# *Manual for the* Conservation Gallery

*Dr. V. Jeyaraj*

# Manual for the
# Conservation Gallery

By
Dr. V. Jeyaraj,
Curator,
Chemical Conservation and Research Laboratory,
Government Museum, Chennai-600 008.

New Series - General Section - Chemical Conservation -
Vol 11, 2003.

Published by
The Commissioner of Museums,
Government Museum,
Chennai-600 008.
2003

Manual for the Conservation Gallery

Year of Publication: 2003

Number of Copies: 500



**Price: Rs. 125/-**

*Cover Design and Book Layout*

J. Abraham Durairaj, M/s. Hepzibah Impressions,
Chennai-600 0078.
Mobile: 91-44-3100 8198

*Typeset by*

Akshara,
303/7, Mount Road,
Chennai-600 018. Ph: 2436 4303

# Contents

**Dr. R. Kannan**, Ph. D., I.A.S.,
*Commissioner of Agriculture and Museums,*
Government Museum,
Chennai-600 008.

# Foreword

The Chemical Conservation and Research Laboratory of the Government Museums is the oldest State Government Museum Laboratory in this country. Among the over one thousand museums of this country, only around 40 museums have conservation laboratories attached to them. The chemical conservation and Research Laboratory of this museum was established in 1930. Dr. S. Paramasivan was the first Curator of the Laboratory. This Laboratory was coopted in to help the Archaeological Survey of India in helping the conservation of wall paintings in Sittannavasal, Thanjavur etc. Many of the research articles of Dr. S. Paramasivan were published in National and International journals. Dr. S. Paramasivan's contribution to this field was well known to this world. He helped the Indira Gandhi Centre for Atomic Research for the Finger Printing of Bronzes project in collaboration with the Department of Museums in the 1970s. His vision has now partially materialized.

Dr. V. Jeyaraj, Curator, Chemical Conservation and Research Laboratory of the Government Museum gave a proposal to start a Conservation Gallery in the museum to educate the visiting public on conservation of cultural property thereby they can contribute in preserving art and cultural objects in the museum as well as elsewhere by not damaging them. The Government sanctioned the setting up of the Gallery in 1997 and was open to the public by the then Secretary to Government, Mr. S. Ramakrishnan, I.A.S.

As one of the measures to modernize the Galleries in the museum for the 151st year celebrations of the museum, the Bronze Gallery building was taken up and all galleries situated in the building were given an opportunity for refurbishment. The Conservation Gallery gives information to the visiting public on how to safeguard cultural heritage through photographs and materials. Dr. Jeyaraj has contributed to the field of Conservation of Cultural Heritage through his extension programmes, outreach teaching, training programmes. I hope that this handy manual for Conservation Gallery will help those interested to learn about the exhibits in the gallery and also enlighten them on conservation of cultural heritage in general.

Chennai-600 008,
30-03-2003.

(R. Kannan)

**Dr. V. Jeyaraj,**
*Curator,*

Chemical Conservation and
Research Laboratory,
Government Museum,
Chennai-600 008.

# Preface

The concept of Conservation Gallery is new to India. Conservation of antiquities is very important as far as the preservation of artistic and cultural heritage is concerned. As such the Chemical Conservation of metallic antiquities took shape in this Laboratory in 1930 itself. In the beginning this Laboratory was catering to the conservation needs of this museum only. Slowly the Archaeological Survey of India, in examining the wall paintings in Thanjavur, Sittannavasal etc., utilised this Laboratory, during the tenure of Dr. S. Paramasivan, who was a doyen in the field of conservation of cultural heritage. Later, the department of museums started establishing the district museums in the district head quarters. When the district museums were established, it was felt that the conservation aspect could also be included in the display in the district museums. Therefore, from 1996 onwards, particulars with respect to conservation of museum antiquities were included in the display in the district museums. Subsequently, it was also decided to start a Conservation Gallery in the Chennai Museum also. It was organised with the existing show cases. This gallery was inaugurated by Mr. K. Dheenadayalan, IAS, then Commissioner of Museums in the rear room of the Bronze Gallery in the ground floor. Then during 1998, the refurbished Conservation Gallery was inaugurated by Mr. S. Ramakrishnan, I.A.S., Secretary, Tamil Development-Culture and Charitable Endowments Department in the presence of Dr. R. Kannan, I.A.S., Commissioner of Museums. Now it is being modernised with vinyl printed display panels and aluminium-glass show cases. This Conservation Gallery is now shifted to the First Floor of the Bronze Gallery at the rear side. This gallery will be open to

public from 19th June 2003, when His Excellency, The President of India, Dr. A.P.J. Abdul Kalam inagurates various activities of the museum in the presence of His Excellency the Governor of Tamil Nadu, Mr. P.S. Ramamohan Rao and Honourable Chief Minister of Tamil Nadu, Dr. J Jayalalithaa. This gallery tries to educate the visiting public with the various aspects of conservation and the role of the public in conserving the cultural heritage. This is the first manual in the history of Conservation in India and it will be an eye opener to other museums to have conservation galleries, enabling the visitors to help in the preservation of cultural heritage. This manual will be useful to those who visit the museum as well as students who learn museology and conservation in particular.

Chennai-600 008,
30-3-2003.

(V. Jeyaraj)

# Acknowledgements

Government Museum, Chennai is well known for its scholarly and popular publications. Government was graceous enough to sanction funds for the publication of the museum including this. I thank the secretary to Government, Tamil Development-Culture and Religious Endowments Department for allocating sufficient funds. I thank Dr. R. Kannan, Ph.D., I.A.S., Commissioner of Agriculture and Museums, for encouraging me to write this manual. I thank Mr. K. Lakshiminarayanan, Assistant Director and the members of the Publication Committee, Mr. M. Mohan, Mr. K. Sekar and Ms. Suseela Rukmani for their help in this publication. I thank Mr. R. Balasubramanian Curator for Archaeology for sparing space for the gallery and specimens for display.

I thank the staff of the Laboratory Mr. J.D. Jagannathan, Laboratory Assistant, Mr. P. Raja Balachandramurugan, Technical Assistant, Mr. S. Sampath and Research Scholars Ms. Y.A. Divya Durga Prasad and Ms. Bessie Cecil and the volunteer, Ms. Dally Verghese for their help in the organisation of the gallery. I thank Mr. J.R. Asokan, Curator for Design and Display and Mr. K. Sekar, Curator for Children's Museum for extending help in the design and fabrication of the gallery. I thank Ms. Nalini Radhakrishnan and Ms. Suchitra Mohan of M/s. Interscape and Mr. G. Venkataraman for their assistance in the fabrication of the showcases. I thank Mr. S. Muthukrishnan, Photographer, Mr. S. Girija Sankar, Assistant Photographer and Mr. G. Ramesh, Technical Assistant for their help in photography. I thank the authorities of the Indira Gandhi Centre for Atomic Research, Kalpakkam for taking IR imaging and x-ray radiography. I thank Prof. P.K. Palanisamy, Anna University for taking hologram for display. I thank Ms. Bessie Cecil, a Ph.D. scholar working under my guidance for her help in proof reading. I thank M/s. Akshara for bringing out this book on time with

the approved design and layout given by Mr. J. Abraham Durairaj, Hepzibah Impressions, Chennai - 600 078.

Chennai - 600 008,
30.3.2003

(V. Jeyaraj)

# Conservation Gallery

## I. Introduction to Conservation Gallery

The knowledge of chemical conservation is essential to the visiting public as well as to those who are interested in preservation and to scholars enabling them join in the great task of conserving our artistic and cultural heritage of the ancient past. Hence the establishment of the Gallery on Conservation was necessitated.

This gallery has several aspects. They are,

1. Introduction to Conservation
2. Acquisition and Classification of Museum Objects
3. Laws Pertaining to Monuments and Antiquities
4. Factors Affecting Museum Objects
5. Traditional Methods of Preservation
6. Preventive Conservation
7. Conservation Activities
8. Conservation and Restoration
9. Authentication of Objects
10. Publication

**Evolution of Conservation**

In the middle of the 19$^{th}$ Century A.D., Michael Faraday studied scientifically the deterioration of easel paintings. The first scientist to have been employed in a museum, however, appears to have been Friedrich Rathgen in Berlin. In 1926, Dr. Harold J. Plenderleith was appointed as a conservation scientist in the British Museum, London. Even though, the first conservation laboratory in India was established in 1917 in Dehradun, Chennai Museum established the Chemical Conservation and Research Laboratory as a pioneer in 1930 in the State level. Now, besides conservation of antiquities, it aims at training museum personnel and youngsters in the field of conservation equipping them to take care of the collections in museums and allied institutions.

