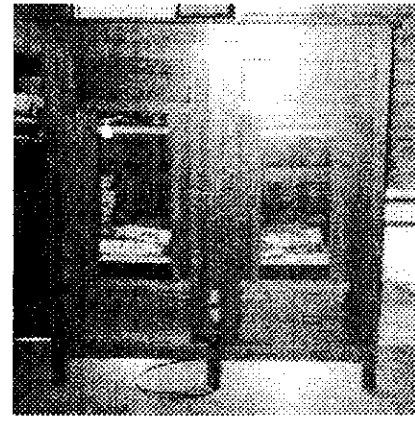
leather, stuffed birds, dried fish, etc. The wood-boring beetles bore into wooden objects, also book bindings and palm-leaf manuscripts. The book-worm beetles tunnel into books, palmleaves etc. Fumingation with methylbromide, ethyl bromide or carbon disulphide is an effective measure to control the beetles. 5% solution of pentachloro phenol, pyrethrum, D.D.T. in kerosene may be sprayed.

There are two main methods of treatment of museum objects with insecticides. They are:

1. Fumigation and
2. Dusting or application in solution form or fogging.

Fumigation

Fumigation is nothing but keeping the insect infested objects for a few hours in an airtight chamber where volatile fumigants are kept. Paradichloro benzene, carbon disulphide, methyl bromide, ethyl bromide, carbon tetra chloride, Nifol, napththalene balls, ethoxide are some of the fumigants used in the eradication of insects from the infested museum objects of organic nature, especially ethno-graphic, natural history specimens, documents, textiles etc. Even if there is no infestation on the objects, the insects prone objects should be fumigated prior to monsoon. The choice of fumigants is very important as some are toxic and some affect certain materials.



Fumigation Chamber

Ethylene oxide has an adverse effect on leather, wet paper, paint, varnish, resin etc. Methyl bromide has an adverse effect on rubber, leather, woollen materials, paper, photographs, feathers etc. Fumigants will not have lasting effect on the objects and therefore periodic fumigation should be done.

Eventhough the application of insecticides in the solution form either by brushing, injecting or spraying is having certain health hazards, it has

long effect on the objects. 5% solutions of insecticides like D.D.T., B.H.C., D.D.V.P., pentachlorophenol, mercuric chloride are most suitable. Storage, cupboards, drawers, shelves etc., should be treated with the insecticides in the solution form.

Cryptogamic Plants Growth

Bacteria, fungi, algae, lichen, liverworts and mosses constitute the cryptogamic plants, which affect museum materials. Among these, only fungi generally pose very high threat to museum objects. Bacteria are found to flourish only when the moisture content of the medium is very high. Organic objects like wood, textiles, paper, leather, musical instruments, certain paintings are disfigured and destroyed to a considerable extent on account of mould growth. Moulds, by reason of their ramifying mycetia, which can seek out moisture from a distance and transport it from one point of growth to another, can grow in atmospheres of little more than 70% relative humidity. Fungi are unable to photosynthesise their own food and hence damage the materials on which they grow. Usually they are aerobic (need air to grow), but some species are an - aerobic also. Fungal spores are present in the atmosphere all the time, but remain dormant. They become active and start developing as soon as conditions of humidity (70%) and temparature (>30°C) favourable for their growth occur.

Damages by the Cryptogamic Plants

Bacteria

There are various species of bacteria. Sulphate reducting bacteria affects iron objects, stone and sulphur containing objects. There are antotropic bacteria, nitrifying bacteria, heterotropic bacteria etc.

Fungi

There are various species of fungi. Out of a large number of fungal species reported, the most common ones are Penicillium, Phorma, Alternaria, Cladosporium, Aspergillus, Niger. Paper, cotton, textiles,

Fungal Attacked Painting

ethnographic objects, wood leather, outdoor stone objects, herbaria etc., are affected by fungi.

Fungus degrades organic materials like paper, leather, textiles and also causes stain on them. It disfigures paintings, stone objects and wooden materials and chemical and mechanical properties of the objects are changed. Oil paintings, which have rough surface, are also found to be affected by fungi at high humidity conditions.

Control Measures

Control of bacterial and fungal growth on museum objects are two fold viz., preventive and remedial or interventive. Since moisture is the very important requirement for the growth of bacteria and fungi, humidity control is the best preventive measure. Since most of the museums cannot afford to have airconditioning facilities, proper air circulation, ventilation may be provided. Cleanliness is essential to avoid bacterial and fungal growth. Therefore organic materials should be dusted using a fine brush or vacuum cleaner regularly. Fungi infested objects should be brushed off and fumigated. Thymol is a very good fumigant. 5% thymol in rectified spirit spray will be an effective check to fungal growth. Fungicidal paper prepared by treating filter paper with 10% P-chloro-m-cresol solution or 1% phenyl mercuric acetate solution and then drying it will eradicate fungi etc.

MAN'S TOOL, ARTEFACTS AND APPLIANCES

Dr. N. Devasahayam,
Retd. Deputy Director of Museums,
Government Museum, Chennai

The prehistoric man manufactured his tools from the rocks and boulders for collecting his food-fruits, roots and animals. The tools were hand-axes, cleavers, scrapers, choppers etc., in Old Stone Age period while in the Middle Stone Age period it was through pigmy stone tools like arrow point, lunate, saw, knife, point, blade etc., for hunting and skinning. But the Neolithic revolution has brought about a change or reformation or transformation in the life style of the people. Domestication of animals, cultivation, village formation and pottery production started. Celts, adze, axe, mealing and grinding stones, pestle and mortar, corn crusher etc., were used as tools. The chalcolithic (Bronze Age) people of Indus and Mohenjodaro started using both the stone ribbon flakes, pestle and mortar along with copper tools such as axe, harpoon etc., and black and red ware decorative wheelmade potteries. Pictographical writings were thus started indicating the beginning of civilization. The Iron Age or Megalithic period is characterised by stone circles, dolmens, cairn circles, etc., and exacavated antiquities of iron, bronze, (Bronze female figurine from Adichanallur) steel, beads and gold, which provide ample evidences for this advanced mixed culture of *Sangam* Period.

Bronze Female Figurine, Adichanallur, Tirunelveli District.

Among the tribal appliances, the food gathering tools such as digging sticks, picks and bamboo vessels for collecting honey etc., are prominent. The fishing and hunting communities concentrated on traps, snares, fishing cages, nets, bow and arrows including the pellet and cross bows. The boomerang, club, mace, harpoon and blow gun are also used for hunting and for fishing by the South Indian tribals. The agricultural tribal folk generally use spade, hoe, plough etc., apart from digging sticks or picks. The terrace and shifting cultivations are common among the tribals.

The nomadic and artisan tribals mosty prepare articles of utility or purchase them from nearby plains. Their apron vary and are simple in style. The dresses of the Lambadis are colourful and glamorous while some tribes go on with modern textiles. Some primitives of the past used leaf and bark aprons.

Apart from this economic life, the social scenario of the tribal, centres around materials they prepare and use in social functions and in religious ceremonies. They live in forests and hills and in isolated plains. They make use of forest materials chiefly bamboo. Dormitories for the youth and connected initiation ceremonies are very important, especially the item like bull roarer, made of wood or stone. Their habitations are thatched huts, or usual small and simple type, made of bamboo reapers and wild grass. The Todas prefer living in half barrel shaped huts or mands. The fire making devices vary from simple tools like flint and steel to fire drill, fire bow, fire saw and fire piston. The jewelleries are simple, elegant but beautiful and are made of beads, glass, leaves and brass.

Thus, the materials that are prepared and used by the tribals constitute the study of material culture or cultural anthropology. We can study man prehistorically through his tools (stone and potteries) which escaped destruction all these years, while the study of man on social base, involves two interrelated features namely the material culture and social aspect. The origin or evolution and the races of man constitute the study of physical anthropology. In fact the anthropological objects are of vegetable, animal and mineral origin. One can see these objects in plenty in the anthropological galleries of this great institution of knowledge, learning and recreation. House keeping, regular inspection, dusting etc., make them fit for posterity.

CARE OF ACHAEOLOGICAL COLLECTIONS

R. Balasubramanian,
Curator, Archaeology Section,
Government Museum, Chennai

The science of archaeology deals with the study of materials relating to the historical times such as inscriptions (stones, copper plates), architecture, sculptures, bronzes, terracotta objects etc. A careful analysis of the various details of these materials is very much essential for a proper understanding of the growth and development of Indian culture.

Inscriptions

Inscriptions are important because they form the ancient source material for the history of India. Inscriptions are in different scripts and may be in stone and copper plates, the study of which is called epigraphy.

In India the earliest examples of writing are those found on the seals from Mohenja-Daro and Harappa. The writing is in the form of pictures.

The inscriptions are generally the records of achievements of a king or of donations, information about various eras, astronomical details, social practices, festivals, administration etc. Besides these, some of the inscriptions are written in beautiful languages and are the only surviving examples of the literary skill of the authors.

The inscribed stone must be preseved by removing the dust through cleaning with water. Copper plates should be physically cleaned and later with neutral soap solution, if necessary. If the encrustation is very thick, it should be removed with suitable chemicals, especially weak chemicals. But every care must be taken to see that the pressure applied is gentle and it does not mar the form or shape of the letters of the inscriptions.

Sculptures

Sculptures of the Tamil country dating from 7th Century A.D. are simpler in treatment than those from other places. The five periods of Tamil sculptures - Pallava, early Chola, later Chola, Vijayanagar and modern - have their own characteristic features.

Pallava Period

The figures are natural in pose and their modelling is fine. The draparies are heavy and ornaments are few and delicately carved. Feminine figures are delicately carved and extremely graceful. In general the

sculptures are distinguished by the simplicity of treatment and high restraint of decorative designs.

Early Chola Period

Sculptures of this period are noted for their grace. In poses and moulding, they tend to be formal.

Later Chola Period

Sculptures show a marked tendency to conventionalise the poses, draperies and ornaments. The classic tradition of earlier period is almost preserved.

Vijayanagar Period

Elaboration of details such as draperies and ornamentation are seen, which are unknown in the earlier periods. The face is somewhat expressionless with sharply pointed nose and vertically grooved chin, pronounced belly and naval are the characteristic features of this period.

Modern Period

Sculptures are usually stiff and lifeless with unduly prominent noses and conventionalised draperies and emblems.

Amaravati Sculptures

Amaravati, on the right bank of the river Krishna occupies a pre-eminent position in the history of Indian Art. Situated about 35 km. on the north of Guntur, importance of the site of Maha Chaitya was realised by Colonel Macknezie as early as 1797. Towards the close of the 19th Century, scholars like Robert Sewell (in 1877), James Burgess (in 1881) and Alexender Rea (in 1888-89) made attempts to excavate and record the sculptured stones systematically. Sculptures from this Maha Chaitya site are distributed over several museums, the main bulk being housed in the Government Museum, Chennai and the British Museum, London. The stupa at Amaravati, the biggest in the Andhradesa had been mentioned in the inscriptions as *Maha Chaitya*. Its extant remains show all its aura and grandeur, just consist of the drum of the brick built stupa, the paved *pradhakshina patha* (circumambulatory path) and the circular alignment of the railing, represented by an array of heterogeneous uprights and pillars. Originally, mounted on the circular drum, was the dome or the hemispherical superstructure, crowned by a railed *harmika* and a *chatra*. It was embellished all over with slabs bearing beautiful bas-reliefs illustrating stories from the life of Buddha and the *Jatakas*. The material used is a

variety of limestone. The monument was neither a work of a single period, nor of a single hand, the sculptures show naturally, variations in their workmanship. On stylistic grounds, the sculptures are divided into four groups. 100 B.C. to 250 A.D. The chief characteristics of these sculptures are varying depths of relief. Most of these sculptures were embedded on the walls of the gallery with mortar about 100 years back are disintegrating due to seepage and capillary action. These sculptures are regularly vacuum cleaned and the salts are removed by poulticing.

Affected Linestone Sculpture

We are now planning to build a new structure to house these priceless, unique sculptures. It is decided to remove them from the walls, treat them and redisplay them in the modern lines prevailing at present.

Metal Sculptures

The Chennai Government Museum, has a rich collection of South Indian bronzes and some of the finest masterpieces are on display in the gallery. The history of metal art in South India is of great antiquity and this is living art today. The earliest specimen in metal in Tamil Nadu is the prehistoric figure of a mother goddess form Adichanallur, Tirunelveli district and may date back to 7th Century B.C. The bronze icons of historical period have survived from the Pallavas, which were on a restricted scale as greater attention was paid to the art of stone sculpting. The survived metal icons of this period show the same characteristics of stone sculptures of this period. Kuram Natesa, Vishapaharana from Kilapudranur, Somaskanda from Thiruvalangadu are examples of the art of this period. Particularly Vishapaharana is a rare representation in metal, has the sacred thread going over the right forearm, a characteristic of early images. Kuram Natesa is the only example of *Urdhvajanu* pose in metal. Mention may be made of the snake in the left hand instead of *agni* commonly met with in Nataraja images. The small image of Somaskanda with a trident and a skull cup in the lower hands is the most remarkable bronze of this aspect.

The Rama group from Vadakkupanaiyur and the Srinivasa group from Sirupanaiyur are the fine specimens of the 10th Century A.D., so far known in metal. Natesa from Tiruvalangadu, much admired by the world famous sculptor, Rodin is dated to the 11th Century A.D. Ardhanarisvara from Tiruvengadu dated to the 11th Century A.D. with the help of the inscription in the Svetharanyesvarar temple, is the best specimen of the aspect yet known in metal. The images of Vishnu with consorts from Komal assigned to the 13th Century A.D. represents him with only one pair of hands having the emblems embedded on the palms. This image wears a lengthy ornament called *Vanamala,* a rare feature in South Indian bronzes. Nagapattinam was an important port in ancient times. Some of the best Buddhist bronzes, ranging from 9th Century A.D. to 17th Century A.D. have come down to us. Mention may be made that quite a number of those bronzes bear dedicatory inscription on the pedestal.

The dating of the metal icons, which is very essential for appreciating better the history of this art, is a question on which no consensus of opinion has emerged, not withstanding a fairly exhaustive and analytical study of sufficiently good number of bronzes unearthed in different regions indicative of more than one stylistic mooring. Dating is done on the basis of stylistic features of the icons.

General cleaning with vacuum cleaner is done. If defects are noticed the bronze objects are sent to the Chemical Conservation Laboratory for necessary conservation work.

Wood Carvings

In the Rig Veda there is mention about wood carvers. We have ample references in early texts about wood. Use of wood and selection of wood for temple car are mentioned. The time and the day in which wood have to be cut for these works are also mentioned. Wood carvings of earliest centuries have not survived for us for wood being a perishable material. Wood was largely used for the construction of shrines and other structures. This is proved from inscription of Mahendravarman at Mandagapattu in South Arcot district. This inscription says, "Vichitracitta constructed the temple for the first time for Brahma, Siva and Vishnu without the use of brick, metal or mortar". In the words of Sir George, Birdwood, South India serves as the best place for the study of wood carvings. Because of the bold relief the South Indian wood carvings occupied a unique place in the sphere of decorative art. Since the temple car is the most important *vahana,* the wood carvers bestowed their full attention in embellishing it with finely carved scenes from Hindu mythology." With the

advent of stone, both for architecture and sculpture, the wood carver tansferred his skill outside for aesthetic pleasure and devotional gratification of the worshippers. The God of the temple moved out like a monarch in processions with all the temple paraphrenalia transferred to wooden counterpart i.e. *Ratha,* which in shape simulated the stone *vimana* over the *garbagriha.* General cleaning by soft brush is done to rid off dust. The wooden sculptures are arranged in the storage and covered with polythene sheets. Badly affected wood carvings are sent to the Chemical Conservation and Research Laboratory of the museum for conservation and restoration treatments.

Terracottas

Terracottas form an important item in the folk rituals and cults. Handmade terracotta or clay figures have been occupying a special position for a long time in Indian art. A large number of examples have been unearthed in Mohenja-Daro and Harappa among which the figures of Mother goddess type abound. The grey coloured figures of Mauriyan period are noteworthy. During the Sunga period, figurines are worked by a double process, namely the hand made body affixed to the head made from a mould. This technique came into being for the first time. After the introduction of this method, the art made rapid progress. The well known examples of this period are the ones discovered at Mathura, Kosambi, Ahichatra, Patna etc. Generally, terracotta objects are affected by salt action and flaked off in the surface. They are washed to remove the soluble salts. Broken figurines etc., are mended by the Chemical Conservation and Research Laboratory.

CARE OF METALLIC OBJECTS

V. Jeyaraj,
Curator, Chemical Conservation and Research Laboratory
Government Museum, Chennai

Objects of metals and alloys form a major part of the collections in museums. Knowledge about their decay and their control measures help one to preserve them for posterity.

The Decay of Metal Objects

Although metals appear strong, they are less durable when compared to stone. The metallic objects decay through various means and become the minerals from which they were extracted.

Corrosion is the main enemy to the durability of metals. Most of the metal antiquities are received in museums from excavation, exploration and treasure-trove finds. When these objects are buried in the soil, they corrode because of the contact with the surrounding saline condition and the equilibrium is disturbed and the objects disintegrate abruptly.

The agents of deterioration of metallic antiquities are high relative humidity, polluted air and mismanagement of the objects.

Iron Objects

The two important facets of chemical conservation are

a) removal of the corrosion products and

b) stabilising and arresting the corrosion products.

a) Removal of Corrosion Products

The removal of the corrosion products are effected by various means:

i) Physical method

ii) Chemical method

iii) Electrochemical method

iv) Electrolytic reduction method

i) Physical Method

When objects have adherent silicieous and corrosion products, they give an ugly look. This can be removed mechanically by means of chisel, knife, vibro tools, etc. By these means the aesthetic beauty of the object

is not lost. Since we do not introduce any chemical in this method, no side effects are noticed. Airbrasive methods can also be adopted. Any how, rectified spirit or other organic solvents such as acetone, toluene, benzene may be used to have a dust free surface on the object.

ii) Chemical Method

By dissolving the corrosion products from the objects by using chemicals, the deleterious materials are removed. When we take up dissolution method, we should use weak solutions of chemicals. No drastic method should be used.

Copper Based Antiquities

When objects are covered with a uniform bluish green carbonate layer on the surface, it adds aesthetic beauty, but has an ugly look when it has the chloride layer. The copper chloride corrosion products are removed by immersing the object in a 10% solution of sodium sesque carbonate (a mixture of equal amounts of sodium carbonate and bicarbonate) the unwanted deleterious chlorides are converted into oxide and the aesthetic colour of the object is retained.

When copper based objects are affected by bronze disease and if the details should be brought out, the objects are kept immersed in a solution of alkaline Rochelle salt (15 grams of Rochelle salt, 5 grams of sodium hydroxide and 80 ml. of distilled water). This immersion dissolves all the corrosion products and the oxide layer is visible. Then the objects are kept in a solution of 10% citric acid, which removes the oxide layer and the underlying original metal surface is visible.

Silver Objects

Silver objects like utensils, jewelleries either appear black, white or green. The green corrosion products can be either due to the leaching out of copper from the silver object or the corrosion transferred from a copper based object, which was close by. Such objects can be treated by alkaline Rochelle salt solution.

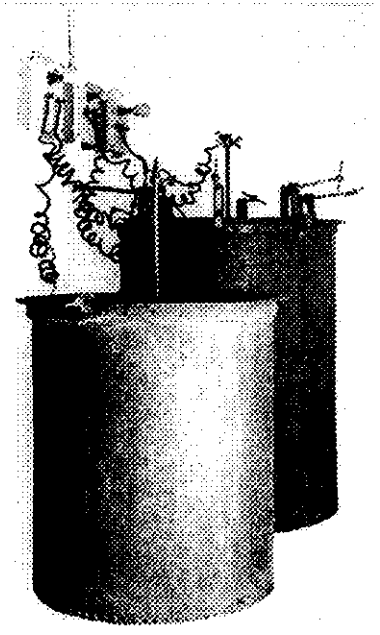
The black colour of silver objects, tarnish, is removed by treating with a 10% solution of formic acid. The underlying white layer is removed by immersing or treating the objects with ammonia solution.

Electrochemical Reduction Method

The corroded metal objects may be electrochemically reduced by placing zinc powder and wetting it with 10% sodium hydroxide or 2% dilute sulphuric acid. By this method, the nascent hydrogen produced reduces the corrosion products into the corresponding metal.

Electrolytic Reduction Method

Electrolytic reduction is carried out in an electrolytic cell keeping the metal antiquity as the cathode with two strips of iron gauze suspended on either side of the object or a cylinder of the same material enclosing the object all around, as the anode in a 5% aqueous sodium hydroxide/ sodium carbonate/ acetic acid / formic acid. Current is passed from a direct current supply from a 1-50 volts source and an optimum density (2 amps per square decimeter with respect to cathodic object for a few to several hours, depending on the thickness of the encrustation. The corrosion products on the antiquity are reduced and removed by alternate brushing and washing until the hidden details are exposed with all its intrinsic artistic details.



Electrolytic Cell

Intensive Washing

Intensive washing is the last but definitely not the least important step in conservation of artefacts. Unless the treated objects are washed completely, free from the residual chemicals left behind on the objects, they will once again react with metal and the corrosion cycle will be repeated. Therefore, washing should be intensive and thorough in the final stages especially with methods involving chemical treatment. The last residual salts in the treated objects are best eliminated by prolonged soaking of the objects in disstilled water or the process may be speeded up by using hot water. This process may be repeated to ensure complete removal of chemicals by heating and cooling.

Consolidation and Protective Coating

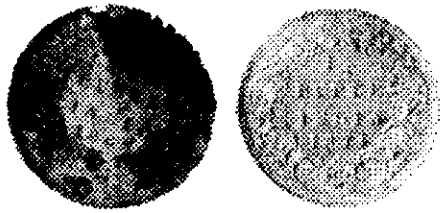
The metallic antiquities, which are very fragile and highly mineralised need to be packed up with resin or acrylics. This process is called "Consolidation". Consolidation of fragile metallic objects can be done with a 10% wax dissolved in benezene or by vaccuum impregnatin. A 2-3% poly vinyl acetate in acetone, toluene or acetone-toluene mixture

can either be coated on the object or vacuum impregnated. in the case of fragile bronzes, the missing corroded portions after treatment are modelled with M-seal, a resin and matched in colour. Mending of objects is done by doweling technique.

Arresting Corrosion

In most of the excavated and treasure-trove objects, it is seen that the corrosion has proceeded to an extreme, where very little metal is left intact. In such cases, the objects can best be conserved by stabilising the corrosion products formed.

Spots of bronze disease formed over protective patina layer may be mechanically removed. The pits found are then filled with a fine paste of silver oxide (in alcohol/water). Insoluble silver chloride formed seals off the underlying harmful effect of copper (II) chloride arresting further corrosion.



Silver Coin before and after Treatment

silver objects displayed inside the cases are also affected. Zinc oxide globules are used to absorb the hydrogen sulphide. Silver objects are coated with 2% solution of polyvinvyl acetate in sulphur free toluene.

Copper

Even though antiquities made of copper and copper based alloys appear to be stable, they are affected at high relative humidity. High humidity accelarates the development of bronze disease. Those objects which are affected by bronze disease, may be cleaned and displayed in a show case, which has provision to keep silica gel with self indicator (blue), which changes its colour (pink) by absorbing moisture.

Iron

Since iron rusts fast, the corrosion should be stopped by applying a water repellent material on the surface of the object. Besides wax, some consolidants and vanishes can be applied on the objects. Poly vinyl acetate, Paraloid B 72 are some of the consolidants.

General Care

Metal objects, gilded objects, painted objects and enamelled objects are very easily abraded or scratched. Therefore, they should not be stacked one over the other.

Bidri wares, inlay works etc., should be handled very carefully. If any inlay is lost, it should be fitted with acrylic resin. Such delicate metallic objects should be stored under dry conditions by wrapping them in tissue paper and keeping in polythene bags.

Since dust and pollutants affect metal objects, they should be kept arranged in racks wrapping them with polythene bags.

Coins are normally stored in small envelopes properly labelled. Shallow wooden drawers, with slots to keep the coins in position are best for their storage. Plastic shallow drawers will be the best for lead and silver coins to be stored.

CARE OF COINS

R. Shanthi,
Curator, Numismatic Section,
Government Museum, Chennai

The introduction of coins is a landmark in the history of civilisation and is a great achievement of the human race. Coins represent an imporant source of history, throwing welcome light on the political, socio-economic and cultural aspects of human development. Many facts connected with administration, historical geography and religious history of ancient India are revealed to us by numismatics.

The Government Museum, Chennai has a valuable collection of coins representing the various dynasties, which ruled different parts of India at different times. Chennai Museum has been augementing its collection over the years through treasure-trove finds, gifts and purchases. It has the unique previlege of holding the richest collection of coins from 6th Century B.C. to the end of the 19th Century A.D. At present, in the collection of this museum, there are about sixty thousand coins of gold, silver, copper, lead and other metals and alloys. Even today, treasure-trove finds of coins are received.

It is well known that coins with well produced devices, symbols and legends can be objects of art. So, besides serving as a medium of exchange, well excuted coins can also be items of art. Therefore, due care should be taken to preserve coins for posterity.

Among the over sixty thousand coins, most of them are copper based belonging to different periods and dynasties. Coins made of lead, copper etc., need much care as they are found to be affected easily. Particularly the treasure-trove copper coins are mostly stuck together and are green in colour. Cleaning of such coins is very essential for classifying the coins. The Chemical Conservation and Research Laboratory of the museum takes up the cleaning and conservation work.

To keep the coin in good condition, periodically the coins are inspected by Curator for Numismatics and the affected coins are treated with the help of the Conservation Laboratory.

Classified coins are kept in separate pouches so that all the particulars about the coins may be given on it.

Gold coins are found in good condition. Normally, they do not need any chemical treatment.

Even though silver is a noble metal, silver coins sometimes get tarnished in the air or form black and thick or thin crust by the action of hydrogen sulphide in the atmosphere. The black deposit obsecures the details. They should be cleaned by chemical means.

Lead coins are very badly affected, even in the atmosphere. Lead corrodes very fast. Such coins are checked often and if found affected, they are conserved with the help of the Conservation Laboratory.

Since coins are small in size, due care is taken as far as security is concerned. So they are weighed, dimensions like thickness length, breadth, diameter, etc. are measured and kept in separate, property labelled, pouches with details of the coins. Once the coins are classified, they are kept in their respective cabinets in the strong room.

The coins are under the joint custody of the Assistant Director of Museums / Senior Curator and the Curator of the Numismatic Section.

The strong room in the storage is checked regularly. Now the coins in the Numismatic Section are kept in pouches. It is difficult to check all the coins in a short time. Due consideration is being given to change the storage in such a way that all the coins are inspected with in a short time.

CARE OF INORGANIC OBJECTS

V. Jeyaraj,
Curator, Chemical Conservation and Research Laboratory,
Government Museum, Chennai.

Care of Stone Objects

All objects made from materials of mineral origin are called as inorganic materials. Stones are portions of rocks. Stones such as granite, basalt, sandstone, limestone, marble etc., are the most common stones used for sculpturing. The stone objects pose a lot of problems in preserving them. If they are not attended carefuly, they deteriorate.

Deterioration of Stone

Excavated stone objects are much affected by crystallisation of salts, which were absorbed with in the stone. Salts deposited in cavities near the surface can impose strains great enough (upto more than 1000 atmospheres) to cause complete distintegration of surface features such as ornamentation.

Outdoor stone objects suffer damages due to acid rain, which is due to the disssolution of oxides of sulphur, carbon and nitrogen in the atmosphere. Leaching of mobile materials from inside and recrystallisation occurs on the surface as an efflorescent deposit. Further more, substances dissolving in the capillary passages of stone may produce high osmotic potential gradients, which can lead to pressure damage. In urban areas black crusts of carbonaceous materials are often present.

Deterioration also occurs due to the growth of algae, fungi, moss, lichen and other microvegetation.

Insects and birds' droppings also affect the stone objects and monuments of they are not removed them and there.

Preservation of Stone Objects

Most of the deteriorations on stone objects are due to water. Now, the job is to remove the unwanted dirts and salts from the objects, protecting the surface with water repelling materials and consolidating the crumbling surfaces with suitable consolidants.

Removal or Dirt

Stone sculptures often accumulate dust, dirt and stains. Loose dust can easily be brushed off. Pure water with detergent like Extran is used to remove the dirt accretions. Stains of grease, oil, wax or paint can

be cleaned with suitable organic solvents like toluene, acetone, benzene, trichloroethylene, triethanolamine etc., or their mixtures. Whenever paints fall on the objects, it should be cleaned before drying. Steam cleaning is also done.

Removal of Salts

Salts that have migrated into the stone is to be removed along with efflorescent deposits on the surface without causing further damage. Smaller objects may be immersed in salt-free water. A 'poulitce' is applied to remove the salts. Porous materials such as cotton wool, paper pulp or sepiolite (hydrated magnesium silicate) are used as poultices.

Clearing the Oil Accretion

Removal of Biological Accretions

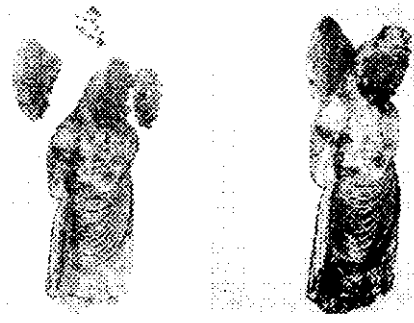
Deposits of moss or algae not only make them appear patchy, green or black in colour but also produce pits on the surface of the stone, thereby weakening the structure. A 5-10% solution of ammonium hydroxide is used for removing algae. Cotton pads dipped in the solution and kept on the affected area for about 15 minutes, brushing and washing will remove the algal growth.

Restoration of Stone Objects

Restoration is often necessary for reasons of safety of the object and is carried out using modern materials in a manner sympathetic to the existing structure.

Dowelling can be done in the case of broken objects. The broken pieces are joined by means of stainless steel rods and adhesives.

One of the main causes of moisture formation in stone buildings and objects which are directly in touch with the ground is the rise of water from the ground to the body of the object through the capillary pores present in the stone. Hence stone objects should never be displayed by embedding parts of them in the ground or in brick or cement pedestals. Stone sculptures can be placed on brick or cement pedestals only when a moisture barrier, like a plastic sheet, is inserted in the pedestal, just above the ground.



Stone Sculpture before and after Restoration

General Care

Stone materials should never be white-washed or painted. The soot depoosits due to burning of lamps etc., should be cleaned by solvents like benzene, spirit, acetone. Oil accretions by touching should also be removed as above.

Care of Glass and Glazes

The use of glass dates back to 3000 BC. Mesopotamians, probably were the first user of glass. Ancient glasses were found to have either magnesium of aluminium. Those glasses, which contained aluminium are much durable than the other. Pottery and mud bricks were also glazed to make them impermeable to water. The glazes used were similar in composition to glass artefacts although often made opaque to cover defects on the surface of substrate. For similar reasons metals were sometimes coated with coloured enamels, which were also glassy in nature.

Liquid glass is cooled below the melting point too rapidly to crystallise. Glass is a supercooled liquid silicate. Glass is made by heating silica (silicon di oxide), soda (sodium carbonate) and lime (calcium oxide). In a typical sodalime glass (75% sand, 15% soda and 10% lime), soda lowers the melting point of silicon dioxide from 1710°c to 700-500°C and the lime stabilises the glass by making it insoulbe in water. Potash glass and lead glass are stronger varieties of glass.