# Evolution of Chemical Conservation

Dr. H.J. Plenderleith
(1898-1997)

Dr. F. H. Gravely
Painted by Dr. C. Sivaramamurti,
then Curator for Archaeology

Dr. S. Paramasivam

Thiru. N. Harinarayana

Thiru. S. Thangavelu

His Excellency, The Governer of Tamil Nadu,
Mr. Bishnuram Medhi along with
Honourable Chief Minister,
Mr. C. Baktavachalam
Visits the Laboratory
after Inauguration

View of the Old and New
Conservation Blocks of the Chemical
Conservation and Research Laboratory

Research Scholars, Volunteer and
Staff of the Laboratory at Work

**Chemical Conservation and Research Laboratory**

Dr. F.H. Gravely, who was the Superintendent of the Madras Museum from 1920 to 1940, was responsible to a great extent for building up the research activities of the great institution and giving it a place among the great museums of the world. The Chemical Conservation and Research Laboratory of the Museum owes its inception to his scientific vision and forethought. With the valuable collection at the Madras Government Museum, it was felt necessary to treat the bronze objects disfigured by corrosive crusts in order to expose the decorative details and to eliminate the *bronze disease*, which brought in added deterioration. It was by then decided to set up electrolytic reduction equipment. In 1930, Dr. S. Paramasivan was appointed as the first Curator of the Laboratory. This Laboratory was also of help to the Archaeological Survey of India. In 1935, Mr. J. R. Blakiston, who was then Director General of Archaeology, New Delhi, requested Dr. F. H. Gravely to spare the services of the Museum Chemist to examine and report on the condition of the *Ajantha* like paintings in the *Brihadisvara* temple at *Thanjavur* and to preserve the paintings at *Sittannavasal* in the then Pudukkottai State. The work in this Laboratory was continued by the successive Curators like Mr. R. Subramanian, Mr. B. Ramachandran, Mr. N. Harinarayana, Mr. S. Thangavelu. This Laboratory is training many in conservation so that the trained people can join in preserving our heritage. In 1996, this Laboratory was recognised by the University of Madras as a research laboratory to carryout research leading to Ph. D. Degree. At present two full time and two part-time research scholars are carrying out research projects in conservation under Dr.V. Jeyaraj.

# II. Acquisition and Classification of Museum Objects

Museum objects are acquired as treasure-trove finds and through field collection, purchase, gifts, exchange, loan, transfer, as confiscated objects, bequests etc. Objects received in the museum are good and damaged, but to be preserved - conserved/restored. The show case has a panel depicting various types of objects acquired by the museum. Bronze, wood, palmleaf, coins, terracotta, leather etc., are on display.

**Classification of Museum Objects**

Museum is a non-profit making institution in the services of the society and of its development and open to the public, which acquires, conserves, researches, communicates and exhibits for the purposes of material evidence of man and his enjoyment (ICOM). But, now a days, a museum has to market its stuff in order to have sustained programmes. Any object representing culture, art etc., preserved in a museum qualifies itself to be a museum object. They vary from one to the other due to nature, type, property etc. Their vulnerability to damage and their control measures also differ. Depending upon the type of treatment to be given to the objects, they can be classified as follows:

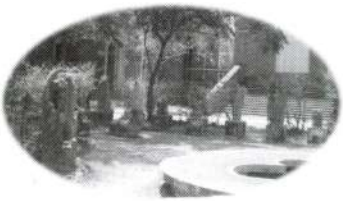
1. Metals
2. Paintings
3. Organic Objects and
4. In-organic Objects.

**Metals**

Metals and alloys form a major portion of museum collections. They are bronze icons, coins, bells, vessels, weapons, jeweleries etc. They are affected by corrosion in moist condition. Corrosion products formed on the objects should be removed or stabilised avoiding further corrosion.

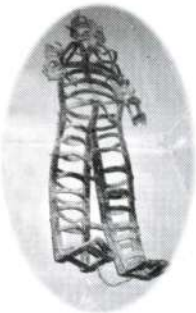
Silver Coins Received through the Treasure-trove Act (Metal)

Excavation Trench



Stone Sculptures Confiscated by the Police (In-organic)

Broken Glass Painting (Painting through Exploration)



Iron Cage Gallows (Metal-Purchase)

Bronze vessel Collected through Excavation at Adichanallur(Metal)

Golden Seal Rings (Treasure)

Iron Anchor (Metal - Transfer)

**Paintings**

Whatever may be the medium, type and variety, paintings are multi-layered and therefore, they require special study and treatment.

**Organic Objects**

Materials derived from living organisms are organic objects. Wooden objects like temple cars, doors, *vahanas*, clothes, palm-leaf manuscripts, leather objects etc., are prone to climatic changes. The environment should be stable and the objects should be attended to carefully as insects also at large easily affect them.

**In organic Objects**

Inorganic materials are very stable. They are complex in nature. Stone pillars, sculptures, stone inscriptions, terracotta objects, glass materials, fossils etc., are some of the inorganic materials. They are mostly exposed to the atmosphere and are affected by rain and weathering takes place. Therefore, they should be treated and preserved.

# III. Laws Pertaining to Monuments and Antiquities

In order to preserve the antiquities and monuments and stop the illegal trafficking of antiquities, the Government of India enacted Acts such as

(i) Indian Treasure-trove Act, 1878

(ii) Ancient Monuments and Archaological Sites & Remains Act, 1958 and

(iii) Antiquities (Export Control) Act, 1947. There are laws like repatriation law to bring the antiquities to the country of origin, if they had been taken earlier from the country.

**(i) Indian Treasure-trove Act, 1878**

As per the Section VI of the Indian Treasure-trove Act, 1878, whenever any treasure exceeding in amount of value ten rupees is found underneath the ground, the treasure should be handed over to the District Collector and the Collector after necessary enquiries with the finder, land-owner etc., and in consultation with the Commissioner / Director of Museums, fixes the value of the treasure and hands them over for preservation in the museums. The finder and the land-owner get 60% and 40% respectively of the compensation (in cash), which is calculated from the existing metal value and 20% antique value. This Act is not observed and therefore, many antiquities have already left the country. One should safeguard the antiquities through this Act and the concerned officials should be informed, if any violation is noticed. In order to safeguard the antiquities, all the antiquities in possession of temples, organisations or with individuals, should be registered with the concerned Registration Officers, who are under the Department of State Archaeology.

**(ii) Ancient Monuments and Archaeological Sites and Remains Act, 1958**

The Ancient Monuments Preservation Act, 1904 had three parts. 1) Protection of ancient monuments, 2) Arresting the

movement of movable objects of historical importance and 3) Protecting historically important sites and prohibiting excavations. In 1958, with a view of bringing the Ancient Monuments Preservation Act, 1904 into lines with the constitutional provisions and also to conform it to the new developments in the changed situation, Ancient Monuments and Archaeological Sites and Remains Act, 1958 was enacted on August 28th, 1958. Under this Act, historic, artistic monuments are declared as protected monuments. It restricts removal of any artistic sculptures etc., without the written permission of the District Collector. It restricts the excavation at the historical sites also. We have national monuments under the control of the Archaeological Survey of India and the State monuments under the control of the State Department of Archaeology. In Tamil Nadu there are 232 monuments and 164 historical sites under the control of the Archaeological Survey of India and 83 monuments under the control of the State Department of Archaeology.

**(iii) Antiquities (Export Control) Act, 1947**

In order to prevent the export of antiquities and art objects, the Government of India enacted Antiquities (Export Control) Act of 1947. According to this Act, coin, sculpture, manuscript, epigraph or other works of art or craftsmanship and article, object or thing detached from a building or cave, any article, object or thing illustrative of science, art, craft, literature, religion, costumes, morals or policies in bygone ages, articles, any object or thing declared by the Central Government by notification in the official gazette to the antiquity for the purpose of this Act, which has been in existence for not less than one hundred years.