Coloured Glasses

Small amounts, usually less than 0.5% by mass of metal oxides impart colour to glass, eg. Ferrous oxide-blue, feerric oxide-yellow, both iron oxides-green, nickel-yellow, blue, cobalt-blue, violet, iron-blue, yellow, green, amber, manganese-violet, pink, black.

Defects in Glass

Glass is preserved well in a dry climate. Devitrification may take place due to the growth of seed crystals into larger in course of time. The glass may lose its transparency and becomes cloudy or crizzled which is commonly called as glass disease. When moisture is in prolonged contact with glass, the cations such as sodium, potassium and calcium are leached out and replaced by hydrogen and a layer of alkali metal hydroxides such as sodium, potasium and calcium are formed at the surface of the glass. They are very hygroscopic and absorb more water. If left untreated at a pH above seven the silicate network breaks down and the glass may become so badly crizzled that small flakes break off when the glass is handled. Acid rain containing dissolved oxides of sulphur, carbon and nitrogen contribute deterioration resulting in sulphates, carbonates and nitrates.

Conservation of Glass

The deterioration of glass can be stopped by avoiding contact of water with glass. The soluble alkali salts are washed with water, dried with rectified spirit, acetone or ether and stored in low humidity cases keeping silica gel. Broken glass vessels are repaired by using cellulose nitrate adhesives like Durafix, which does not shrink or undergo discolouration.

In the restoration of glass i.e. in filling missing parts thermoplastic, methacrylate resins such as perspex are often used. The most successful results are with certain acrylic and polyester resins, as they are transparent, do not yellow, appear similar to glass and can be tinted similating the stained glasses.

Care of Ceramics

Early man started using the naturally available materials for his daily use. Clay was certainly among man's earliest discoveries of natural materials adaptable to his needs. Ceramics is the general term for an object made out of clay like pottery, porcelain and earthem ware. Ceramic materials were in vogue in the sites of ancient culture throughout the world. The red and black wares, polished wares, megalithic potteries and the modem glazed wares are familiar to india.

Constitution and Types of Ceramics

Ceramics has its principal raw material clay, whose ingridients are alumina and silica, with varying quantities of other minerals. The composition varies from clay to clay. When clay is fired dehydration, oxidation and vitrification takeplace. Ceramic objects differ according to the kind of clay used and the heat applied in firing. The various types of ceramics are earthernware, terrracotta, stoneware, pocelain. Clay forms may be decorated in a wide variety of ways glazed or unglazed.

Deterioration of Ceramics

Most of the ceramic objects are excavated and are saturated with the salts of the soil, if they are unglazed or broken.

Unbaked clay objects are very fragile and are easily affected by water. Even high humidity will make it to distintegrate.

Unbaked clay objects are vulnerable to shock and distintegration occurs when severe vibration or shock is inherited by the object. Baked clay objects are also vulnerable to shock and severe vibration.

Rough unfired clay objects as well as weathered baked clay objects are easily accumulated with dust and is difficult to remove the dust.

Since clay objects are fragile, they are vulnerable to abrasion and scratches.

Conservation of Ceramics

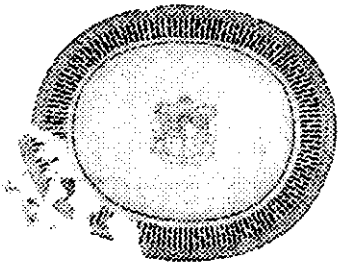
Since unbaked clay objects are prone to the damages due to water, moisture, shock, vibration etc., care should be taken to conserve them. Such objects should be impregnated with a consolidative resin like poly vinyl acetate. Larger objects may be impregnated by means of brushing and small objects may be vacuum impregnated. Unbaked clay object may be handened by baking it. Clay objects, if once baked then they may be washed to remove the salts present in them.

The excavated baked objects may be soaked in running water and the soluble salts present are leached out by this process. Any stain found on them may be removed by using solvents like acetone, benzene, after they are dried. In order to remove the dirt, 1% Extran solution may be used and brushed well with a soft brush.

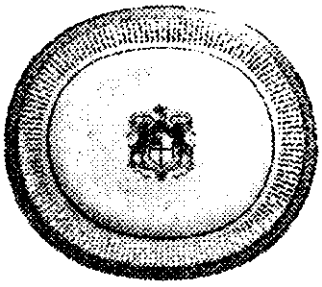
Encrustations on the ceramics may be softened by moistened pads. Fine scalpels may be used to take off the softened encrustations.

Mending of Ceramics

Most of the excavated ceramics are found broken and portions are not found. The broken pieces have to be mended. It requires great patience. It is always better to number them and put them together. The broken edges should be cleaned with a soft brush and then with rectified spirit. The adhesive, normally the acrylic resin, should be used to mend them together.



Damaged Porcelain Plate



Restored Porcelain Plate

CARE OF GEOLOGICAL SPECIMENS

D. Jawahar Prasad Raj,
Formerly Curator, Geology Section,
Government Museum, Chennai.

The fascinating term "geology" is simply defined as the study of earth science. The history of the geological galleries in the Government Museum, Chennai is indeed quite interesting. The museum itself was founded with a small collection of geological specimens in 1851. The principal geological exhibits are displayed under the five major headings viz.,

1. General Geology
2. Petrology
3. Mineralogy
4. Fossils and Palaeontolgoy
5. Economic Geology.

Generally, geological specimens do not require preservatory treatment. However, some minerals and fossil specimens require proper treatment in order to preserve them. Mineralogy is the study of minerals. A mineral is usually a natural inorganic substance having a definite chemical composition and a characteristic molecular structure. The minerals, which require a preservatory treatment can be grouped under the following headings:

1. Pyrite and Marcasite
2. Deliquescent minerals
3. Efflorescent minerals
4. Photosensitive minerals
5. Thermosensitive minerals

The minerals are the backbone of our modern industries.

"Palaeontology" is the study of ancient life such as fossils. The fossils are the remains of animals and plants, which lived in the past Geological Ages and preserved in the rocks of the earth's curst. Since, the fossils are chance findings and very rare specimens, great care should be taken for preserving them. In order to preserve fossils, they should be

first extracted from the rocks in which they are embedded and then cleaned and finally preservatory treatment may be given to them.

"Petrology" is the study of rocks. The rocks are the aggregates of minerals. The rocks are generally classified into three major divisions, namely,

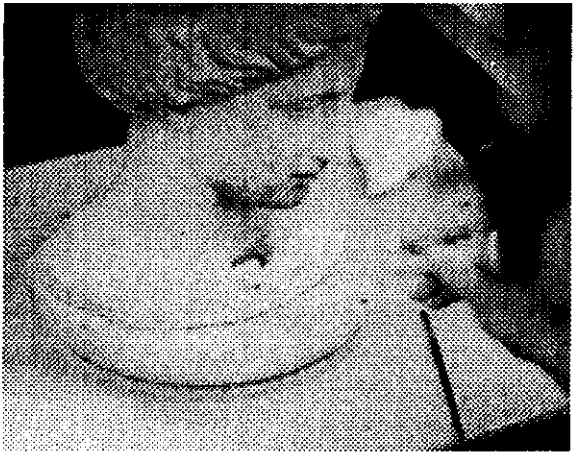
1. Igenous rocks
2. Sedimentary rocks and
3. Metamorphic rocks

The rock specimens do not require any preservatory treatment. The preservatory solutions required for preserving weathered geological specimens are as follows:

1. Celluliod solution
2. Polyvinyl acetate
3. Silanes and
4. Resins

Geology illuminates the past, sustains the present and promotes the future.

Moss and Lichen on marble sculptures are removed by laser methods.



Laser Cleaning
Courtesy : Conservation Centre, Liverpool, U.K.

CARE OF STONE MONUMENTS

G. Ramachandran,
Retd. Assistant Superintending Archaeological Chemist,
Archaeological Survey of India, Chennai

Introduction

Monuments objectify man's efforts to express his administration of the unknown through media. This has resulted in construction of places of worship as per the faith he has over the unknown which can be broadly termed as religion. This religious faith culminated in the construction of temples, churches, mosques, gurudwaras etc., as per the period of provenance of the particular religion, whose constuctions acquired antiquarian value through the passage of time entailing the sacred duty of preserving them for posterity.

Materials Used for Construction

The ancients realised that stone was a permanent media capable of withstanding the effect of atmospheric elements, chose it as the major construction material.

Different Kinds of Stones

Geologically stones can be calssified in a broad manner, viz.

a) Igneous b)Sedimentary and c) Metamorphic, of these igneous rocks are much stable and able to withstand the climatic effect better than the other two types. Granite belongs to this group whereas sandstone belongs to the other two categories.

Causes for the Deterioration

Deterioration of the stone surface due to long exposure to the atmosphere is termed as weathering of stone. There are three types. They are: i) Physical weathering ii) Chemical weathering and iii) Biological weathering.

Physical Weathering

Though stone is supposed to be the most stable medium for construction, because of the continuous exposure to atmospheric elements such as sun, wind, rain for centuries, stone surface undergoes slow process of deterioration which is left unattended, will lead to complete collapse of the monument.

Chemical Weathering

The moisture in the atmosphere combines with the carbondioxide and forms a weak carbonic acid which then reacts with the salts present in stone to form carbonates which are capable of being dissolved in rain water. Thus the strength of the stone is reduced.

Biological Weathering

The general black or greenish black colour seen all over the monuments are due to the formation of biological growth, called moss or lichen. These cause slow deterioration due to the fact that they take for their subsistence vital materials from the stone and in turn inject through weak but harmful acidic substances through their micro roots. Also the plants growing out of the seeds dropped by birds in the gaps of the stone joints slowly grow into tree and finally destroy the monuments through their strong and deeply penetrated roots. The birds' droppings, which get collected over a long period containing very harmful organic materials cause harm to the structures by slow erosion.

Monument with Vegetation

Causes for Deterioration Due to Location

The situation for monuments on desert type also or on the sea coast face special type of threat due to impact of sand particles and saline (salty) atmosphere respectively.

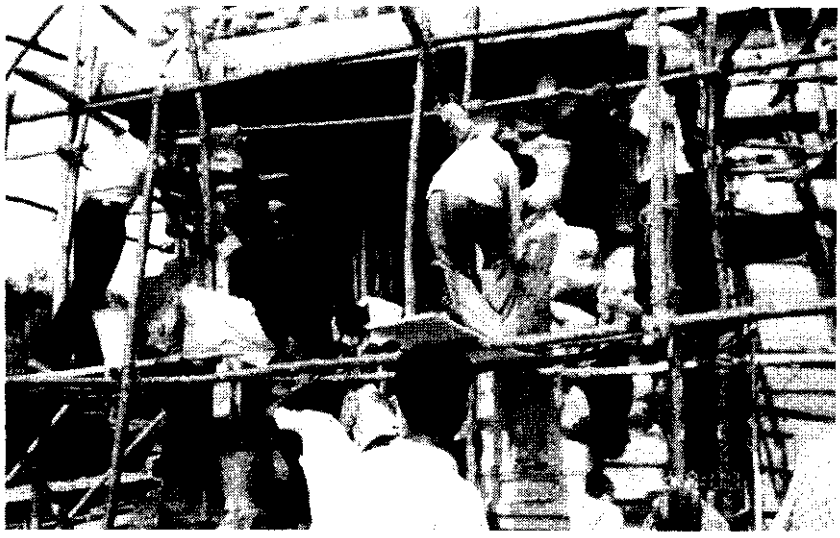
Internal Causes

If the water table (level of ground water due to spring underneath) is high due to capillary action, stone structure sucks water and this water content reacts with salts and slowly causes harm to the stone.

Remedial Measures

This dealing with causes of deterioration we now go for remedial measures which are adopted in stages. They are:

1) Removal of biological growths 2) Consolidation of weathered area in stone 3) Removal of soluble salts by poulticing 4) Application of fungicides 5) Application of preservatives.



Removal of Salt by Poulticing at Shore Temple

Conclusion

As these monuments are of very huge proportions and are continuously exposed to atmosphereic action no single and blanket measure as a permanent remedy is possible; but they have to be periodical. Though this will involve constant and careful monitoring involving perinnial expenditure, it is worth doing because it is a labour of love for our invaluable heritage and any neglect will lead to irrepairable national as well as international loss.

CARE OF ORGANIC OBJECTS

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Government Museum, Chennai.

Care of Wooden Objects

Any material derived from living organism forms organic materials. They are wood, leather, paper, palmleaves, barks, textiles, bone and ivory, feather etc.

Wood is a part of a tree. Wood can be obtained from monocot plants (Palm tree) and from dicot plants (branched trees). There are two parts in all these timbers. They are heart wood and sap wood. The heart wood (strong) contains some organic liquids like 'lignin', which makes the wood insect proof. The sap wood (soft) is easily prone to insects.

Deterioration in Wooden Objects

Wood, even though hard and durable, being an organic material is very vlunerable to various causes of deterioration both natural and manmade. Wood is fibrous and cellular. A seasoned wood is said to have its water content in equilibrium with the atmosphere. When the wood is kept in a very dry atmosphere because of its quick drying cracks are developed. Because of the changes in relative humidity, wooden objects warp. In moist condition wooden objects are easily affected by insects such as beetles. The powder-post beetles make their entries into wood and give out fine powders. This damages the whole wood without anybody's knowledge. Among the insects the most damaging one is termite or white ant.

If wooden objects are kept in damp condition for a long time, they may develop fungal growth, which weakens the surface. A really dangerous type of fungal attack on wood is called *dry rot.*

Wood carvings from temple cars appear to have hardened oily accretions disfiguring the details of the sculptures. This is due to the application of protective coating of oil to preserve the sculptures at the time of festivals. Repeated coatings of oils and leaving the temple cars along the streets allowing dust to accumulate makes the woodcarvings appear disfigured with caked up oil. Similar case may also occur when repeated painting is done to protect the surface.

Mishandling and vandalism also affect wooden objects. Faulty handling and storage create a havoc in the protection of wooden objects.

Conservation Measures

Wooden objects should be segregated from the soil and walls in order to avoid the contact of termites. The showcases and the area of the display as well as storage should be treated for insects and pests with aldrin, chloropyriphos etc.

Wide variations of climate cause disastrous effects on wooden objects. Therefore, maintaining microclimate of humidity range between 45 to 60% avoids damages on objects.

Insect attacked wooden objects may be fumigated with a mixture of carbon disulphide and carbon tetra chloride (1:4) in a closed chamber.

This kills the powder-post beetles. Then the holes are filled with wooden putty mixed with an insecticide like D.D.T. The growth of fungus is eradicated by the application of 1% orthophenyl phenol in rectified spirit. Warping of wood may be set right by the application of water and oil at the concave side and keeping light weight on the other side with proper padding. After required flat surface is regained, the sides are coated with polymers like poly vinyl acetate to avoid water absorption.

The accretions on the wooden objects may be removed by the use of solvents and softening agents. If accumulated dirt only is found on unpainted wooden objects, they may be removed by using 1-2% Extran in rectified spirit. The excess Extran used is removed by rectified spirit. If dirt is accumulated on painted wooden objects, care should be taken to remove the dirt. Benzene, rectified spirit etc., may be used by means of cotton swabs and that too area by area.

In the case of oily caked up accretions, the conservation treatment is difficult. In such cases, the accretions may be softened, by the use of organic solvents like acetone, rectified spirit, benzene etc. Care should be taken to avoid fire. Otherwise, a hot solution of 5% sodium carbonate is conveniently used to soften the hard material. Brushing with tooth brush and removing the materials using blunt scalpels will clean the wooden objects. Thorough washing to remove the sodium carbonate used is necessary. The wooden object should be dried under shade. When dried, the insect holes and cracks are filled with putty made of wood and insecticide like D.D.T. A 2% solution of AsCu in water may be applied as an insecticide as well as fungicide.

Since wooden objects are delicate in nature great care should be taken in handling and storing them. Wooden objects may be wrapped in polythene bags in the storage to avoid dust. They may be stacked in wooden racks. The storage area where the wooden objects are stored, insecticides like B.H.C., D.D.T. may be sprinkled. Fogging with D.D.V.P. may be done to drive off insects.

Proctective Coating

When the surface is cleaned for the accumulated dirt, the surface is cleaned and it should be protected from further accretions. Varnish may be applied to give a glossy look when there is no painted surface. If painted surface is available a 2% solution of polyvinyl acetate in toluene may be applied as a protective coating.

Care of Paper Based Objectives

Among the materials used for writing, the oldest records are stone and baked clay (6000 B.C.). Papyrus was widely used in Egypt from 3000 B.C. to about 900 A.D. Leather, parchment, vellum, silk, ivory, bone, wood, metal, paper, palmleaf etc., are some other materials. Papyrus and paper, eventhough prone to decay, were widely used as writing materials.

Papyrus

'Papyrus' - a type of sedge - was used to manufacture papyrus. (Greek, Papyros = the paper reed). Rolls of paper have survived for thousands of years in the dry atmosphere of Egypt.

Deterioration of Papyrus and its Remedy

1. Brittleness is the major defect due to loss of water. The normalcy will be regained by moistening.

2. Biological damages can be stopped by treating them with fungicides and insecticides.

Paper

The word paper is derived from papyrus. The method of manufacture of paper is entirely different from that of papyrus. The plant fibres were used for the manufacture of paper in the earlier days. Until 20th Century linen and cotton rags were used. But now a days, wood pulp is mostly used for this purpose. The credit of inventing paper goes to the Chinese. Eventhough the use of paper was known for so many centuries, at about second Century A.D., only it was used for writing purposes. Cellulose is

the chemical compound present in paper. Cellulose in paper is a condensation polymer.

Deterioration in Paper

The two factors responsible for the deterioration of paper are

1) Instrinsic factors and 2) Environmental factors.

Instrintic Factors

'Acidity' is the major deteriorating factor in paper. The essential cause of acidity is the existence of hydrogen ions. If the pH range is less than 7 it is acidic and it is alkaline, if the pH is above 7.

The acidity in paper is due to the formation of acid within the molecules. The 'alum' used in paper is hydrolysed and this increases the acidity. The lignin present in the paper increases the acidity. The residue of the chemicals used during the manufacture of paper increases the acidity. The cellulose decomposes and increases the acidity.

Environmental Factors

The various environmental factors responsible are moisture, dust, oxides of nitrogen, sulphur and carbon, biological agents etc., besides mishandling, faulty storage and vandalism.

Moisture

Either the increase of acidity, volume increase or sticking of art papers are due to excess of moisture. The moisture content is measured by means of relative humidity (R.H.). When the relative humidity is more than 60%, it adds water to paper which encourages various deteriorations to follow. The ideal condition is to maintain the R.H. at 55 to 60%.

Suspended Particulate Matter

Suspended particulate matter in the atmosphere settles on the paper and helps to disintegrate at moist condition. The suspended particulate matter is very high in industrial area and in Chennai it goes above 1300 micrograms per cubic meter at certain areas.

Oxides of Sulphur and Nitrogen

In the Chennai city the oxides of sulphur, carbon and nitrogen are very high due to industries and automobiles. These oxides dissolve in moist air and increase the acidity of the atmosphere, which increases in turn the acidity of paper.

Biodeterioration

The moisture in paper encourages mould and fungal growth and insect clothes attack. Common insects are silver fish, moth, beetles, bookworm etc. Foxing is the formation of small brown pots which are due to biological activity as well as due to iron impurity in the paper.

Deacidification of Paper

Deacidification is the removal of acidity from paper. This can be effected by dry methods as well as wet methods.

Dry Deacidification

The paper materials are deacidified by keeping them in an ammoniacal atmosphere in a closed cabinet. The acid is neutralised by the ammonia, which is basic in nature.

Wet Deacidification

If the paper has permanent inks wet deacidification can be effected. Otherwise the writings will be lost. Anyhow, the wet deacidification may be done with the help of methanol, ethanol, diethylether etc.

By Hydroxide

A saturated lime water deacidifies the paper material and then reacts with carbon dioxide forming, calcium carbonate, which acts as a reserve to neutralise any subsequent acidity. If the use of water is to be avoided sometimes barium hydroxide is also used as it dissolves in methanol.

By Bicarbonate

Magnesium bicarbonate is also used to neutralise the acid and the magneisum carbonate thus formed is used as the reserve.

Cleaning and Bleachng of Paper

The stains formed on paper may be removed by the use of non-abrasive erasers, soaking in water to remove or reduce staining and the use of organic solvents like toluene, hexane, methanol, ethanol, pyridine, chloroform, trichloroethane, acetone etc. The pigment should be tested before the use of the above solvents.

The chlorine dioxide evolved by the action of formaldehyde and sodium chlorite is a mild bleaching agent in water medium. Chloramin-T in alcohol is also used. Chlorates or hypochlorites are powerful bleaches.

Therefore they should be used in a very low concentration. Hydrogen peroxide is also used. In case water is to be avoided, hydrogen peroxide in diethyl ether must be used.

Inks and Adhesives

In the earlier times soot mixed with vegetable gum was used as ink. Later iron gall inks were used. Now-a-days chemical inks are used. Therefore it is always safer to test the ink for the fastness before any conservation work is started.

In order to remove the old pastes used in binding etc., enzymes are used to separate the sheets, if rebinding is required. In the present day, carboxy-methyl-cellulose, wheat flour paste, maida flour paste etc., are used along with a little (0.1%) fungicide like paranitrophenol and insecticide like mercuric chloride, copper sulphate.

Repair of Paper Materials

If the paper is very fragile, it can be strengthened by lamination. This can be effected by a laminator with the help of cellulose acetate foil and tissue paper under heat or by hand lamination with cellulose acetate foil and tissue paper and acetone in cold condition.

Chiffon lamination is also effected by the use of chiffon and maida or wheat flour paste. All these repairs are reversible. If any method is ineffective the lamination can be reversed at a later date.

Care of Paper Materials

A suitable storage condition is a constant temperature of about 20°C and a relative humidity of 55-60% in a pollution free atmosphere.

Affected and Restored Paper Print

A proper storage of paper manuscripts should be made. The manuscripts, books etc., should be kept perpendicular to the shelves and cleaned periodically by vacuum cleaner.

It should be ensured that proper ventilation and air circulation is made if air conditioning is not done.

While handling, if the books or manuscripts are very fragile, a proper book rest should be provided.

Paper materials should be periodically fumigated with the help of thymol or paradichlorobenzene to eradicate the fungal and mould growth.

Care of Textiles

There are references for the use of leaves and leather as dress materials. Barks of certain trees were also used to make clothes. When man learnt to spin and weave, fibres and textiles came into existence. The invention of dyes made man to make coloured fabrics. Designing of the textiles took importance when man wanted to have aeshetic beauty.

Types of Textiles

Textiles are made out of fibres of nature and man made. Fibres from plants, animals and insects, like cotton, flax, hemp, jute, wool, silk are natural fibres. Nylon, polyesters, terylene etc., are made out of synthetic materials and are man-made. Museums possess all types of textiles viz. barks, leaves and costumes ranging from a simple cotton saree to ornately decorated costumes of silk or wool. Care of textiles of natural fibres is of importance and of concern to the museum curators and private collectors.

Biological Agents

Mirco-organisms like fungi, moulds grow on textiles made of cotton, flax, hemp, jute, wool etc. Fungus not only weakens the fibres but also leaves stains which are difficult to remove.

Insects play a havoc in the case of textiles. Termites destroy all types of textiles when suitable damp condition prevails. Wool-moths attack woollen materials. Certain beetles like the dermested beetles damage wool and silk.

Mishandling and Vandalism

Improper display and storages cause greater damages to the textiles. Neglect and ill-maintenance also matter much. Vandalism is yet another serious factor, which damages our museum textiles.

Conservation Measures

Acidity in textiles make them to change the colour and weakens the fibres. Acidity of the textile is found out by pH papers. From the colour change, we can find out the pH and say whether the textile is acidic (pH:upto7) or alkaline (pH:over7). If the textile is plain without any colour, it may be deacidified by fumigation with ammonia in a closed chamber. In case of fast coloured fabrics the acidity may be removed by keeping the textile in between chiffon cloths on a glass support and washing with 1% Extran in distilled water. It should be thoroughly washed in water to remove acidity as well as the soap completely.

The stain may be removed by *ringing* method. The stained side is padded with cotton and from the other side a solvent like acetone is applied, which loosens the stain and is absorbed by the cotton pad.

There are several methods of strengthening textiles. This can be done either by mounting, lamination or by impregnation. Mounting of weakened textiles is done on strong backing cloth by stitching. Lamination by chiffon is also done by stitching. Impregnation can be done by methylmethacrylate. Freeze-drying may be done once a year to avoid all biological activities at -20°C.

General Care

Since all kinds of textiles are extremely susceptible to light care should be taken in the following lines. In the displayed area the intensity of illumination should be kept low, which may range from 50-100 lux. Ultra violet absorption filter may be used in the light sources. Natural light has ultraviolet radiation and so natural light should never be allowed in the galleries as well as storage areas but only aritificial source of light, that too indirect light, should be used.

High relative humidity favours always fungal growth as well as insect attack. Therefore, it is always good to control moisture by airconditioning the galleries. In order to avoid fungal growth in the textiles, they may be periodically fumigated with thymol. Napthalein balls may be kept in the display cases. Fumigation with D.D.V.P. may be done periodically both in the galleries as well as storage areas.

Since insects damage textiles, insecticides and termicides should be applied both in the galleries and storage areas. Termicides like Durshban TC, aldrin and insecticidies like D.D.T., B.H.C. may be used. Since dust creates a lot of problems, dust filters may be fixed in the airconditioners.

Regular vacuum cleaning should be done both in the galleries and storage areas. Textiles are covered by polythene covers and stored.

Because of various shapes and sizes of costumes, it is difficult to have a proper storage. One method is to store them in cabinets and hang them on padded hangers, with polythene sheets or bags to cover them. Contrarily, they are stored flat with pads or sheets of tissue paper inserted in the folds. To store costumes in a flat position, wooden drawers in cupboards are useful.

Regular inspection is to be made to find out the defects, if any. Periodical application of insecticides, fungicides and termicides and a good maintenance of the area keep all the textiles in good condition.

Care of Bone and Ivory Objects

Bone and ivory were early raw materials for carving out artifacts. Bone was used to make fish-hooks, arrow heads, tools, implements etc. Ivory was used to carve, etch, stain, paint, gild, inlay with metals and with precious and semiprecious stones. It was also used to inlay on wood and for veneering.

Composition of Bone and Ivory

Objects made of bone and ivory are indistinguishable by mere sight. The main inorganic constitutents are calcium phosphate associated with carbonate and fluoride and the organic constituent is ossein. Both have cellular structure. Ivory has a hard and dense tissue known as dentine, which results in situations which may be seen radiating from the centre of the task. Ivory has magnesium content.

Deteriorations in Bone and Ivory

Bone and ivory are anisotropic having directional properties and for this reason they are easily warped upon exposure to heat and damp.

They are decomposed by the prolonged action of water due to hydrolysis of the ossein. They are disintergrated by acids.

Being porous and of light colour, they are easily stained. They tend to become brittle with age and they lose their natural colour when exposed to sunlight. When buried in the ground for prolonged periods of time, they are distintegrated either by salt encrustation or by water. With the onset of fossilization, the organic content gradually disappears and the remaining calcareous matter becomes associated with silica in the from of quartz and with minerals salts derived from the ground. Old bone and ivory often

have an yellow colour and this is accepted as a form of natural patination, which may help to enhance the appearance.

Conservation of Bone and Ivory Objects

There are various methods of conservation of bone and ivory objects. Depending upon the type of defects, the treatment varies.

Removing Surface Dirt

Accumulated dirt, soot and grease obscure the beauty of the objects of bone and ivory. If the condition of the bone or ivory object is fairly good, a 1% solution of Extran is water is brushed on the surface and the dirt is removed with cotton swabs. Prolonged contact with water should be avoided. When fragility is observed the procedure is adopted with Extran in rectified spirit.

Removing Solube Salts

Excavated bone and ivory objects are found to contain absorbed salts, which tend to cyrstallise out effecting distintégration, if they were buried in a salty ground. The removal of salts from bone and ivory objects is extremely difficult. The solube salts should be dissolved out by water. But, prolonged immersion or washing will damage the structure and it may warp. The soluble salt-encrusted objects are immersed in distilled water for 5 seconds and is repeated a number of times with fresh distilled water. Then two washings in 95% alcohol is made. Finally, the object is immersed for one minute and dried in air.

Removing Insoluable Salts

Removal of incrustations of calcium carbonate or calcium sulphate from bone and ivory objects are a professional conservator's job. A small area of about 1 square centimeter is taken and brushed with a 1% solution of hydrochloric acid for a few seconds and the reacted material is removed immediately by a blotting paper. This is repeated. The incrustation is removed by means of pin or scalpel without making any scratch or abrasion. In order to remove the traces of acid the object is washed in several changes of distilled water for a few seconds at a time, and then dried by alcohol and finally with ether. If only calcium sulphate is present, it should be removed by mechanical means even by vibrotool very carefully provided the object is strong enough. Other wise it may be left as such.

Strengthening

When bone or ivory object is weak, it may be strengthened by impregnating it with a 5% solution of polyvinyl acetate in toluene. This

may be done 3 or 4 times to do a justification. Fragile objects may be vacuum impregnated. During excavation, a water emulsion of poly vinyl acetate (PVA) or polymethacrylate may be used to strengthen wet and soft bone or ivory objects before removal of the object. Bone and ivory objects may be given a protective coating of 2% P.V.A. in toluene.

Restoration of Bone and Ivory Objects

In the restoration of bone and ivory objects, suitable adhesives which will not be affected by humidity are used. Nitro cellulose based adhesive is good for restoration. Water soluble adhesives should never be used.

General Care

Since bone and ivory objects are porous and are easily scratched, stained etc., they should be wrapped in a clean soft tissue paper and kept on padded shelves or in padded boxes.

Very badly affected objects should be kept in showcases, which are provided with silica gel to control relative humidity by absorbing moisture.

Care of Feather Objects

Feathers form art objects on their own rarely. They become part of an object such as head-dress, crown, etc. They are almost always secured to some kind of substrates, such as netting, basketry or hide and the method of attachment of the feathers may be sticking, tying etc.

Composition

Protein - 'keratin' - is the main constituent in feather. It is similar to that of hair but with a rather different molecular structure. Feathers are not flexible as hair but will break, if folded or stretched.

Causes of Deterioration

Feathers are inherently quite stable, but gradually they become brittle over a period of years. They become brittle below 40% R.H. and mould develops over 65% R.H. The bright yellow and red colours in the feathers fade at higher levels of light. Feathers are susceptible to dust, which settles and become trapped. The dirt soils the appearance and also provides an additional food source for insects and moulds. Insects attack feathers at larval stage.

Treatment of Feather Work

Dirt may be removed by brushig with soft brush using rectified spirit. The eggs of the insects may be removed by brushing. Feather work is fumigaed with D.D.V.P. (Vapona). New acquisitions should be fumigated with paradichlorobenzene.

Control Measures

It is better to maintain the R.H. between 45 and 60% and temperature between 20° to 22°C. In the case of coloured feathers, they should not be exposed above 100 lux. Dust should be avoided either by filtration or keeping the objects in showcases.

Infested objects should be separated and fumigated. Careful handling is important as feathers can be easily bent or broken, or the vanes disrupted.While handling, such objects both the hands should be used. Folding should be avoided.

Feather work should be stored in dark and cool areas with protection against dust. Open storage should be avoided. Handling of objects while inspections should be avoided. Objects should be displayed within cases allowing lesser light upto 100 lux.