Shore Temple,
a World Heritage Monument,
Mahabalipuram

Madurai Nayakar Mahal-
a Monument Protected
by Tamil Nadu Government

Jain Temple at Vijayamangalam
a National Monument

Adichanallur, One of the
Historical Sites,
a National Monument

Treasure-trove Bronze Icons

An Antiquity Controlled by the
Export Control Act

A Non-Antiquity,
Which Cannot be
Controlled by Export
Control Act

Green Stone Mosque, Arcot

Dargah at Erode
Looks Like a Temple

Brough Memorial Church, Erode
Looks Like a Mosque

Christhukula Ashram Church,
Thiruppatthur Looks Like
a Hindu Temple

# Factors Affecting Museum Objects

Musical Instrument Affected by Moisture and Heat

Fungal Affected Painting

Earthquake Damaged Minaret of the Achyut Kuki's Mosque, Ahmedabad

Sudden Termite Spreading from the Floor

Temple Structure Damaged by Vegetation Growth

Damage Due to Carelessness

Vandalism

Sculptured Pillar Affected by Smoke Due to Camphor Burning

Direct Light Like This is Not Good for Painting

Ceiling Painting Affected by Seepage

Stain Due to the Chemical Used During Moulding

Woodborer Beetle Affected Inlaid Wooden Picture

Dark Oil Accretions Due to Human Touch

# IV. Factors Affecting Museum Objects

Conservation refers to the whole subject of the care and treatment of museum objects both movable and immovable. Two aspects of conservation are - the control of the environment to minimise the decay of museum objects and their treatment to arrest decay and to stabilise them where possible against further deterioration. Therefore, one who is interested in the conservation of museum objects, must know the damaging effects of the environment on them such as light, humidity and air pollution, sound and vibration and what to do to minimise the damage. Moss and lichen affected stone, damaged wood, palmleaf etc., are on display.

**Aggressions of Cultural Heritage**

The aggressions or the deteriorating factors of an object can be natural or man-made. They may be due to the environment, building, visitors and staff. The natural aggressions may lead to immediate destruction or progressive destruction.

**Immediate Destruction**

Immediate destruction to the cultural heritage may be brought about overnight by flood, fire, earthquake, theft, insects etc.

**Progressive Destruction**

Progressive destruction is also natural one. This is brought about by environmental pollution due to air, dust, moisture, heat, light, micro organisms, wind, salt and intrinsic factors like chemical changes with in the material, physical changes etc.

Man made aggressions are classified as public aggression and professional aggression.

**Public Aggression**

The public aggression is mostly due to unawareness. They are such as vandalism, encroachment of a declared monument or site, more tourism attraction, theft, war and terrorism, urbanisation, misusing the cultural heritage.

**Professional Aggression**

The aggression due to the professional mishandling of the antiquities and cultural objects is called professional aggression. This is due to the lack of awareness, planning, training, security, control and **improper** execution of curative conservation, restoration or transportation, storage, exhibition, support, lighting, handling, maintenance etc.

**Biological Agents**

Museum objects are affected by biological agents such as fungi, moss, lichen, liverwort etc., when relative humidity is very high.

**Light**

Light is a form of energy. It can change colours, can bring about deterioration on the surface; where surface is the very essence of exhibits like paintings, drawings, textiles and can bring down the strength of the object. Stone, metal, glass and ceramics are not affected but all organic objects containing cellulosic and proteinaceous materials are affected. Light is much more potent than heat as far as art objects are concerned. The spectrum of radiation from museum light sources such as daylight, fluorescent and incandescent lamps etc., can be divided into three regions, by wavelength. They are ultraviolet radiation (300-400 ηm), light or visible radiation (400-700 ηm) and infrared radiation (beyond 700 ηm). The light of wavelength up to 500 ηm brings about degradation on materials by photochemical reaction. Therefore, the light should not directly fall on the objects, but only reflected light from a surface painted with zinc oxide or titanium oxide should be allowed. These chemicals absorb the ultra-violet radiation from the light.

All organic objects are subject to damage by light, as many of the colours used in miniatures, water colours and art on paper, natural history specimens are sensitive to light. Oil paintings change more with light. The paint medium whether oil, egg, gum or glue, is certainly damaged by light.

The colours of the materials absorb both the Ultra Violet (UV) and the visible radiation and they deteriorate. Daylight has the highest proportion of UV radiation and therefore, it must be filtered. Fluorescent lamps have less UV radiation than daylight but they need to be filtered. Light from incandescent lamps need not be filtered, as they do not emit UV radiation. The illuminance of light is measured in terms of lux. Digital lux meter is used to measure the intensity of light. The rate of damage depends on the exposure. The exposure is the simple product of illuminance and time. Therefore, in order to reduce damage to objects by light, we have to reduce both illuminance and time. When we want to control the illuminance, it is better to have artificial lighting up to 50 lux. In order to avoid glare and have a good look of objects, the light should be partly directional and partly diffused. Fibre optic lighting is nowadays used in the European museums. In the Government Museum, Chennai, the oil paintings by Raja Ravi Varma are displayed in the Contemporary Art Gallery, where they are lit by the fibre optic lighting. This lighting does not produce both heat and UV light and therefore this type of lighting is safer to the cultural and art objects. In the Conservation Gallery also, dichroic halogen lamps are used. This lamp dissipates heat at the back while not producing ultra violet light.

The exposure to light may be avoided by,

1. Limited objects should be brought out from stores.
2. Illumination should be given only during opening hours.
3. Illumination may be provided only while on view.
4. Use of replicas may be thought of.
5. Curtains over desk-cases are a best conservation measure, which should be followed.

**Heat**

A small change in temperature can have several effects. But, temperature change is not as important as humidity change except when it, in effect, causes humidity changes by drying. Storage with low temperature can be of benefit to archival materials and textiles. Excessive radiant heat must be avoided,

but there should be no problem at 50 or 200 lux of light. Rise in temperature influences the rate of deterioration by light.

**Humidity**

The moisture content of air is humidity. Humidity is measured by a scale called Relative Humidity (R.H.). Objects originated from plants and animals have water in them. If the moisture is taken away from wood, ivory or bone, they contract and very likely to split and warp. The absorption of moisture makes objects swell and vice-versa. *Veena* affected by humidity in shown. In changing size, they also may change shape or warp. Many museum objects are made of composite materials.

Hygrometers are used to measure R.H. They are sling or whirling hygrometer or sling psychrometer, hair hygrometer, recording hygrometer, electronic hygrometer etc. An instrument for monitoring R.H and temperature is on display.

Various classes of museum materials respond to R.H. The different modes of deterioration, which are influenced by R.H., are physical, chemical and biological modes. All moisture absorbent materials, such as wood, bone, ivory, parchment, leather, textiles, basketry and matting and adhesives swell when the R.H. rises and shrink when it falls, causing warping, dislocation between parts, splitting, breathing of fibres etc., especially at low R.H.

Most insect pests flourish at higher humidities. Very low humidities would be preventive but impracticable. Insect damage may be discouraged but cannot be prevented by humidity control. Freeze-drying is done at –20°C. Nitrogen atmosphere is created to get rid off the insect pests from movable cultural heritage

**Humidity Control**

Air-conditioning not only controls humidity but also removes dust and gaseous pollutants from the air. One single equipment cannot humidify and dehumidify. Therefore, humidifier or dehumidifier can operate but with a humidistat,

which maintains a constant R.H. by switching a heating system on and off.

There are electrically operated humidifiers of atomising and evaporative types and dehumidifiers of desiccant (drying) and refrigerant (cooling) types. For humidification, an evaporative type of humidifier should be chosen because of its convenience. For dehumidification in warm climates, a refrigerative type of dehumidifier and in cold climates a desiccant type should be used.

In the showcases, a buffer can be used. A buffer is a moisture-containing solid which, when the R.H. rises, absorbs moisture and gives it out when the R.H. falls. The best buffer is silica gel with a self indicator (normally blue) , not in its dry form, but brought into equilibrium with air of the required R.H. 20 kg silica gel per cubic metre of case volume is suggested for best result. Silica gel is on diaplay.

Dampness in buildings may originate from roof, foundation, exposed wall, plumbing failure, toilets or drinking water facilities etc. It may also be carried in by visitors. This dampness may be brought to control in the event of no humidity control system by ventilating the outside climate through windows, dry conditioning by electric immersion heaters and fans. Damp walls should be avoided for displaying organic materials, paintings etc., as fungi etc., are present in the atmosphere will cause damage.