CARE OF ARCHIVAL MATERIALS

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Conservator, Saraswathy Mahal Library, Thanjavur

The development of culture and civilisation urged the search for various writing materials. The archival materials were evolved for recording past historical events and other activities for the present and future use. The art of writing documents existed in various forms. Most of the available archival documents are in the form of papyrus, bark, leather, parchment paper, cloth, silk etc. The archival materials are of organic nature, which are subjected to deterioration by environment, living organisms and other factors of deterioration. So they need protection from the factors of deterioration. The art of preservation is as old as human civilisation. Learned people and scholars developed indigenous methods for conserving them. The first natural material used as insect repellent was cedar oil. In due course certain aromatic flowers, leaves etc., were identified to protect documents. The development of science and technology have contributed much in identifying proper conservation techniques for archival materials and other cultural properties. For proper preservation we should know about the basic constituents of the materials, factors of deterioration and various techniques of preservation of archival materials. Now-a-days most of the documents are paper based materials. The life of these materials are based on the raw materials, the method of preparation, sizing materials, bleaching materials, writing and other accompanying materials. Paper is an organic material, which is cellulose. It is susceptible to various deteriorating factors.

Deterioration

Deterioration is a change of original state produced by interaction between the object and factors of derioration. The archival materials get deteriorated by the physical, biological and chemical factors.

Physical factors are light, heat, moisture, water and fire. The ultravoilet rays from the sunlight and artificial light sources make discoloration, fading of inks also activate chemical deterioration. Heat evaporates moisture from archival materials, which causes the loss of flexibility resulting in brittleness. The archival materials absorb moisture, from the atmosphere. The excess of moisture in the atmosphere, leads to expansion, physical instability, growth of fungus, loss of adhesiveness and sizing materials, discolourising the inks etc. Water and fire unless guarded, destroy the archival materials completely. Deterioration brought

by biological factors is generally referred as 'Biodeterioration' The problem of biodeterioration is a matter of considerable significance in tropical humid climate. The suitable climatic condition accelerates the growth and multiplication of living organisms. Common biological agents of biodeterioration are fungi, insects, rodents etc. Fungi is a group of micro organisms of plant kingdom. They are grey, dark, brown etc., in colour. The fungi affect cellulose and sizing materials of the archival materials, which also add black and brown stains. The most common insects, which attack archival materials are silver fish, booklice, book worm, cockroach, termite etc. Silver fish is a silvery carrot shaped insect, which is a surface feeder and affects the smooth surfaces, binding materials, glue etc. Book worms are the larvae of 300 species of insects, which travel from the surface to the other end, making tunnels on the sheets and eat the cellulose fibres. Cockroaches attack the edges and spine of documents. Termites eat all types of organic materials.

The chemical factors, which cause deterioration are the impurities of atmospheric gases such as hydrogen sulphide, oxides of sulphur, nitrogen and carbon, ozone, dust, moisture etc. The oxides of sulphur, carbon and nitrogren and atmospheric moisture add acidity to the archival materials. The acidity affects stability of the materials, ink, colour and the materials become brittle.

Preventive Conservation Measures

Preventive conservation is the creation of an environment in which the enemies of archival materials cannot thrive or controlling the factors of deterioration of the archival materials. Environmental control, proper storage, handling practice, frequent cleaning etc., control of direct light, humidity and dust may solve most of the problems. Modern lighting techniques and U.V. filters can be used for controlling light. Heat and humidity can be controlled by air - conditioning the stack room/storage. Since air - conditioning is very expensive it is very difficult to put in use. So other means of control of climate by installing humidifier in summer, dehumidifier in winter and using buffer materials can control the climate better. The ideal temperature and R.H. in the stack room is 21° - 25°C and 45 - 60% ideal R.H. The above ideal temperature and relative humidity control the growth of fungi and insects. Periodical inspection, dust removal and keping insect repellents control the insects. If there are insect affected materials, they should be immediately fumigated with paradichlorobenzene. Most of the archives follow vacuum fumigation method. Acidity in the archival materials can be removed by deacidification method. It can be done by

aquous, non-aquous or vapour phase methods according to the condition of the documents.

Insect affected or acidified archival materials need strengthening. This strengthening process can be done according to the type of materials and type of damages. The various methods of strengthening of archival materials are mending, lamination etc.

The proliferation of scientific researches give various modern and indigenous techniques of conservation of archival materials. But **'prevention is better than cure'**, is a common proverb. The Archivists, Librarians and Educationists must know the causes of deterioration and their preventive measures to preserve the archival materials for posterity.

CARE OF LEATHER OBJECTS

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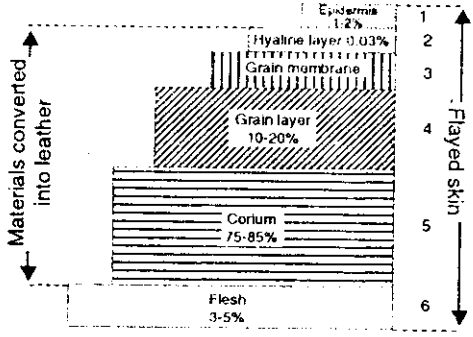
Scientifically an animal hide or skin has six distinct structural layers namely, (1) Epidermis, (2) Hyaline layer, (3) Grain membrane, (4) Grain layer, (5) Corium and (6) Flesh. Out of these, the materials from layer 2 to 5 are converted into leather, that is to say that leather is a converted bye product of animal hides and skins. In other words like meat, hides and skins and therefrom leather are bye products of animals. From leather numerous articles are manufactured by man for his everyday use. It is a universal phenomenon, which is coming down from the ancient history of mankind. Cow, buffalo, goat, sheep etc., are the common sources of raw hides and skins for making leather.

Structural Layers of Hides and Skins

Articles made out of leather are (1) Agricultural goods (2) Industrial articles, (3) Apparels, (4) Footwear, (5) Receptacles, (6) Sports goods, (7) Warfare articles, (8) Travel goods and so on. Hides and skins, not conventionally processed are used in a different form called parchment, which is used for making (1) Percussion instruments, (2) Puppets, (3) Writing surface etc. Preservation of leather - based articles begins right from the raw stage of hides and skins after removing them from the carcasses. To check the biodeterioration of the materials, three phases of chemical preservation are performed.

In the first phase, the raw hides and skins are preserved or cured with sodium chloride (common salt) for preventing bacterial growth and thereby to protect them against putrefaction. Sodium carbonate and naphthalene are mixed to enhance the curing effect of sodium chloride because the commonly used cheap commercial sodium chloride has many impurities in it like chlorides and sulphates of magnesium and calcium.



Structure of Skin

There are two methods of application of sodium chloride to raw hides and skins: (1) Dry salting and (2) Wet salting. It is experienced that the leather produced from dry salted hides and skins is better in quality. They are resistant to insect attack. The salted hides and skins can be preserved for a longer period. As and when required these are further processed by (1) Soaking, (2) Liming (dehairing and fleshing), (3) Deliming and (4) Pickling.

Soaking is submerging of hides and skins into water adding into it some little quantity of wetting agent and disinfectant to clean and wash out all dirts and salts and also to restore the original moisture and softness of hides and skins to carry out further process. The soaked articles are then treated with a mixture of sodium sulphide (about 1%) and slaked lime (calcium hydroxide - about 5%), which is called liming process. In order to remove the epidermis, hair and flesh, manual and mechanical methods are used. After scudding and ashing, the articles are passed through a soluble compund of ammonium sulphate (about 1%) or ammonium chloride (about 1%) for deliming, i.e. to remove the alkalinity of the hides and skins after which the cleaned pelts are pickled with a prepared mixutre of sulphuric acid (a mild solution) and salt (about 3%). The scientific chemical preservation of hides and skins of the first phase ends at this stage and carried over to the second phase.

This phase starts with tanning operation, the most important point for converting the raw collagenous substances of hides and skins into a stable and nonputrescible product called 'leather'. Tanning is followed by fatliquoring, dyeing etc. Tanning is generally practised in three methods - (1) Vegetable tanning, (2) Chrome tanning and (3) Oil tanning. The softness, flexibility, colouration and different quality of finishes of leather are attributed to this phase of preservation.

The complete process of leather making is lengthy. The episode narrated in this article is only a summarised version of the very deep and complicated subject matter. It is only a dotted outline of leather processing given for briefing a museum restorer for his guidance to undertake scientific preservation of leather objects.

The third and the last phase of preservation of leather appears to be superficial, but overlooking is harmful. The articles are in the form of ready made products, which have been talked about earlier. In this phase, various biodegradation of leather-based objects are insect attack, rodent hazards, fungal growth, discolouration, dryness, brittleness, aging etc.,

due to fluctuation of humidity and temperature, excessive sunlight and dusty and sooty atmosphere. Leather products of a museum collections require regular inspection for their proper care and also require careful application of suitable insecticides, fungicides and various other repellents, which are recommended and available in the market to control the enemies of museum exhibits, specially of leather objects. Therefore, apart from scientific preservation, a day - to day maintenance of museum articles by dusting and cleaning, covering in polythene bags, in short, a good 'house keeping' practice is necessary. A team of like minded workers should be trained in the job.

This is to mention here that hides and skins of exotic animals, such as, elephant, rhinoceros, tiger, deer, snake etc., are preserved by taxidermy technique in which the chemicals used are borax, alum, salt, arsenic paste etc.

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CARE OF ZOOLOGICAL SPECIMENS

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Museums are treasure houses where rare, old and unusual valuable objects are preserved and put on display for visitors. Biological objects of museums require special care and attention since they have to be properly preserved. Since decay sets immediately after the death of the living animal, steps should be taken forth with for preserving the body. While preserving the animals one should aim at preserving the colour, form and the general appearance of the living specimen. Biological specimens in museums include animals and their various parts, skeletons, eggs, nests etc., plants and plant materials such as fruits, seeds, timber, bark and fossils of plants and animals.

There are two different methods of preservation of zoological specimens followed in this Museum. They are :

1. Wet Preservation
2. Dry Preservation.

Wet Preservation

Liquid chemicals such as formalin and rectified spirit are mainly used for preserving animals in wet condition. Formalin, which is available as 40% strong has to be diluted to a strength of 4% formalin. This 4% formalin has to be neutralized by the addition of 10 gms of borax powder to every litre of the solution.

Certain animals can be preserved by using 4% formalin and certain animals can be preserved by using 90% alcohol. Sponges can be preserved either in dry condition or in wet condition. For preserving sponges in wet condition, only 90% alcohol should be used. Jelly fishes can be preserved only in wet condition using 4% formalin. For preserving other specimens either formalin or alcohol can be used.

Insects, birds and mammals can be preserved as dry preserved specimens. Snakes can be preserved as wet preserved specimens.

The zoological collection of any museum includes displayed specimens and reserve collections. These preserved specimens are naturally susceptable to dust especially to unfavourable lighting and to climatic hazards.

The conservation of zoological specimens needs the following requirements:

(i) Conservation in general

(ii) Preservation and display of the zoological specimens and

(iii) Conservation in relation to storage.

General Requirements

Museum personnel at different levels (Assistant Curators and Curators) must be trained in continuous checking of the collections, taking care of and handling of specimens and cleaning the interior of show cases, so that the staff pertaining zoology gets training with the simple routine works in galleries such as refilling of specimen jars, chemical treatment to the mounted specimens and skeletons and provision of insecticides inside the showcaces.

It is absolutely essential to maintain environmental control by maintaining temperature and relative humidity at desirable levels and controlling their fluctuations. Tropical climate compels measures to reduce the heat effects, since heat accelerates chemical action. Excessive heat also results in low humidity and make the integumentary structures brittle. Humid conditions also make the insects flourish and fungal growth to the dry mounted specimens from the attack of fungi, olive oil and xylene mixture can be used in the ratio of 1:4 respectively. Dust stains the objects. Major cause of damage to the objects is neglect and mishandling. When the objects are needed for renovation, study by scholars, for changing exhibitions, loan to schools and colleges or to other museums, they should be carefully handled, placed in trays and carried carefully. Sudden rushing with objects in hand or even in trays is not advisable.

Cleaning of galleries with brooms raises dust, therefore wet cleaning and vacuum cleaning should be introduced. White washing and painting of museum building is another hazard to the museum objects. The painters should not be allowed to start until the objects are properly covered with polythese sheets to save them from splashing. Conservation does not only mean chemical treatment or environmental control but also day - to day care and handling is an integral part of conservation.

Preserved and mounted animals, integumentary structures of animals, silk carpet, needs protection from excessive lighting and from insects. Excessive lighting is hazardous for zoological specimens also. The ultra violet radiation of sunlight and even artificial light is very harmful. The hazards of lighting can be minimised by the use of filters and by the

use of indirect or reflected light. This however necessitates frequent covering of the objects by polythene covers during the sunny or rainy and dusty days.

Storage of museums collections is very important part of the museum and should be paid regular attention. The storage collection or reserve collection should be well lighted and ventilated. The system of visual storage where all the objects are kept in glass cases is very advantageous. It allows easy inspection of deterioration setting of the specimen jar, which requires refilling and facilitates the curator to inspect the collection at a glance.

Therefore, preservation is the job of museum curators. They should be fully conversant with conservation requirements of museum materials in relation to different functions of museums.

CARE OF BOTANICAL SPECIMENS

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The appreciation of "Flowers" and "Nature" interestingly influenced any piece of art work, whether it be a painting or a sculpture or a bronze or a wood carving. The love of flowers kindles rapport across the centuries. Moreover, the plant remains in archaeological sites, leads one to know about the climatic condition that prevailed at that time. In this way plants form the basis for everything including food, shelter and clothing. Besides imparting knowledge of taxonomy and systematics of the plants, study of botany helps in the dissemination of knowledge of ecology and economy of natural resources.

The subject of botany includes morphology, taxonomy, anatomy, ecology, termatology, genetics, physiology and the economic botany wherein the utilisation of plant products is dealt with.

'Morphology' and ' taxonomy' are always represented in herbaria, which play such a vital role, that it becomes necessary to preserve them.

In this fast growing scientifically and technologically advancing days, the flora is destroyed for various reasons, thereby disturbing the ecological balance. The need to preserve plants and botanical specimens arise thereby.

Museum, which is the treasure house of art and artefacts, plays a prominent role in educating the laymen about various subjects, wherein the study of botany is one.

Dead plants are prone to attack by insects or fungi, which cause putrefaction. Bacteria causes decay. Hence the necessity arises to preserve them. This is done by means of 'dry preservation' and 'wet preservation'. The former technique is involved in the preparation of 'herbaria' mainly apart from the preservation of seeds and fruits. In this method, plants are collected, poisoned, put into blotters and preserved in the ventilators and made as ' herbarium specimens'. For displaying these herbaria special herbarium drawers are made, where in fungal infection will not take place. These 'herbaria' form source material in knowing about the flora that prevailed even a century back.

Sometimes the other botanical specimens after displaying in the showcase, due to leakage or dampness of the walls are prone to attack

by fungi. In that case, the specimens are taken out and treated with saturated solution of mercuric chloride in alcohol. The botanical specimens such as fibres, millets, pulses, spices, drugs, dyes and tans after giving the preliminary preservative coating as mentioned above are kept inside the fumigation chamber with thymol for a period of one or two months.

Similarly, in the case of wet preservation, 5% formalin is made use of in preserving algal specimens; its colour is preserved by treating with 1% solution of copper sulphate in 2% formalin. Leaves of gymnosperms are preserved in 5% formalin. Angiospermic flowers are poisoned with 90% alcohol, 5% formalin and 5% acetic acid and displayed accordingly in the showcases.

Preservation of nature's beauty involves much knowledge, ingenuity and patience. When compared to other organic materials, preservation of botanical specimens needs special care since they are easily prone to decay.

'Preserve flora' should be the motto of every citizen, for preserving the flora for the posterity of the nation.