**Air Pollution**

Air pollution is one of the serious dangers posed to museum objects. Particulate matter, gaseous pollutants, salt sprays, sound and vibration etc., are some to name.

**Particulate Matter**

Particulate matter in the atmosphere is due to expulsion of smoke from the factories, due to fuel combustion, vehicular traffic, salt spray from the sea etc. The normal level of particulate matter in a clear weather is 0.9 to 1.5 microgram per cubic metre. In a highly industrial area of a foggy weather, it goes up to 5 micrograms per cubic metre. The walls of new

concrete buildings give off dust of alkaline in nature inside the buildings.

**Removal of Particulates**

Particulate matter can be avoided to certain level by well made closed show cases in exhibition rooms and polythene bags in storage, providing screens to windows, foot-mattresses at the entrances, regular vacuum cleaning etc. Removal of particulate matter involves full-ducted air-conditioning so that air passes through the filters. Disposal of waste by burning should be avoided in the campus and yards, as it creates particulate matter.

**Gaseous Pollutants**

Like the particulate, the burning of fuels in power station, factories, domestic buildings and automobiles causes gaseous pollution at large. There are various pollutants in the atmosphere. They are oxides of sulphur, nitrogen and carbon, ozone, hydrogen sulphide etc.

**(a) Oxides of Sulphur, Nitrogen and Carbon**

When the fuel is burnt, sulphur combines with oxygen in the air to form sulphur dioxide. Sulphur dioxide further combines with oxygen to form sulphur trioxide. As soon as this is formed, it combines with water to form sulphuric acid. Sulphuric acid is a very strong and corrosive chemical and it cannot be removed by cleaning the air because of its involatility. The chief materials to suffer from sulphur dioxide pollution are calcium carbonate containing materials like marble, limestone, frescoes; cellulosic materials like paper, cotton, linen; proteinanceous materials like silk, leather, parchment and wool and other organic materials; metals etc. Similarly oxides of nitrogen form nitrous and nitric acids and oxides of carbon forms carbonic acid.

**(b) Ozone**

Ozone is a poison found at high concentration in polluted areas. Ozone can enter the museum from three sources; by the natural production in the upper hemisphere, by the effects of sunlight on automobile exhaust gases and from certain kinds of lamp and electrical equipment, which are used inside

the museums. Ozone also increases the rate of oxidation of silver and iron and sulphidation of silver and copper. Fading of colour from paintings textiles, natural history specimens is expedited by ozone.

**Salt Sprays**

The salts present in dust in the atmospheric air are chlorides, silicates, carbonates, ammonium sulphates etc. The chlorides are the most dangerous contaminant, which affect metals, stone objects, terracotta objects etc. Droplets of seawater are thrown into the air and they may evaporate to form sodium chloride crystals, which are carried by the wind inland. In fact, only coastal museums will be affected most.

**Removal of Gaseous Pollutants**

It is essential to keep the museum objects out of contact of the gaseous pollutants. There are two well-known methods for removing the gaseous pollutants from the museum environment. They are (a) water spray method and (b) activated carbon filter method. In the water spray method air is passed through a water spray in the air-conditioner by which the soluble oxides of nitrogen, sulphur and carbon are absorbed. But, ozone is not absorbed by this system.

Activated carbon filters and copper impregnated activated carbon are used to absorb the gaseous pollutants. They have to be replaced periodically. Copper impregnated activated carbon filters are replaced once in 5 years. Disposal of waste materials by firing should be avoided to cut off the oxides.

**Sound and Vibration**

Sound and vibration affect weak museum objects. Sound affects museum objects and therefore a specification is suggested for maximum allowable background noise from traffic and local machinery in an exhibition or storage area. Vibrations caused by building work, traffic, ventilation equipment and other machinery affect weak museum objects. High frequency sound and vibration should be avoided in the galleries and storage areas. Rubber cushioning may be provided for weak objects on display and storage. Earthquake affects even monuments.

# V. Preventive Conservation

There are three types of work in a museum or any organisation connected with the preservation of cultural heritage. They are:

1. Preventive Conservation
2. Curative Conservation
3. Restoration

**Conservation**

All forms of direct and indirect actions aimed at increasing the life expectancy of (an) undamaged and or damaged element(s) of cultural heritage are termed as conservation.

All forms of direct action aimed at enhancing the message(s) carried out by (an) damaged element(s) of cultural heritage are termed as restoration.

All forms of indirect action aimed at increasing the life expectancy of an undamaged element of cultural heritage is termed as preventive conservation. All the collection in a museum or a cultural organisation are sound, stable and some are damaged. What ever may be the condition of the objects preventive conservation is essential. Preventive conservation is all forms of indirect action taken to increase the life expectancy of any cultural heritage.

**Strategy for Conservation**

For better conservation of the cultural heritage, a systematic strategy is to be adopted. There are seven steps for the conservation measures to be taken. They are:

1. Know Your Collection
2. Categorise and Identify the Aggressors
3. Avoid the Aggressors
4. Block the Aggressors
5. Check or Monitor the Aggressors
6. React against the Aggressors
7. Communicate to the concerned.

Covering an Object with
Air Bubble Paper

A Showcase Protected
from Leakage

Traditional Fumigation Chamber

Fumigation Chamber with Nitrogen

Fire Extinguisher in a Gallery

Training Staff in Fire Fighting

Proper Way of Carrying an
Oil Painting on Canvas

Environmental Monitor to Monitor
Relative Humidity, Heat, Light and UV Light

Fibre-Optic Lighting with
Fibre-Optic Lamp

Handling Bronze Object
with Gloves

# Traditional Methods of Preservation

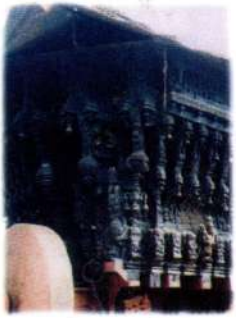
Oil Preservation to
Avoid Salt Action

Sandal Preservation to
Remove Salt

Textile is being Preserved
with Neem Leaves

Palm-leaf
Manuscripts
being Preserved by Covering
with Red Silk

Palm-leaf Manuscript
is being
Rubbed with
Leaves of Kovai Plant



Wooden Temple Car
Coated with Oil

Fumigating
with Camphor to
Avoid Fungi

Butter Applied
Stone Sculpture

The preventive conservation measures may be taken on the above lines.

**Preventive Measures**

The Curator in consultation with the conservation scientist must determine the degree to which a collection is to be handled and the display area and storage arrangement must be tailored to the demands made upon it.

1. Correct levels of heat and humidity: Full air-conditioning; improvised microclimate (21 ± 1°C, 50 ± 5% R.H.)
2. Well-planned storage areas.
3. Protection from light: correct levels of light; blind and curtains (50 lux for organic objects; 150 lux for oil paintings etc.)
4. Use of proper conservation techniques and materials for housing.
5. Full instructions to the users of collections; i.e. clean hands, correct handling, no smoking, no pens or inks.
6. Good surface for viewing.
7. Cleanliness.
8. Use of facsimiles instead of the originals. E.g. Holograms, models etc.

**2. Curative Conservation**

All direct actions aimed at increasing the life expectancy of an object is interventive conservation. When a unique piece is actively damaged, it needs curative conservation. It is an urgent and vital process to be carried out by a trained conservator.

**3. Restoration**

All froms of direct action aimed at enhancing the messages carried out by a damaged element of cultural heritage is termed as restoration. A trained conservator-restorer may do restoration. Some objects are in need of only conservation. There are objects, which are in need of both conservation and restoration.

# VI. Traditional Methods of Preservation

The study of the history of various traditional conservation methods in India is much interesting. Parts of plants were used for preserving the cultural heritage, both as insecticides and fungicides.

**Metal Icons**

Normally, icons made for worship are given *abhisheka* regularly with milk, coconut water etc., but they are not washed properly. This makes images to deteriorate. Accretions are removed by using tamarind followed by washing.

**Stone Objects**

Stone images used for worship were used to be applied with oil, ghee, coconut water as well as milk with an idea of preserving them in the name of *abhisheka*. The accretions on stone surfaces are removed by various poulticing methods such as oil preservation, flour preservation and sandal preservation regularly in temples by the application of the paste made out of the above mentioned flour with water and removing them when dried. This was repeated till the accretions were removed. This is practiced even today in the name of *poulticing*. A stone image poulticed with sandal and flour is on display.