CARE OF ART COLLECTIONS

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The Contemporary Art Section has a collection of 219 oil paintings on canvas, 217 tempera paintings on cardboard, paper, etc., Tanjore paintings, miniatures, Kalamkari paintings, drawings etc. Contemporary paintings by Raja Ravi Varma, Roy Chowdhury etc., and paintings of the British Artists are some to mention in our collection. The total number of paintings in this section is around 900. These paintings belong to the modern period. The paintings of this section are either purchased, gifted or transferred from other government institutions or departments.

Display of Paintings and Storage

The paintings are displayed in two buildings. National Art Gallery is ideal for the display of paintings. The painting are displayed within showcases. Certain cases are even closed with glasses. The large British paintings are displayed above the cases on the walls at an inclined angle to avoid dust accumulation on the painted surface. Most of the paintings are provided with glass front. Two wings of this gallery have been refurbished recently.

The Contemporary Art Gallery is a very modern building and it has three floors comprising the temporary exhibition areas as well as storage including the curator's office. Only modern paintings are displayed in the panels fixed to the walls. In order to avoid dust accumulation most of the paintings are provided with glass front.

Sliding Screens

A portion of the Curator's office as well as a portion of the National Art Gallery are serving as the storage areas. The paintings were stacked and some were hung on the walls. The stacked paintings were covered with polythene sheets. Now sliding screens have been provided, in which the paintings are suspended and stored.

Problems Facing the Paintings

The problem in the National Art Gallery is less when compared to the Contemporary Art Gallery because of its architectural construction. The walls of the building (Contemporary) become moist during rainy season and the paintaings are affected by fungi. Now necessary repairs have been undertaken making it fit for display of art works.

Humidity

The humidity is very high in the new building and the proper ventilation provided controls the humidity. It is planned to have giant fans to circulate air.

Dust

The accumulation of dust in the Contemporary Art Gallery was more because of more of open ventilators. The accumulated dust on the paintings is removed regularly with soft brush and cloth. The reserve collections are covered with polythene covers. Now the openings are closed and thereby dust is avoided considerably.

Damages by Biological Agents

Monsoon season has a lot of threat from the insects, fungi etc. Termite attack, fungal attack, insect attack are noticed if no proper premonsoon care is made. Therefore a premonsoon treatment is done with insecticides like Durshban TC, D.D.T.

Care and Maintenance

Since most of the paintings have organic materials as the support, frame, backing etc., they are given close examination regularly and insecticides are sprayed at the frames, back side of the panels etc., to avoid insect attack. Dusting is done with soft brush regularly.

Measures have been taken to control the natural light by black coating the window panes suitably. Proper air circulation is made by fans to reduce the relative humidity during the monsoon. Dichroic halogen lighting is provided in the contemporary Art Gallery. The Raja Ravi Varma paintings are displayed in the rear room of the National Art Gallery and provided with Fibre Optic lighting which is free from heat, UV light etc.

Vandalism is avoided to the greatest extent by providing glass front to the paintings and also providing barricades keeping them beyond the reach of the visiting public.

Seriously damaged paintings are sent to the conservation laboratory for conservation work. The paintings are inspected by the Curator for Chemical Conservation along with the Curator for Art Section and suggestions for the proper care and maintenance are made regularly.

CARE OF PAINTINGS

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Introduction

Paintings are one of the most important materials among the materials entrusted to a Curator not only because they are often of great monetary value but also because their structure and composition are somewhat complicated and hence they present peculiar conservation problems, entailing special skill and care in their maintenance and proper preservation.

It is essential to remember that a painting is a layered structure, consisting of different layers viz., (a) the support (b) the ground (c) the paint layer and (d) the varnish layer (in the case of oil paintings) bound closely to one another and the state of preservation of each of the layers has to be considered and remedial measures taken wherever necessary, besides ensuring the good mutual adhesion of the layers.

In an oil painting, the support is usually canvas (of cotton or linen in our country but of hemp or flax in Europe). The canvas is first treated with glue and then a priming consisting of lead white or zinc white in linseed oil is laid. This is the ground for receiving the paint. The paint layer consists of pigments ground in a medium, which is linseed oil in this case. (In tempera, the medium may be a gum or a glue or, in the case of egg tempera, the yolk or the whole egg). Finally a coat of varnish, usually consisting of mastic or dammer dissolved in turpentine, is applied. The varnish serves a double purpose. It affords protection to the paint layer and secondly it brings out the colours in their full richness. Recently some synthetic materials have been recommended for use as varnish.

In a paper painting, if it is in water colour wash technique, the paper itself serves both as support and ground. In miniature paintings as well as in the traditional paintings of the Thanjavur and Mysore schools, a ground of some inert material like chalk is laid on the paper before doing the painting. The technique is temporary, if the painting has a ground with a gum or glue as the medium. These paintings do not have a varnish coat (except in rare cases where a varnish might have been applied for a special purpose).

Deterioration of Paintings

i) Since the canvas support consists mostly of cellulose, excessively damp conditions can weaken the canvas due to disintegration of the cellulose. The same is the case with paper supports.

ii) Canvas and paper can become brittle due to oxidation of the cellulose, especially in the presence of bright light. This is called photo-oxidation. Colours (particularly water colours) may fade due to excessive light.

iii) Sulphur dioxide in an urban/industrial atmosphere, being converted to sulphuric acid, can affect canvas. In the case of paper, the effect is even more pronounced. Some kinds of paper already have some residual acidity from the manufacturing process itself. Increasing acidity, renders the paper very brittle.

iv) Atmospheric pollutants like sulphur di-oxide (SO_2) hydrogen sulphide (H_2S) etc., react with certain pigments resulting in change of colour. For instance, lead white and red lead can turn black after reacting with H_2S, due to the formation of sulphide. The effects of these gases is not pronounced in the case of oil paintings due to the protective film of oxidised inseed oil, but in the case of paper paintings, the effect can be drastic.

v) Some pigments themselves can affect the paper under certain circumstances. For instance, verdigris, which is a copper acetate can become acidic and damage the paper in contact with it.

vi) The canvas can undergo expansion and contraction due to fluctuations in the relative humidity of the atmosphere. Being hygroscopic, the canvas absorbs moisture from the atmosphere. It expands when it is damp and shrinks when it dries.

The paint layer and ground do not expand and contract to the same extent. The movements of the canvas being much more than the paint layer and ground, the latter are subjected to strain. As a result, a network of fine cracks develops on the paint layer extending to the ground. This is referred to as craquelure. It develops almost on all paintings with age.

Cracks can also appear on oil paintings due to faulty techniques and materials. Such cracks are usually wider and appear within a short time.

vii) Due to the breakdown of the binding medium, cleavages in the paint layers blistering or even flaking can occur. In extremely dry conditions,

the binding medium of tempera paintings may disintegrate and the paint layer, reduced to powdery condition.

ix) The varnish layer can also be a source of trouble. Due to uneven expanision and contraction, it can exert a strain on the paint layer causing cracking. The varnish layer itself may develop shrinkage and cracking. Natural resins, such as mastic, turn yellow after some time due to atmospheric oxidation and this fades the colour of the painting.

x) Another potent source of deterioration of paintings is biological agents like moulds and fungi. The gum or glue in tempera paintings serves as nutrient for these organisms and relative humidity of 75% and above provide optimum conditions for their growth. Appearance of greyish puffy growths indicate their presence.

xi) Various types of insect, which attack paper, cloth and wooden frame etc., are yet another common cause. Their activity is ecouraged by lack of cleanlines and insufficient light etc.

xii) Rodents and squirrels etc., are known to gain entry into the collection. Therefore, suitable precautions have to be taken to exclude these

xii) Last but not the least is the human factor. Damages caused to paintings and other precious objects due to wrong or careless handling, storage etc., are not at all uncommon. Wrong methods or materials used in previous attempts of conservation can also cause considerable trouble.

3. Preservation of Paintings

The conservation or restoration treatment of paintings is a specialised job to be attempted only by a trained conservator. However, since prevention is better than cure as the cliche goes, our aim should be to take adequate measures to prevent deterioration as much as possible.

i) Since climate plays a crucial role in the deterioration of paintings, it should evidently be controlled.

If it is possible to have air - conditioning in galleries and storage areas, maintaining the temperature between 20 and 22°C and relative humidity between 50 to 55%, it would be ideal. But, the air-conditioning should be present all the 24 hours, if the gallery is air-conditioned. Otherwise, if there are any intervals of time of a few hours without air conditioning, the fluctuation in temperature and R.H. will have a more drastic effect on the paintings than if there had been no air-conditioning at all.

However, all museums may not afford air-conditioning. The aim should be to have well-ventilated rooms, with suitable screening to keep off dust.

ii) Under high humidity conditions, de-humidifying plants can be operated in the rooms to bring down the R.H. to desired levels and R.H. can be continuously monitored with the help of hygrometers.

iii) If any fungal attack is noticed on objects displayed or stored in a room, the entire room has to be sterilized by fumigating with formalin vapours. The objects should be immediately sent to the laboratory for fumigation.

iv) Similarly, if there is the slightest evidence of insect activity, the object should be at once isolated and sent to the laboratory for treatment. The storage rooms, not to mention the galleries, should be kept scrupulously clean.

vi) The handling of delicate objects like paintings should be done with great care.

vii) For keeping the paintings inside the store room, stacking them one against the other should be avoided. Suitable arrangements for sliding screens on which the paintings can be hung, will be useful for storing even a large number of paintings within a limited space.

viii) Miniatures and other paper paintings can be mounted on acid - free mount boards using window mount arrangement with the painting surface protected with tissue paper. They can be kept in wide steel cupboards, with a suitable insect repellent like para dichloro benzene in small cloth bags being placed in the corners out of direct contact with the paintings. In high humidity conditions, small quantities of silica gel in small sachets can also be kept inside the cupboards to control the R.H.

ix) Paintings on display should be regularly dusted with a feather brush or soft cloth.

x) In display, the back of the painting should never be in direct contact with the wall, because moisture and sometimes even soluble salts can pass from the wall into the painting.

xi) Light being a potent cause for the deterioration of paintings, it has to be controlled carefully.

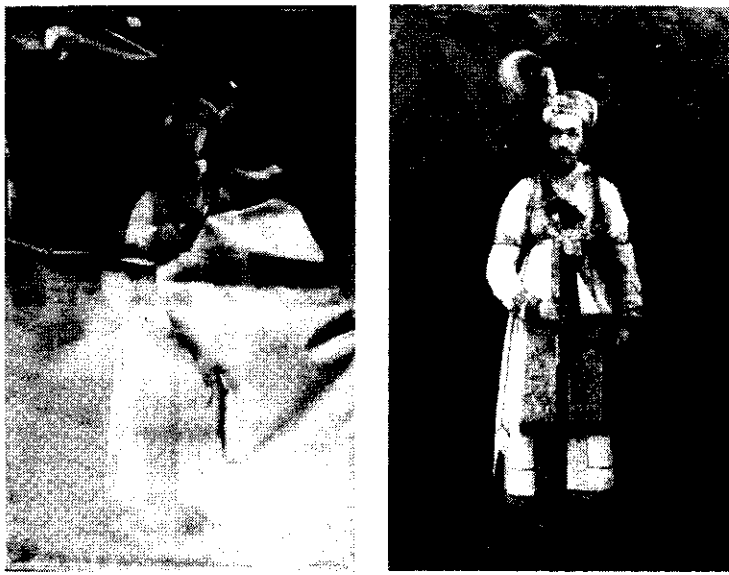
The ultra-violet component of light as well as the intensity of visible light are known to cause fading of colours. The ultraviolet light can be minimised by

(a) avoiding fluorescent tube lights as far as possible or

(b) by fitting the tube lights with filters and

(c) absorb the light from the sun light entering the room by painting the windows with film containing UV absorbing chemicals. Of course, direct sun light should never be allowed to fall on paintings.

The intensity of illumination should also be controlled. The maximum amount of light permissible for sensitive material like water colour paintings is 50 lux and for oil paintings it can go as high as 150 lux.



Painting before and after Restoration
at the Government Museum, Chennai.

CARE OF WALL PAINTINGS

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Wall paintings, as the name cannotes, are executed on the wall. They are also known a mural paintings or murals, in short. Sometimes, these are also called as *'frescos'* though this is not quite correct when applied to most Indian wall paintings. This is because in true *'fresco' or 'fresco buono'*, the painting is executed on wet lime-plaster with pigments - which are compatible with lime ground only in water. The pigments are fixed to the ground by the carbontation of the slaked or hydrated lime [Ca (OH_2)] as it reacts with the carbon - di -oxide of air to form the insoluble carbonate. The true *fresco* reaction can, hence, be represented as follows:

$CaO + H_2O \rightarrow Ca(OH)_2$

Quick lime Water Slaked lime (Lime plaster)

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Lime water

The technique adopted in India is of tempera where the painting is executed on dry plaster with a binding medium for fixing the pigments. The essential difference between the two techniques - the fresco and the tempera - is that in the 'fresco' the pigments form part of the ground while in the 'tempera technique' the paint layer can be noticed distinctly.

Stratically, the wall paintings consist of a' carrier' in the form of wall, a ' ground' of lime plaster and 'pigment' with or without binding medium. The ground can again be classified as consisting of rough plaster and fine plaster.

Causes of Deterioration

The causes of deterioration of wall paintings can be both external and internal. Among the external causes, the side variations of temperature and humidity can be cited as most important.

Moisture is very often the principal cause of deterioration. The sources of moisture can be due to the infiltration of water arising out of leaky roof, cracks and crevices on the walls, rising dampness, condensation etc. This might affect the paint film and the painted plaster.

If this is allowed to continue, the plaster itself might get detached from the wall. Excess moisture can cause deterioration of the binding medium as well, leading to the detachment of the pigment layers.

Another damage that moisture can cause is salt fluorescence. The soluble salts that might be present in the carrier are dissolved by the moisture and in the course of evaporation, they are brought to the surface of the paintings and are crystallised. This is a serious problem to tackle with.

Apart from the moisture present directly, the relative humidity of atmosphere has also a significant part to play in the deterioration of wall paintings. High humidity is conducive for the growth of micro - organisms. Excessively dry conditions can cause the binding medium to become brittle and lose its adhesive strength. This will ultimately result in the loss of pigments by flaking. Also frequent, mild fluctuations of humidity can cause movement of moisture through the painted plaster. Hence, this is also a source of damage.

Similarly, sharp fluctuations of temperatures subject the paint surface to stresses and cause sudden changes in relative humidity. Hence, this condition is also harmful to the wall paintings.

If the ground is prepared out of mud plaster, the vegetable matter present in the mud plaster is a source of nutrient for certain species of insect and hence attract insect activity. Small holes are caused in the plaster surface by these insects. Sometimes insect nests and cocoons are also found adhering to the paint surface.

Lack of proper ventilation and natural light are another source of deterioration for wall paintings. If the paintings are found in caves or temples, the above situation can be encountered. In such cases, bats' activities can be noticed. The urine and excreta of these bats deposited on the paintings are one of the difficult problems to be tackled.

Atmospheric pollution is another source of deterioration for wall paintings. The pollutants like sulphur-di-xide and hydrogen sulphide have highly deleterious effect on wall paintings.

Smoke emanating from chimneys, oil lamps or burning camphor etc., cause deposition of soot on the paintings. This not only disfugures the paintings by completely covering but the oil matter associated with soot has harmful effect on those paintings.

Similarly, natural aerosols contain minute particles of dust, dirt and other industrial pollutants, which can cause much damage to these paintings.

Lastly, but not the least, human vandalism in the form of scratching or etching on the paintings can cause serious- at times, irrepairable - damage to the paintings.

Among the internal causes of deterioration, the development of cracks, decay of binding medium, alligatoring of pigment layers,chemical change of pigments, friablility of plaster ground etc., can be mentioned. However, both the internal and external causes are inter-related as the deficiency of any external factors might set in the process of deterioration.

Preventive Conservation

Restoring a painting can be regarded as only half the task, the other half being to ensure that the objects, kept and exhibited in a condition best suited for the preservation. Thus the museum environment has become a matter of serious study. Problems of light, humidity and heat, toxic vapours and ultra - violet radiation etc., have to be set right.