**Palm-leaf Manuscripts**

Palm leaves were used for writing purposes. In the preparation of the palm-leaf manuscripts itself, preservative methods were adopted. Turmeric powder was used to avoid insects and fungi. They were cleaned and bundled by cloth keeping natural materials like dry *neem* leaves, *vettiver*, pepper, turmeric powder etc.

**Wood Carvings**

Woodcarvings of temple cars were coated with *mahua* oil to preserve them. They were annually cleaned by applying curd on them followed by flushing with water. The application of oil and curd kept the woodcarvings free from deterioration and drying. Traditionally, the temple cars are put under thatched or zine roofed shed and preserved.

# VII. Conservation Activities

The activities of the Chemical Conservation and Research Laboratory of the Museum are many. Some of the activities are given below:

**Conservation Work**

The chemical conservation and research Laboratory conserves and restores objects belonging to Government Museum, Chennai and the district museums in twenty districts throughtout the state.

**Conservation Research Activities**

The Laboratory is interested in the conservation research in order to find out new techniques and materials in collaboration with leading research institutions such as Indira Gandhi Centre for Atomic Research, Kalpakkam; Indian Institute of Technology, Chennai; Anna University, Environmental Engineering wing of the CSIR, Chennai and foreign institutions like the Australian Museum, Sydney and Getty Conservation Institute, Canada. The Laboratory has been recognised as a research institution in 1996 by the Madras University to conduct research leading to Ph. D. Degree. Dr. V. Jeyaraj, Curator of the Laboratory is a recognised guide.

**Training**

In order to disseminate the expertise of the Laboratory, a refresher course on *Care of Museum Objects* was started in 1974. It was well received by professionals and students of museum related subjects. In 1995, a course on *Care of Temple Antiquities* was conducted for the Executive Officers of the Hindu Religious and Charitable Endowments Department. In 1997, a course on *Care of Archival Materials* was conducted exclusively for the Archivists. Students from the College of Fine Arts were given practical training for a period of 3 months on the conservation of museum objects especially on paintings. Later, this course was named as the course on Care of Art Objects. A week long Capsule Courses on Conservation of Cultural Heritage for the benefit of Curators, Archaeologists, Executive Officers of the Hindu Religious and Charitable

# Conservation Activities

Fine Arts Students
are Engaged in Cleaning
During Training

College Students
are Used in Conservation
Work after Giving
Training (1996)

Artist-students
in Care of Art
Objects (2001)

Executive Officers
in the Course on
Care of Temple
Antiquities (1996)

Workshop on
Oil Painting (1991)

Thiru. K. Dheenadayalan, I.A.S.,
Commissioner
Goes Round
an Exhibition (1996)

At Silver Jubilee
Celebrations
of the Course

Exhibition Inauguration-
Thiru. S. P. Elangovan, I.A.S.,
Secretary & Thiru. M. Ramu, I.A.S.,
Commissioner (1994)

Book Release-
Restoration of
Paintings by
Dr. R. Kannan, IAS
& N. Harinarayana (1999)

Exhibition on
Conservation
of Stone Objects (2001)

International
Seminar Participants
Visiting the Gallery (2001)

Training in
Conservation in the
District Level

Awarding Cetificate-
Dr. Rodrigues (1999)

Prize Distribution -
Oratorial Contest on
Conservation-Father
Innasimuthu

*International*
Workshop on
Metal Conservation

Endowments, Engineers of the Southern Railway and Police Officials of the CBCID Wing were conducted in Chennai, Trichy, Salem and Madurai. Besides these, training programmes to the school and college students are given both in Chennai and districts on Care of Cultural Materials and Preservation of Monuments. It has entered its name as the number one in the field, by introducing *Internship Training* for a period of one year.

**Conservation Services**

Even though the strength of the staff in the Laboratory is very small, the Laboratory has extended service to the public and other institutions interested in the preservation of objects of the past at nominal charges. The Laboratory is not able to meet the requirements of the museum as well as the outside demand due to want of staff in the Laboratory. On request, the Curator delivers lectures on conservation in order to popularise the subject.

# VIII. Conservation and Restoration

Interventive conservation is any measure taken by intervening the natural agencies in prolonging the life expectancy of the museum objects or artistic and cultural heritage. This can also be called as curative conservation. This is the job of a professional Conservator.

**Conservation of Metals**

Museums are getting ancient metal objects of materials such as bronzes, brass items, iron and steel weapons, coins of different metals and alloys, jewelries made of silver and gold, copper plate grants etc. They need to be preserved. They are preserved using physical or chemical means. One should know the method of fabrication and the constituents and therefore, information regarding the fabrication techniques are shown in the gallery.

**Metal Casting Technology**

Metallic objects were fabricated either by casting, forging, welding, forge welding, punching, gilding, plating, raking etc. Here, objects fabricated by solid casting, hollow casting, piece mould casting, punching, forging etc., are on display. There are different types of casting like solid casting, hollow casting, piece mould casting and iron core casting.

Conservation of excavated or once conserved objects may be considered as one of the most important off shoots of archaeological chemistry. Metallic antiquities are prone to corrosion of one type or the other. Unless one knows about the corrosion principle it is not possible to control the corrosion factors. The corrosion has to attract the immediate attention of the Conservator or the Conservation Chemist or collectors.

**Dowelling of Antiquities**

Dowelling can be done in the case of broken objects by joiing the pieces by means of stainless steel headless pins, called dowel and adhesives. This can be done in the case of wood, stone etc., besides metallic objects.

**Gold Objects**

Gold is a noble metal. If gold is pure, it does not corrode even if gold objects are found buried under the earth for a long time. Red gold (gold and copper), white gold (gold and silver) and electrum (silver and gold) are some of the important alloys of gold. When such alloyed objects are exposed to the corrosive atmosphere, the baser metals corrode first Eg. copper is baser to silver and gold.

Gold objects, which are in contact with copper appears greenish blue because of the corrosion products of copper present in it. Gold objects, which are buried in the lime deposits, are found to be covered with calcareous materials. Such objects are immersed in a 1% solution of nitric acid followed by thorough washing, which removes the calcareous materials.

**Silver Objects**

Silver is a noble metal. It corrodes when it is buried or exposed to an unfavourable environment. Silver objects get tarnished (blackened) in an environment of hydrogen sulphide. Sometimes, lavender coloured deposits are formed in a chloride atmosphere. Silver objects are treated with a 10% solution of formic acid to remove the black deposits and then in dilute ammonia solution to remove the white deposits. Then the silver objects are washed well in distilled water and dried.

**Copper Objects**

The metal copper was extracted from ores consisting mainly of green copper carbonate (malachite) and copper silicate (Chrysocolla). The deposits in Cyprus were mined as early as 3000 B.C. The mines located in Cyprus were the prized possessions of the empires that followed the Egyptians and became the chief source of copper metal for the Roman Empire. The metal was named '*aes cyprium*' and subsequently *cuprus* from which is derived the English word 'Copper' symbolised, Cu.

Recorded reports on the first investigation was made on the findings at the Indus Valley sites, which dates back to 4000-3000 B.C. Analysis of ancient Indian copper artefacts excavated at *Mohanjodaro* and *Harappa* has been reported and the findings have revealed the type of manufacture and the type of metals and alloys used in that period.

**Bronze Objects**

Bronze is an alloy of copper and tin. In Indian context, it is called as *panchaloha* connoting five metals. Viz. copper, tin, zinc, gold and silver. These objects are normally affected by corrosion under moist condition. *Patina* is one such corrosion formation, which protects the metal forming an uniform transparent coating on the surface. This can be green or brown. If it is powdery, then this is called *bronze disease*. This spreads and spoils the bronze icons. Therefore the bronzes can be either cleaned mechanically, chemically or the corrosion products got stabilised, if the objects are very weak. Naturally formed, copper carbonate is on display.

**Lead Objects**

Lead objects very easily corrode forming a thin film of lead oxide, which is a protective coating. In a very bad environment lead objects bulge out to form the lead carbonate. They are very fragile and care should be taken to clean them. Lead objects are treated with a 5% solution of acetic acid and washed well to remove all the acid. Contrarily lead objects may be cleaned with the help of Amberlite IR 120, an ion exchange resin, to clean the corrosion products with out any damage to the objects. Lead coin along with lead carbonate powder is put on display.

**Iron Objects**

Iron objects corrode easily, giving rise to unsightly rust that cause swelling and deformation of the decaying objects. Many iron objects buried under the ground are heavily mineralised leaving behind only a thin core of iron. Chlorides are very dangerous for the iron objects and therefore, the chloride corrosion products should be removed completely. An iron piece is kept on display.

# Conservation of Bronze Icons and Coins

Green Patinated
Bronze Icon

Red Patinated
Bronze Icon

Bronze Diseased
Bronze Icon

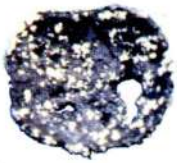
Bronze with
Weeping

Bronze Diseased Bronze Icon
before and after Treatment

Restored Broken
Pedestal Using
Fibre Glass

Affected Lead Coin Covered with Silver
and the Same after Restoration

Lead Coin in a
Preserved State



Corroded Lead Coin

If not Cared, Lead Coin
Gets Powdered

# Conservation by Electrolytic Reduction

Corroded Bronze Icon

Bronze Icon under Electrolytic Treatment

Bronze Icon after Electrolytic Treatment

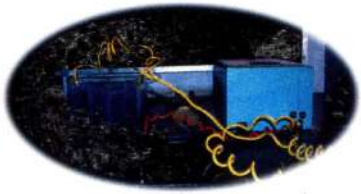
Corroded Silver Coins

Silver Coins after Chemical Treatment

Electrochemical Cleaning of an Iron Sword

A Corroded Copper Coin

Copper Coin after Treatment



A Miniature Electrolytic Cell for Conserving Coins

Bronze Icon is Washed in Water after Electrolytic Reduction

**General Principles of Conservation of Metallic Objects**

The corrosion products of metallic objects can be removed in the following ways:

(a) Removal of the corrosion products both physically (using tools) and chemically (using chemicals).

(b) Using electrolytic and electrochemical means.

(c) Stabilisation of the corrosion products.

**Removal of Corrosion Products**

**(a) Physical Methods**

The corroded objects may be cleaned using tools, vibro-tools, ultra-sonic cleaners and other methods like laser beam. These are a harmless methods, as we do not include any chemical in to the metallic objects.

**(b) Chemical Method**

The corrosion products of the metallic objects can be removed by dissolving them by some of the chemical solutions.

**(c) Electrochemical / Electrolytic Reduction**

The electrochemical reduction involves the reduction of the corrosion products by nascent hydrogen evolved by the action of 10% sodium hydroxide on zinc granules or powder on the affected spots. Electrolytic reduction is done in an electrolytic cell keeping the 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% solution of sodium hydroxide. When direct current is passed, the corrosion products will be removed very easily. Coins are cleaned electrolytically.

**(d) Stabilisation of Corrosion Products**

The corrosion products of the metals can be stabilised with the help of some chemicals. This procedure will not allow the corrosion process to proceed further. By this, the bronze diseased objects can be stabilised with the help of a 2% solution of benzotriazole in rectified spirit. Benzo triazole is kept on display.

**(e) Intensive Washing**

Washing is a very important aspect in the conservation of metallic objects. The metallic objects are immersed in distilled water and heated slowly and cooled. This process is repeated till all the soluble salts such as chlorides are removed from the metallic objects.

**Paintings**

There are many types of painting preserved in museums and galleries. What ever may be the type of painting, their structure is more or less similar. They have multi-layered structure. They are the support, the ground, the pigment and the protective layer like varnish. Wall paintings, canvas paintings, panel paintings, paintings on glass, ivory, cardboard, mica etc., are some to name.

**Wall Paintings**

The paintings executed on wall are called wall paintings or *mural* paintings (*Muir* = wall). If the painting is executed on wet wall it is called *fresco buono* (true fresco) painting. If it is executed on a dry wall, it is termed as *fresco secco* painting.

**Deterioration of Wall Paintings**

Flaking of paint layer, lifting up of the paint layer in the form of cups, blistering, cohesion, scroll formation, fading of the paint layers, abrasion, physical damage by mishandling and vandalism are the deteriorations of the wall paintings. Dust, soot, moisture, heat, vibration, pollution, cracks in the structure; salt action, biological degradation, seepage and leakage of water are the various causes for the deterioration of wall paintings.

**Conservation of Wall Paintings**

The accumulated dust may be gently brushed off. The cracks may be set right. Leakage and seepage should be avoided. The conservation can only be done with an expert. Physical barriers may be provided inside the monuments or galleries to avoid visitors going near the paintings and touching them.

Thanjavur Painting Affected by Insects and after Restoration

Thanjavur Painting Affected by Flaking and Browning and after Restoration

A 9' x 6' Large Sized Thanjavur Painting of Arulmigu Meenakshi Temple , Madurai is being Restored during a Workshop

The Gold Rake of a Thanjavur Painting is being Cleaned with Rectified Spirit

# Conservation of Thanjavur Paintings

# Conservation of Oil Paintings

Heavily Cracked Oil Painting

Torn, Hardened and Restored Oil Painting

Oil Painting Affected by Bubbles
and after Restoration

Dripping of Old Varnish
Applied on an Oil Painting

*Relining of an Oil Painting with Canvas*

A Fungal Attacked
Damaged Oil painting

Restored Oil Painting

**Thanjavur Panel Paintings**

Panel paintings have wooden support. *Tanjore* panel paintings have jack or teak planks pasted with cloth and primed with *sukkan* (unbaked lime) paste. In this type of painting, ornaments are decorated with gem or glass or gold rakes.

**Deterioration of Panel Paintings**

Since, this type of paintings is composite in nature, the problems are also multiple. The wooden joints get loosened, cohesion between the layers, the added materials get lost. Stain formation due to leakage, fading of paints etc., are noticed.

**Conservation of Panel Paintings**

The loose planks are rejoined together after removing the painted cloth along with the cardboard, if any. The lost materials are added. The flaked off portions are repainted. If there is no glass front, a new glass front is provided. The backing is also provided, which will avoid dust accumulation as well as insect attack. The technique of painting, materials used etc., are on display.

**Paintings on Canvas**

Cotton canvas or linen canvas had been used as the support for the canvas paintings. Priming is necessary for painting the subject on it. The pigment is in oil medium. After drying, the pigments are coated with varnish.

**Deterioration of Paintings on Canvas**

The deterioration of the painting may occur either in the canvas, ground, pigment or varnish layer. Canvas may be affected by acidity and get brown colour and become dry and brittle. There may be separation between the support and the ground, or ground and the pigment layers. There may be tear of canvas, cracking of the painted surface, loss of pigments etc.

**Conservation of Paintings on Canvas**

If the canvas is weak and torn, the painting may be relined with fresh canvas of comparable thickness using reversible

adhesives like *Paraloid B72* or wax and resin mixture. The loss of pigments may be replaced by infilling with acrylic colours. Dust, moisture, light etc., affect the paintings. Therefore, it is better to air-condition the gallery or storage round the clock.

## Leather Objects

Leather is nothing but cured skin, which is dehaired, defatted, made non-putrient and impervious to water. Skin is a net-work of protein fibres chiefly collagen. Tanning is a method of processing skin to produce leather.

### Deterioration of Leather

Leather is an organic material. High humidity encourages mould growth and other biological activities. Low humidity dehydrates leather objects there by leather gets hardened. Dust and pollutants make leather to absorb acid formed, there by objects become brittle.

### Conservation of Leather Objects

R.H. and temperature should be controlled where the leather objects are displayed or stored. Leather objects should be fumigated with thymol or para dichloro benzene to avoid the biological activity in the objects. Hardened leather objects can be made flexible by the application of 2% castor oil in rectified spirit. Fungal affected leather objects are fumigated and cleaned with a vacuum cleaner and treated with 0.1% para nitro phenol in rectified spirit. Light intensity should be around 50 lux in the gallery, if painted leather objects are displayed. In the storage the leather objects should be kept covered to avoid dust accumulation.