(a) Light : In a museum, light means both the visible and the ultra - violet range of electromagnetic spectrum.

The normal aging and fading of paintings is mainly due to photochemical and oxidative deterioration, the principal source for which is light and to some extent, heat. The shorter wavelengths of ultra-violet light are potentially more harmful. The ordinary window glass absorbs radiations including ultra - violet below 310ηm.The source of ultra - violet light is either natural or artificial light.

Natural light contains ultra - violet light to an alarmingly great extend and suitable protection against it can be achieved by employing ultra - violet absorbing filters over the glass - panes through which light passes. The filter may be available in the following forms.

a) Self supporting acrylic sheet.

b) Thin foil - usually acetate.

c) Varnish.

d) Special coated glass sandwiched with ultra violet absorbing filter.

In case, the above filters are not available to the museum, other methods like painting the gallery wall with modern white paint containing

titanium di oxide can be resorted to. Titanium di oxide is known to absorb ultra - violet ray quite well.

Fluorescent light generally emit ultra - violet rays excepting the more expensive white variety (Philips 37) and needs filters as well. By employing louvers and placeing the object not directly under the incident beam, some degree of ultra - violet elimination can be achieved.

b) Preventive Measures Against Humidity and Heat

There are two ways to tackle this problem.

One, where finance is available, is to opt for complete air - conditioning with both temperature and humidity control. This is the best solution as far as preventive conservation is concerned.

There are, however, certain simple measures, which might provide reasonably good results where air - conditioning cannot be implemented. These measures are labour - intensive and need periodic check - up to getting satisfactory result.

(i) Re-orienting the Display

The museum objects can be suitably classified as more susceptible to relative humidity fluctuation and displayed suitably. Circulation of air also helps to prevent formation of stagnant air pockets, which favours mould growth.

ii) Humidifiers and Dehumidifiers.

iii) Use of buffering materials including salt hydrates.

By providing partition walls and such barriers and by introducing circulation of air one may establish a relative humidity gradient. Use of such materials like wood, cork, paper, silk etc., which are hygroscopic buffers also help to smoothen the relative humidity fluctuations.

(c) Air Pollution

The two basic types of pollutants are the particulate matter and the gaseous ones.

i) Particulates

They vary in size from 0.01 μm to 20 μm. Their source is diverse. One of the preventive measures is to encase the museum objects in transparent cases with proper ventilation with precautions against steep

variations of microclimatic factors inside the case. Curtains hung around the windows and walls also help to catch air - borne particulate.

ii) Gaseous Pollutants

This is an ever- increasing problem. These are emited by burning of fuels in cars etc., and from natural biological sources. These can be sub-divided again into acidic and oxidant pollutants. Acidic pollutants contain mainly sulphur dioxide, carbon - dioxide (CO_2) and nitrogen dioxide (NO_2) and are also active. The principal oxidant present in the atmosphere is ozone. The effective preventive measure is air - conditioning of the gallery.

CARE OF EXCAVATED OBJECTS

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Introduction

Care and preservation of objects, related, to past human activities, is in fact a kind of national duty and social obligation. Day by day, more archaeological objects and structures are being located and excavated. And, many more yet remain hidden underground or undiscovered, which may be brought to limelight in due course of time.

Archaeological Survey of India has a separate branch called, Excavation Branch. An excavator carefully brings to lime - light the unknown things created by our forefathers, whereas, a conservator meticulously preserves them for posterity. In between simultaneously, new creations are also taking place and quite a good number of them will certainly continue to exist as our legacies for the future generations.

Classification

The excavated or discovered objects may be inorganic or organic materials or a composite of both inorganic and organic. Objects of stone, metals, bricks, ceramics, pottery, terracotta, stucco, glass etc., come under inorganic class. Materials of organic class are originally derived from living things. These may be wood, ivory, bone, textile, shells, paper, leather and parchments, palmleaf manuscripts, painting. Paintings on canvas or on the walls are good examples of the composite class.

Effect of Surrounding Media and Analysis of the Decaying Process

Most commonly before being excavated, objects are buried in the soil or under water along with associated historical structures or they may be lying elsewhere in open condition. Many objects are also displayed or stored inside old palaces, forts, temples, mosques and churches in our country or abroad.

The nature of the material of objects and the condition in which they remained prior to excavation, determine the extent or rate of their decay. Effect of soil is of great importance. The mineral constituents of the soil, presence or absence of water, the rate of percolation of rainwater in to the soil and also the contents of organic matters derived from vegetable or animal remains, are the factors, which produce the specific kind of effect by the soil on the objects very fast. Sometimes, the effect of alkaline

soil is so much that the object may become powdery. Wooden objects remain in better condition under water, because of the lack of oxygen and consequently non - growth of fungi. Pottery, limestone, sand-stone, stucco and plaster are considerably damaged by acidic action of the soil. Likewise, the metallic objects are also affected by acidic soil. Metallic surface is also corroded by sulphate - reducing bacteria underground.

In buried condition, a kind of equilibrium is established between the object and its environment. But, as soon as the objects is excavated out, the balanced state of equilibrium is disturbed. It happens so due to the change of environment. In fact, this dramatic phenomenon is experienced by many excavators in course of their field works. For example, wet wooden, ivory or bone objects start shrinking and crumbling into pieces, at least superficially, within a very short time soon after their excavation. Wet metallic objects behave similarly on exposure to the new dry surroundings. In this way, it is imperative that before excavating any object, we should also know the environmental factors responsible for its decay.

Treatment

Taking into consideration the important practical aspects, the treatment may be preventive or curative. If suitable preventive treatment is not given to the excavated object on priority basis, there is every chance of losing it or at least its antique value. Problems vary from object to object depending upon its material and the surrounding media before excavation.

Certain points are to be remembered and care taken accordingly by the excavator in consultation with conservation chemist at the site of excavation, as a part of his planning and work. These are i) The excavator should be prepared for the type of material with which he is likely to come across during excavation. ii) Excavated objects must not be allowed to dry, otherwise their cellular structure shall be destroyed. This in turn will create problems in identifying and preserving them properly, iii) Needed chemicals and equipments should be made available at the site of excavation for the first hand (preventive) treatment. iv) Prolonged and complicated chemical treatment must not be carried out at the excavation site.

For carrying the objects to the laboratory, as a preventive step, they should be placed in a preservative solution better called as the stock solution. In the case of organic objects, fungicide (thymol paper piece) has to be added at the time of placing the object in the stock solution. A mixture of water and ethyl alcohol in equal proportions is used as stock

solution. Nine parts of this solution, one part of glycerine and O.5 cc of formalin are mixed together to obtain the preservative solution, which is used for dipping the object to carry it to the chemical laboratory. For wooden objects, poly ethylene glycol (PEG) 4000 is the efective stock solution. Here, the water molecules in the wood is slowly replaced by PEG molecules and the object remains in a stable condition during transit to the laboratory for curative treatment. Dry wooden objects have to be kept in a polythene bag along with a desiccating agent such as silica gel, anhydrous calcium chloride in order to prevent them from being wet. Temporary mending or repair if required, can be done with paraffin wax. In the laboratory treatment of dry wooden objects with sufficent compactness and strength is carried out by wet method. For removing soily, muddy, dirty and sooty accretions, a liquid non-ionic detergent 'Extran' diluted to 10% is applied over the wet wooden surface with the help of soft coir or nylon brush, rubbed and washed thoroughly with plenty of water. The dried surface is then consolidated, if needed, by filling up the pores, holes, cracks etc., with 5 to 10% solution of poly vinyl acetate in toluene, bees wax and or a filler mixture made up of sawdust and synthetic adhesive (fevicol) as per requirement. Use of emery cloth / paper may be necessary to make the treated spots uniform and even in appearance, in certain cases, finally, a solution of P.V.A. in toluene is applied uniformly with soft hair brush. Deterioration of wooden objects may also be observed due to the insect activity (termites and white ants are very destructive). In such cases, before preservation, fumigation with carbon di sulphide or carbon tetrachloride and ethylene dichloride (1:1 in proportion) and also application of 1% solution of penta chlorophenol in rectified spirit or a pyrethrum based product namely, flytox as insecticide, may be necessary. Similarly, further corrosion and flaking in case of iron objects (or any metallic object) can be prevented in the field by storing them in a sealed container having dry crystals of silica gel. Silica gel turns from blue to pink on absorption of moisture. It can be reused after making it dry in an oven. If the iron object is found in water logged condition, it has to be kept wet by storing it in 2% solution of sodium carbonate or sodium hydroxide. In the laboratory, treatment of iron objects has to be done by reduction method with sodium hydroxide and zine granules. Afterwards, excess of alkali can be neutralised by treatment with dilute solution of sulphuric acid and thoroughly washing with plain water. The dry iron object is then preserved with 3% solution of P.V.A. in toluene. Copper, bronze or brass objects when excavated, have usually the deposits of corrosion products (chlorides, carbonates, oxides and sulphates). This is called the 'bronze disease'. It is very harmful. The stock solution for such objects is 5% solution of sodium bicarbonate. Besides the corrosion products, there may be calcareous or and siliceous

accretions over the object. In the laboratory, elaborate treatment with 5-10% solution of alkaline Rochelle salt (made alkaline by adding 1% of sodium hydroxide flakes) is carried out to get rid off the bronze disease. It is done by carefully applying the solution by dipping the object, brushing with brass wire brush and washing with water repeatedly. Application of thiourea for prevention of corrosion in the cleaned objects is useful. For removal of calcareous and siliceous deposits, 10 grams of citric acid and 4 grams of thiourea with 86 cc of water or a solution of 10% sodium hexametaphospate in water are used. A 3% solution of benzo tri azole in ethyl alcohol, is used for treatment of copper objects. (The action of this treatment is rapid in vacuum). In this case, final washing has to be done by ethyl alcohol or rectified spirit. Some times, it is desirable to retain the patina (green incrustation on the surface of old bronze, considered as superficial ornamentation or decoration). In such cases, treatment with mild solution of sodium sesque carbonate (sodium carbonate and sodium bicarbonate in equal parts) is advisable.

Excavated silver and gold objects are also found covered with corrosion products. But, in case of gold, the corrosion products are of other metals associated with it. It is quite possible that copper or bronze objects are also discovered in association with gold and silver objects, and sometimes, a coating of silver may be found on copper objects. Usually, after excavation, gold and silver are not affected by process of corrosion. But, physical care has to be taken for their safe transportation to the laboratory 30 to 50% solution of ammonia, 10% solution of formic acid and alkaline glycerol are used for removal of any corrosion product or the tarnished look from silver and gold objects. In the case of lead objects also, corrosion is very rarely observed in the field of excavation. So, this can safely carried for laboratory treatment, which is similar as in the case of iron objects.

Besides metals, stone, pottery, terracotta, stucco, unbaked clay objects are also classified under the inorganic class, as discussed earlier. Except the clay objects, all other objects are made of sufficiently strong materials. In their case laboratory treatment involves the removal of external incrustation / deposits in the form of carbonates, chlorides, silicates and sulphates. For removing soluble salts, repeated washing with distilled water is carried out. Alternatively, repeated application of salt-free paper pulp soaked in distilled water may also be done. Insoluble incrustations have to be cleaned mechanically by scrapping etc., or chemico-mechanical means. Drops of hydrochloric acid can be used very cautiously in certain cases for softening the deposits before mechanical washing and scrapping. After that, thorough washing and drying is necessary in all cases. In order

to consolidate fragile and weak pottery and terracotta, a 3% solution of poly vinyl acetate in toluene is used under vacuum to ensure more penetration. For mending and joining broken pieces, adhesives like shellac in spirit or a quickfix or araldite can be used. Surface flaking can also be repaired and prevented by this treatment. For restoring missing pieces in pottery and terracotta objects, unbaked clay objects may have valuable inscriptions. They should be first dried in air and then baked in a kiln at 750°C. Only after that cleaning should be done in an usual manner. Removal of dirty and dusty deposits from stone can be successfully carried out by a mixture of ammonia and Extran (3:1) 10% solution in water. After cleaning, washing and drying, preservative coating (3% PVA in toluene or any other preservative like' perspex' in toluene) is given.

Among the organic materials, wood, ivory and bone are most commonly discovered in archaeological excavations. Treatment of wooden objects has already been dealt with. Now, let us see the treatment of ivory and bone, which are usually found in fragile and weak condition (at times, even broken into pieces). Moreover, due to their porous nature, soluble salts from the soil is readily absorbed into these objects. Because of their delicate nature, dry treatment is only desirable, except in certain cases. Superficial soily and calcareous accretions are removed with the help of coabroom or match sticks very carefully. The use of iron needles should be avoided as it may harm the object. The use of dilute Mowilith (a kind of nylon, a product of Hoechst Co.) solution may be found necessary for strengthening such objects are observed in a very fragile condition in situ, at the time of excavation. In exceptional cases, the usage of 1 % solution of hydrochloric acid in a localised manner may be required in the laboratory. But, it must be washed out immediately. For cleaning away the dirty stains or marks, 50% ammonia solution and or 10% hydrogen peroxide solution soaked in cotton wool swabs are very effective. Preservative solution made of 3% PVA in toluene and acetone is used under vacuum for achieving better results in strengthening of the matrix of the object. Packing and transporting of these objects have to be done with special care. In order to avoid abrasion during transit, each object should be first wrapped in cotton wool and then in thin tissue paper separately. After preservation, the objects should be displayed preferably in air-conditioned museums.

A complete record of the treatment given to the excavated objects in the field and also in the laboratory should be maintained for future reference etc.

CARE IN MUSEUM DISPLAY

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Different types of museums exist today. The obejcts displayed in the museum are multivaried and we have to take proper care in displaying the objects so that they are preserved well. In the earlier part of the last century, the restoration of antiquities was done only for immediate display. Now the trend has changed and the conservation of museum objects has become a more scientific one. This may also apply to biological materials.

Care may be taken in the display of museum objects as follows :

1. Designing of the museum building is important. It must have the following considerations :

a. Utility of indirect natural light b. Proper ventilation facilities c. Proper pest control methods d. Required length of halls with necessary electrical connections. e. Proper safety measures to avoid theft, fire etc.

2. Erection of show cases may be done, leaving a minimum gap of two feet between walls and show cases. Back side inspection may be done regularly by utilizing the gap.

3. When showcases are newly constructed, the display portion should be separated from light source to avoid excess heat inside the show cases.

4. Cleaning and periodic checking of museum objects is very much essential. Hence while designing the show cases, the following points may be considered. a) Wooden materials are coated well with insecticides. b) Show cases are designed in such a way that opening and closing are easier. C) Changing of electrical light will be easy, if the light source is separated above the display space.

5. As far as possible small museum objects are to be displayed in show cases instead of open display. When we talk about biological materials, it is always very much essential that they should be kept in show cases only, since they are vulnerable to physical damage and insect attack. Wet preserved specimens have to be looked after properly. Sealing of the wet specimen jars have to be done properly to avoid evaporation of the preservative.

6. Insecticides have to be placed inside the show cases. This is very much essential for biological specimens.

7. As far as possible 'open exhibits' (sculptures) should be avoided as environment factors deteriorate them easily.

8. Handling and transportation of sculptures, paintings and other museum objects have to be done carefully. A lot of damages occur due to mishandling of museum objects.

9. When we exhibit sculpture on cement pedestal an insulation of synthetic material may be provided between the sculpture and the base of the brick work. Capillary action of water or salt may be avoided by this.

10. Likewise, in the galleries when exhibiting bronzes or stone sculptures on wooden pedestals, the objects have to be fixed properly on the pedestals, otherwise accidentally they may fall down and get damaged.

11. While fixing the museum specimens vertically in the show cases, it has to be done properly, avoiding accidental falls.

12. Adhering stamps, coins or other museum materials on the walls of the show cases may be generally avoided, since this spoils the specimens.

13. The following care may be taken for display of paintings

a. Natural light may be avoided as far as possible, since it contains more ultra violet radiation.

b. Concentration of minds of visitors on museum objects is better in artificial light rather than natural light, since the natural light cannot be controlled.

c. Paintings and other openly exhibited museum objects have to be displayed in such a way that the visitors do not touch the objects easily.

d. In lighting, incandescent lamps are better than fluorescent lamps, Fibre optic lighting is still better, but costly.

e. Permanent long exposure of paintings to light in one place has to be avoided. Paintings may be replaced now and then in the galleries.

f. Direct light focussing on paintings has to be avoided, since it affects them badly.

14. Fire fighting equipments have to be placed in all the galleries and they should be in working condition and the staff have to be trained in fire fighting.

MISHANDLING, NEGLECT AND VANDALISM

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Much wear and tear, as well as accidental damages to museum objects can be significantly reduced by the judicious management and adapting certain basic conservation principles. Many damages to the museum objects are attributed to poor handling, lack of training to staff, neglect and vandalism.

Mishandling

Human factors such as poor handling and lack of training to staff to tackle objects result in serious dmages to the objects either in the storage, transportation or in museums.

Mishandled Terracotta Object

Careless handling of the objects results in soiling, dents, scratches, abrasions etc.

The Display of Paintings

Damage occurs when objects are dropped, objects tear or break when outsize or heavy objects are handcarried instead of being transported on trollies. Objects break when they are lifted from points of weakness. Surfaces of objects get damaged when surfaces of objects are dusted or drastically cleaned or with coarse or soiled cloths etc.

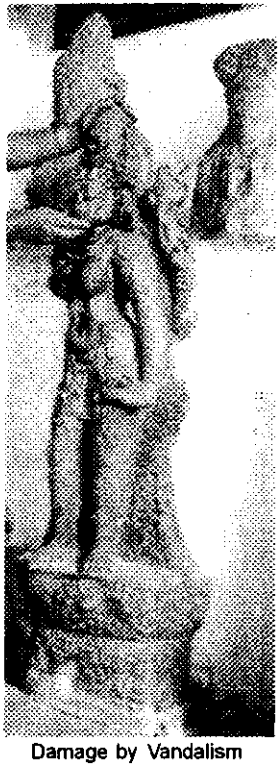
Neglect

Neglect of museum objects results in various problems. Areas where any type of work on art objects is done must be kept absolutely clean. Very often it is noticed that perspiration and grease of hands stain art objects. The natural oils of hands, deposited on objects, attract dust, which is chemically harmful. It is advisable to wear clean cotton gloves when handling objects of art, or to use a clean cloth between hands and the object. Hands should not touch painted surfaces, as in the case of miniatures or manuscripts, photographs or slides and negatives.

Vandalism

Vandalism is a deliberate act by which damages are made on the museum objects. Acts of true vandalism are fortunately a few. The visiting public are generally respectful of the deities etc. The motivation of the deranged individual to damage the objects take place in crowded galleries. The defacement of paintings or sculptures with graffiti by pencils, felt pen, etc., particularly on nudes and female figures have moral and behavioural connotations, which require study by psychoanalyses. Other instances of willful damage can be altributed to political, religious or racial fanaticism.

In the majority of situations the conservation and security precautions in museums are sufficient to prevent accidental damage, negligence and to inhibit the less determined vandal. These measures include physical or psychological barriers, such as floor elevations, ropes and stanchions drawing *Kolam* etc. These barriers will deter many visitors from approaching too close and touching, marking or accidentally scratching the objects. However, mischievous visitors will find ways to outwit the guards. Other means of security protection depends on the guard's perception of deviant behaviour in visitors. Close circuit TV, scanning of queues of visitors can often pinpoint strange behavioural pattems and the guard on duty can be alerted to be more watchful of the individual spotted. Another method is to pass the visitors through airport style security electronic barriers and remove potentially harmful devices. A cloak room is a must so that the visitors may not take with them halmful weapons or the baggage may not scratch against the displayed objects.



Damage by Vandalism

Whether it is mishandling, neglect or vandalism, it can be reduced to the minimum by the close monitoring of the duties of all the staff and by imparting training to the concemed staff who preserve the museum objects for posterity.

CARE IN STORAGE

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There is a natural tendency to relax conservation vigilance when the museum objects are out of sight in storage or in vaults. The basic principle of storage is to keep the object in a physically secured environment and yet to permit ready access for inspection before their removal to the galleries, storage or other locations.

Storage Devices

There are various storage devices and they are expected to meet the physical and environmental criteria intended for preserving the museum antiquities against damage.

Stacking

Paintings and flat framed works, prints, photographs etc., may be placed on pads and stacked vertically using cardboards as separators. In group stacking, it is necessary to ensure that the pads are skid - proof, that the angle of stacking is secure, and that the largest objects are kept first. Three dimensional objects like sculptures, large objects should be placed on pallets to permit handling and lifting.

Shelving

Shelves may be constructed either by wood or preferably by anodised steel metal for storage of two-dimensional or three-dimensional objects. Vertical slots may be designed for flat items and bays set up for objects. Boxes of different sizes may be made and objects kept wrapped inside. This method will utilise all the spaces available in the shelves.

Drawers and Cabinets

Drawers are used for flat works of art on paper, card-board and textiles, maps and similar items. Cabinets should be designed suitable for such objects.Interleaves of acid free tissue papers are used.

Vaults

Vaults and security storage area are used for extremely valuable objects, e.g. gold and silver coins, precious stones or other treasures like silver, gold and diamond jewelleries.They should be under lock and key.

Conservaton Guidelines

1. Storage area should be maintained clean and the waste and condemned furnitures should not be stacked in the storage.

2. Regular vacuum cleaning should be done to get rid off dust.

3. If open storage is maintained, the objects should be covered by poly ethylene sheets or bags.

4. In order to avoid wastage of space in the storage as well as to avoid dust, slotted angle shelves should be arranged with different sized boxes containing objects.

5. The R.H. and temperature should be maintained at the optimum level and it should be monitored regularly.

6. Light sensitive objects should always be kept closed by screen.

7. When scholars are allowed to study the reserve collection, pencil only should be allowed for writing. Otherwise there is a likehood of objects being stained by ink either deliberately or unknowingly.

8. Biocides should be used regularly. Before the advent of monsoon organic objects should be fumigated with thymol in order to avoid the growth of fungi and fogged with D.D.V.P. to avoid insect attack.

9. Smoking should never be allowed inside the storage area, as it may involve fire risk.

10. Open fire should never be used in storage, but emergency lamps should be used.

11. When objects are removed from higher shelves, ladders should be used.

12. Objects should never be kept near windows.

13. Proper pallets should be placed under heavy objects in order to facilitate lifting.

14. No objects should be directly placed on the floor.

Storage of Textiles

CARE IN LOANING AND INSURANCE

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When some national or international great exhibitions are conducted, museum objects are received on loan basis. Loan agreement is made between the lending and borrowing institutions. The memorandum of agreement of loaning sets out the conditions, duration of loan and insurance coverage for the specified number of works of art or museum objects and for a definite period. In the loan agreement the lender and the borrower agree on the security, conservation and all technical conditions for the entire period of the loan on 'nail to nail' or 'wall to wall" basis. When specifications are made on the conservation and care of the loaned objects in the agreement, these are implemented both by the borrower and the lender.

The loan agreement will have the following facts :

1. Exhibition title, description of borrowing and lending institutions and date of agreement.

2. Ownership and details of the onwer of the objects

3. Complete description of the object including materials, artist / craftsman, provenance, accession number etc.

4. Dimensions and weight of object including photograph or shape.

Technical conditions of loaning of museum objects are laid by the lending institutions and the borrowing institution agrees to it. Condition reports are prepared by the lending institution or the reports are prepared jointly by both the institutions. Borrowing institution has to prepare condition report, when there is any change in the appearance of the object and send it to the lending institution. Borrowing institution will maintain environmental control. Conditions to photography is laid as too much light will affect works of art. All care should be taken by the borrower in the exhibition and storage. Both the institutions agree that the assessed value is for insurance purposes and the liability of the borrowing institution will be limited to the insured value only. The borrower should do the packing, transportation and insurance at their cost. The agreement is signed by both the institutions along with witnesses.

The loaned museum objects will be accompanied by couriers who are the *defacto* ambassadors of the lending authorities and as such are often empowered to make spot decisions, when emergency arises. The couriers are normally Curators, Registrars, who have enough knowledge of shipping, transportation and conservation of museum objects. The condition reports, associated photographs, environmental records, charts etc., are filled in properly so that they can be readily accessed in the event of subsequent insurance claims etc., when such damage or loss occurs.

Insurance

Insuring museum objects sent on loan is very important. Insurance is made on 'nail to nail' or 'wall to wall' basis. This means the overall protection of the loaned objects from the time they leave the lending institution till they reach the lending institution back safely, within the prescribed time limit. There are a lot of scopes for damage or loss to occur to the objects in transit, at airports, docks, storage areas, exhibition areas or upon arrival and despatch at each venue of the exhibition.

Expert and Evaluation Committee

This committee is either constituted by the Government or the managing body of the lending institution to assess the insurance value in the event of loss or damage of the object to be sent for exhibition outside the museum. This committee will have 6 to 7 members. viz. Head of the lending institution, 2 or 3 experts, 2 or 3 conservators, a representative from the Government. Based on the age, rarity, value etc., of the objects, they may be categorised as

A : rare -cannot be loaned

B : can be loaned after the approval of the committee followed by the order of the Governemnt or the management body.

List of objects to be sent along with photographs and catalogued data such as photograph, weight, description, materials etc., is given to the Expert and Evaluation Committee members. The committee will decide the insurance value of the objects and the total insurance value will be arrived at.

Insurance Coverage

Insurance coverage rates are called for from various insurance companies. The lowest rate is accepted and the same is paid after the

approval of the committee as well as the Government or management body of the lending institution.

Loss or Damage to the Loaned Objects

In the event of damage or loss, the borrowing institution intimates the case to the lending institution and insurance company. The extent of damage on receipt of the object will be assessed by the Committee and the Collection Managers, the same should be intimated to the insurance company for settlement after seeking orders from the Government or management body of the lending institution as the case may be. In case, there is a loss of the loaned objects, the full insured value will be received from the insurance company.

Thus conservation plays a very important role in the loaning and insurance of objects. But, insurance does not save the object but compensates monetarily. No one should feel that insuring an object will safeguard the objects. Therefore, museum objects should be preserved well for posterity.

DOCUMENTATION IN CONSERVATION

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It has been stated earlier that all conservation works should be carefully recorded. There are several reasons for insisting on it. One reason is that a good record would give us information about the change in condition of an object. Plenderleith's book gives photographs of the plaster cast of a freize of Parthenon made in 1802 and of the freize itself as if existed in 1968. The two photographs reveal the immense change brought about by weathering in the atmosphere of London, which is different from that of Athens, where it was originally sculpted.

Another reason for a record is to know how the treatment given by us to a museum object has succeeded, whether there is any recurrence of the adverse chemical reactions which damage the object originally and whether the protective coatings given to the object after treatment had really protected the object from the ravages of the atmosphere. Sometimes by varying the protective coating, it may be even possible to know which one functions better than the other.

The still further reason for a good record is that we could reverse the processes of conservation given to an object at one time if better methods become available at a later date. A striking example of this is the scroll from Ur, which was first conserved in 1920 and completely redone in the recent decades.

Once we are convinced about the need for a record it may be necessary to know what to be recorded. To make this simple, index card have been designed in this laboratory which give the various headings under which the details are to be noted. A sample of this card is reproduced below :

CONSERVATION RECORD
Chemical Conservation Laboratory, Govemment Museum, Chennai.
Dimensions : length breadth height diameter other particulars
Weight : Before treatment and after treatment
Condition of Object on Receipt :
Treatment Given :
Ref. to photographs taken. Ref. to Preservation Register
Other References, if any
Name of Object : Provenance and Date Accn. No.

(Reverse side)

Condition after Treatment :

Date of Commencement Date of Completion :

Treatment carried out by :

Bibliographic References

On the first side of it, it may be seen that all the physical details of the object such as its dimension, its colour, its condition are recorded. At a prominent place on the card, its museum classificatioin number (the accession number) and the title of the object are also recorded to identify it easily. The card shown above has been prepared for use with an index cabinet called Kardex cabinet. The scond side gives details of the condition of the object aftef treatment, date of commencemetnt and completion of treatment and the name of the person who carried out the treatment. There is also a column for any reference to the object in art or scientific literature.

Classification of Index Cards

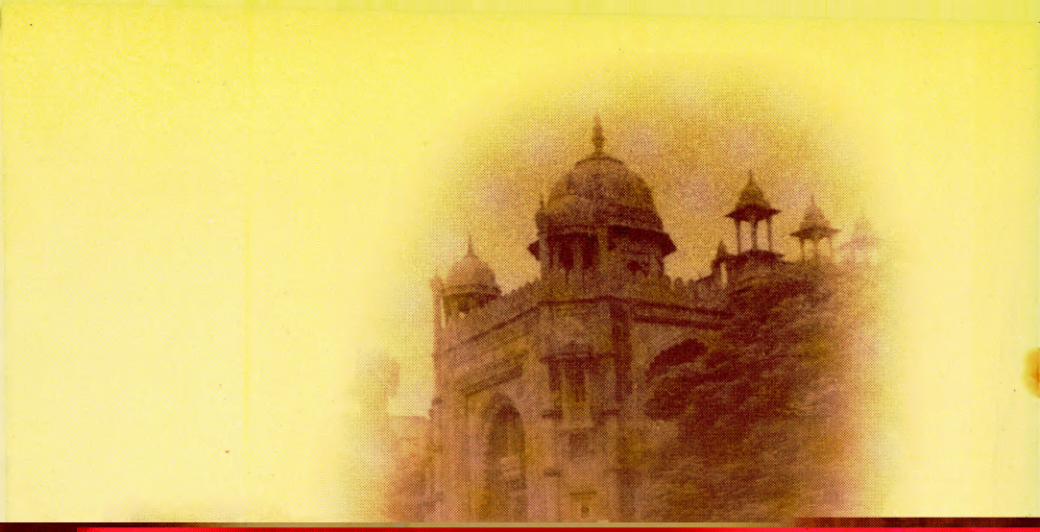
The Index cards can be kept in the canbinets according to a well defined system. In the Chennai Museum, the cards are kept in the Kardex cabinets under the following heads: Metals, Inorganic Materials, Organic Materials, Paintings, Chemical Analysis and Microscopic Analysis. This is a simple and elegant system, which permits quick retrieval of a card and also permits the keeping of ancillary material like photographs, samples etc., in the pouch for the card.

Another system of classification that can be used is the one given in the earlier issues of AATA (Art and Archaeology Technical Abstracts) published by International Institute of Conservation. In this system conservation work is classified under the following headings:

A) General Methods and Techniques B) Paper C) Wood D) Textiles E) Paintings F) Glass and Ceramics G) Stone and Masonry H) Metals I) Animal and Vegetable Products.

The arrangement of the cards can be further facilitated by numbering them according to the Dewey System of classification. There is a number for conservation in the system and further divisions under this number can be planned according to one of the classifications mentioned above namely, the one used in the conservation laboratory of the Chennai Museum and the other is given in AATA.

As soon as the work on an object is commenced, the first thing to be done is to prepare the index card and continuously fill up the relevant columns as the work goes on. Every conservator should do this scrupulously.



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serving the museum objects under the Department of Museums
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ning people in conserving the art, cultural and natural heritage for posterity.
viding research facilities leading to Ph. D. Degree under the University of Madras.
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ions of this Laboratory are
ok on Conservation in Museums, Care of Museum Objects, Care of Archival Materials(Tamil),
tion to the Chemical Conservation and Research Laboratory, Conservation of Cultural Property,
ion of Paintings from Madras Christian College, Care of Paintings and brochures..

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