## Textiles

Textiles can be made out of natural and manmade fibres. Fibres from plants, animals, insects and synthetic materials are some of the examples. After the evolution of dyes from natural materials like turmeric, madder etc., fabrics were dyed with them. Many rare and interesting textiles are being preserved in museums. India is the forerunner in handloom

Wrinkled Painting on Leather

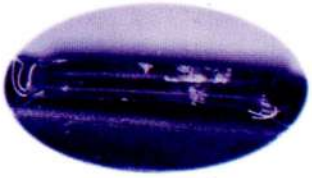
Conserved Painting on Leather

Insect Eaten Leather
Percussion Instrument

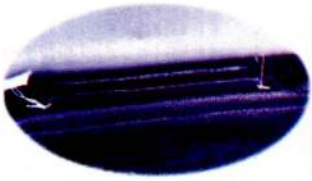
Treated Leather Puppet with Castor Oil
in Rectified Spirit

Affected Leather
Percussion Instrument

Chemically Treated Leather
Percussion Instrument



Leather Box Affected by Fungi



Treated Leather Box with
Para Nitro Phenol in Rectified Spirit

# Conservation of Leather Objects

Weaving Cloth

Kadalikaruppur Saree and the Affected Portion

Kadalikaruppur Saree and the Lined Cloth

Damaged Kalamkari Cloth

Repairing the Cloth by Darning

Cloth after Darning

The Cloth Decorated Fan before and after Restoration

Cloth is Dyed Using Natural Dyes

A Kalamkari Painting is Washed with Detergent

textile technology. E.g. *Kodali Karuppur* sarees, *Kanchipuram* silks.

**Deterioration of Textiles**

Textiles are mostly organic in nature. They get affected when moisture and heat are in excess. Biological agents affect them. Termites eat away textiles in most condition. Wool-moth attack woollen materials. Acidity affects the textiles very much. In certain cases, the dye itself eat away the textiles. Eg. Verdigiris.

**Conservation of Textiles**

Highly acidic textiles can be de-acidified by fumigating them with ammonia. In case the stain is found along with acidity, the textile piece is kept in between two chiffon cloths, rested over a glass plate and washed in salt free water. 1% solution of *Teepol* is applied and brushed. Then the textile is washed well in running water. This can be done only in the case of textiles with fast coloured dyes. Providing a support to the textile may strengthen weak textiles. Darning can also do the strengthening. In case there are loss of textiles, similar cloth may be used to fix in those affected spots with the help of 5% solution of poly vinyl acetate. It is advisable to maintain 45-60% R.H. and 19-21°C through out the day. Objects such as natural products, dyes and textile pieces are on display.

**Wooden Objects**

Wood contains two portions viz. Heartwood and sapwood. The heartwood is durable and contains some chemicals, which avoid insects. The sapwood is very soft and vulnerable to the insect attack. In museums, wooden objects are plenty in number. They include woodcarvings, drums, structures, implements, household articles, folk and tribal objects etc.

**Deterioration of Wooden Objects**

As wooden objects are organic in nature, they deteriorate due to the environmental conditions both biologically and mechanically. Heat changes make the wood to warp or bend.

Dry rot, a type of fungi, affects wood seriously. Termite attack is very dangerous, if not inspected often. Soot, dirt, oil accretions affect the woodcarvings very much.

**Conservation of Wodden Objects**

Wooden objects should be segregated from the earth and wall, if they are positioned so. Variation in the climatic condition should be avoided. Regular dusting should be done to avoid the dust becoming dirt. Wooden objects will not absorb moisture, if coated with water repellent materials like poly vinyl acetate. Large number of objects can go for freeze drying to avoid the biological damage in the objects. Galleries, which are displayed with woodcarvings should be vacuum cleaned. The storage area should be treated for the insects and fungi with chloropyriphos, thymol etc.

**Palm-Leaf Manuscripts**

Palm trees grow more in the tropical countries like India, Indonesia and therefore palmleaves were used for record purposes in the ancient times. Two types of palm-leaves such as *tala* (palmyra) and *sritala* or talipot were in use. Palm leaves were processed before they were used for this purpose. Tender palm leaves were cut, dried under shade, boiled with turmeric solution and cut to size and were used to incise records. The main constitnent of palmleaf is cellulose.

**Deterioration of Palm-leaf Manuscripts**

Since palm-leaf manuscripts are organic in nature, they are prone to biological deterioration. Humidity, heat, insects, microorganisms etc., affect these type of objects. Fungi, woodborer beetles etc., affect seriously palm-leaf manuscripts. Hot climate makes them brittle as well as to twist.

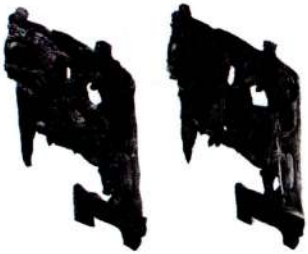
**Conservation of Palm-leaf Manuscripts**

Some times, palm-leaf manuscripts are affected by insects and are stuck together. It will be very difficult to separate the leaves. When the affected palm leaves are boiled in steam bath, the leaves get separated. Leaves are cleaned, dried and bundled together so that they will be straight. Normally, palm-leaf manuscripts used to be covered with soot and dirt.

# Conservation of Wooden Objects and Palm-leaf Manuscripts

Front and Back View of a Termite Attacked Ganesa Woodcarving Received on Transfer

Wooden Temple Car is being Cleaned with the Help of Washing Soda Solution and Ammonia



Temple Car Sculpture before and after Chemical Conservation

Confiscated Wooden Sculpture, Jesus before and after Restoration

Palm-leaf Manuscript Affected by Worms

Broken Palm-leaf Manuscripts

Restored Palm-leaf Manuscripts

Coating of Citronella Oil-Rectified Spirit to the Palm-leaf Manuscripts

Bundled Palm-leaf Manuscripts

A Three and a half-foot Long Photograph Affected by Fungi, Insect and Acidity

Photograph after Restoration

Fungal Attacked Painting on Paper

Restored Painting on Paper by Hydrogen Peroxide

Photographic Painting Eaten by Insect

Photographic Painting Restored by Filling with Putty

Bleaching a Paper Print with Sodium Chlorite and Formaldehyde

Bleaching a Paper Print with Sodium Chlorite and Formaldehyde

Photograph Eaten by Insect

Photograph Restored by Filling with Putty

Insect Eaten Paper Print

Paper Print after Restoration with Putty

The accretions should be cleaned with the help of rectified spirit. In order to make the incised matter legible, citronella oil mixed with rectified spirit and lampblack may be coated. This restores the flexibility to the palm leaves and the incised portions look legible. The bundles are protected by keeping two teakwood planks on either side and are arranged in the racks. It is always better to control the environment to the optimum level. Regular fumigation with thymol and para dichloro benzene is carried out to avoid the bio-deterioration of the palm leaves. Processed palmleaf, affected palm leaf and treated palm-leaf manuscripts are on display.

**Paper Based Objects**

Paper is the word derived from the word *papyrus*. The major constituent of paper is cellulose. Paper is made out of rags, wood, plant fibres etc. Paper is made for writing or drawing purposes by the application of sizing materials, which are proteinaceous in nature.

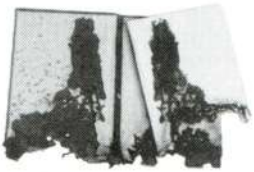
**Deterioration of Paper**

There are two factors acting for the deterioration of paper. They are the internal factors such as acidity, contents of paper etc. The other is the environmental factors such as moisture, suspended particulate matter, oxides of carbon, sulphur and nitrogen, bio-deterioration, mishandling etc.

**Conservation of Paper**

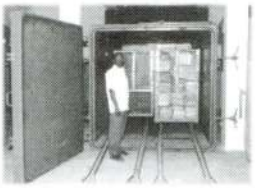
Acidity in paper is gained by the presence of moisture. This makes the paper brown and brittle. Acidity can be removed, but we cannot bring back the strength of the paper by the removal of acidity. Acidity in paper can be removed by keeping the paper in a chamber where ammonia vapour is present. On the contrary, acidity affected paper can be wet de-acidified with the help of calcium bicarbonate solution. Papers with water soluble inks, which are very badly affected by acidity, can be bleached with the help of chloramine-T in rectified spirit. Paper materials can be well preserved by reducing the light intensity falling on the manuscript and moisture. Since paper materials are organic in nature, all

Book Affected by Fungi



Book Affected by Insects

Damaged Document and the Same after Leaf-casting



A Large Iron Chamber for Vacuum Fumigation of Records

Book, which Lost the Binding


Book, after Restoration and Leather Binding

Chiffon Cloth Mending with Maida Flour Paste

An Affected and Torn Map

Wrinkled Document under Brown Paper Stretching

Map after Restoration

precautionary measures should be taken to protect them from biological dangers.

**Feather**

Feather consists of protein called Keratin. It is similar to hair but with a different molecular structure. Feathers are not flexible like hair; but will break, if folded.

**Deterioration of Feather**

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 when the R.H is over 65%. Feathers trap dust and the dirt not only soils the appearance of the feather, but a food source for insects and moulds. Insects attack feathers at larval stage.

**Conservation of Feather**

Dirt may be removed by brushing with soft brush using rectified spirit. They can be fumigated with para dichloro benzene before they are added to the collection. Open storage should be avoided. Light intensity up to 100 lux only should be allowed. Control of climate is essential for the protection of feather objects. (R.H. 50%, Temp. 20 °C)

**Bone and Ivory Objects**

Bone and ivory are from animals. The main constituents of bone and ivory are calcium phosphate associated with carbonate and fluoride and the organic constituent is ossein. Both have the cellular structure. Ivory has a hard and dense tissue known as dentine, which results in striations, as if radiating from the centre of the tusk.

**Deterioration of 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 the hydrolysis of ossein. Acids also disintegrate them. Being porous they easily go stained. They lose their natural colour due to the long exposure to light.

**Conservation of Bone and Ivory Objects**

Accumulated dirt, oil and grease can be removed by brushing with 1% solution of *Teepol* in rectified spirit. The washings are removed by blotting paper. The absorbed soluble salts can be removed by immersing the objects in distilled water for about 5 seconds and repeated a number of times with fresh distilled water. Then the objects are washed in 95% rectified spirit twice and dried in air. Weak objects can be strengthened by 2% poly vinyl acetate in acetone. If the object is very fragile, it may be vacuum impregnated in 5% solution of poly vinyl acetate in acetone. In the case of restoration, nitro cellulose adhesives may be used.

**Art Work on Paper**

The drawings on paper, paper prints and the paintings on paper, pose a lot of problems. Here paper is the support. In the case of paintings, ground is also applied on paper making it good to execute the painting.

**Deterioration of Art Work on Paper**

Since paper is organic in nature, moisture and biological agents easily affect these types of art works. Acidity affects the paper and it becomes brittle. They are easily mishandled.

**Conservation of Art Work on Paper**

Acidity affected art works may be dry fumigated with ammonia. They should be fumigated regularly for the eradication of microorganisms. The gallery or the storage may be environmentally controlled. Light intensity should be within 50 lux.

**Photographs**

Photographs are also images on paper. The images are obtained due to the photo chemical reaction with chemicals like silver halides. The negatives are found on glass or celluloid or cellulose nitrate or cellulose acetate or even polyester film.

**Deterioration of Photographs**

Photograph is a very complex material, having several components like support, binding medium and photosensitive image forming chemicals, which may react in different ways to various factors of deterioration. The common deterioration noticed in photographs are yellowing, stains, separation of emulsion, fungal attack, insect attack, scratches, fingerprints, folds etc.

**Conservation of Photographs**

In the negatives, due to age, the emulsion curls, becomes brittle, cracks and falls off at the slightest shock or touch. They should never be touched with bare fingers. R.H. should be with in 45-60% and the temperature with in 20-22°C. Affected negative, affected photograph etc are on display.

**Ceramics**

Ceramics is the general term for an object made out of clay and burnt like pottery, porcelain and earthenware. They mainly consist of alumina and silica. Kiln firing temperature can vary from 650°C for terracotta to 1400°C for porcelain.

**Deterioration of Ceramics**

Most of the ceramic objects are excavated and are saturated with the salts of the soil, if they are unglazed and broken. Rough and unfired clay objects as well as weathered objects easily get accumulated with dust and are difficult to remove the dust. They are vulnerable to abrasion and scratches.

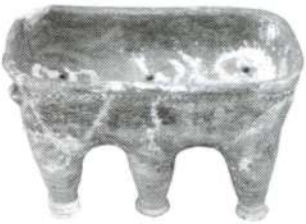
**Conservation of Ceramics**

Salt affected baked objects may be cleaned with salt free water. If they are very fragile, they should be consolidated with the help of consolidants. For salt removal, the methods that are used in the case of stones may also be used.

**Mending of Ceramics**

The broken ceramic pieces should be numbered and joined together. The broken edges should be cleaned with a soft brush and then with rectified spirit. The acrylic resin should be applied at the broken edges and joined. The joints should

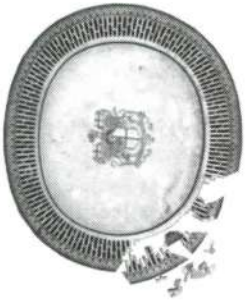
Restored Sarcophagus
Made Like a Ram



Restored Sarcophagus

When Broken,
the Broken Pieces Should be Preserved

Painted Ceramic Jar



Broken Ceramic Plate

Restored Ceramic Plate

be filled with filler like acrylic resin and matched with acrylic colours.

**Stone Objects**

Stone objects monuments and ceramics and minerals are in abundant and consist of silicate units. Geologically, based on the formation of rocks, they are classified as follows:

1. Igneous Rocks – e.g., granite, basalt etc.
2. Sedimentary Rocks – e.g., sandstone, limestone, shale etc.
3. Metamorphic Rocks – e.g., marble, schist, gneiss, quartz, slate etc.

Based on the chemical properties they can be classified as follows:

1. Siliceous Rocks – Eg. granite, quartzite
2. Argillaceous Rocks – Eg. laterite, slate
3. Calcareous Rocks – Eg. limestone, marble

**Siliceous Rocks**

Rocks, which contain maximum amount of silica, are called siliceous rocks. E.g. Granite, quartzite.

**Argillaceous Rocks**

Rocks, which contain argil or clay predominantly, are called argillaceous rocks. E.g. Laterites, slates.

**Calcareous Rocks**

Those rocks, which contain calcium carbonate predominantly, are called calcareous rocks. E.g. Limestone, marble.

**Deterioration of Stone Objects**

Stone objects deteriorate continuously as a result of physical, chemical and biological processes. The durability of stones is mainly dependent on its internal structure and petrographic composition and also to the environment to which they are exposed. The various types of deterioration are decay due to:

1. Quarrying
2. Dampness
3. Soluble Salts

4. Temperature Changes
5. Atmospheric Pollution
6. Growth of Moss and Lichen

**Conservation of Stone Objects**

Most of the deterioration on stone objects is due to water. This is aggravated due to the presence of dirt, salts etc. The unwanted damaging accretions should be removed and the surface should be protected from the entry of moisture into the stone objects.

**Removal of Dirt**

Stone objects such as sculptures often accumulate dust, dirt, stain, grease, smoke, soot etc. Dust is dusted off. Dirt, oil, grease, soot etc., are removed by the application of a 1% solution of *Teepol* in water followed by brushing and washing. *Wishab*, a type of pencil eraser, can be used to remove the accretions.

**Removal of Soluble Salts**

The absorbed salts into the stone objects should be removed out of the object. Soluble salt from the small stone objects gets removed by immersing the objects in salt free water. A poultice like paper pulp, *Sepiolite* can be used to remove the absorbed salts by applying it over the objects continuously. Paper pulp applied brick, a stone absorbing saline water etc., are on display.

**Removal of Biological Accretions**

Deposits of moss or lichen or algae not only make the stone surface to appear black but also produce pits in the surface of the stone objects, there by weakening the structure. Now a days, in the European countries, the black deposits are removed by laser beam. Sand blasting is done in Indian context, but this removes the accretions along with stone.

**Consolidation of Stone Objects**

What ever may the chemicals applied to remove the accretions and salts from the stone objects, the surface should be washed very well with distilled or deionised water. The

surface should be protected with a suitable consolidant like poly vinyl acetate, alkoxy silanes etc. Organo silane coated sand stone is on display.

**Restoration of Stone Objects**

Restoration is often necessary for reasons of safety of the stone object and is carried out using modern materials in a manner simulating the existing structure, but not necessarily identical with it. Dowelling can be done in the case of broken stone objects by joining the pieces by means of stainless steel headless rods called dowelling. The stone objects should never be in contact with the ground. A moisture barrier should be kept in between the masonry structure and the objects.

**Conservation of Monuments**

In India ancient monuments are made of three types known as *Nagara, Dravida* and *vesara* with special reference to temples. They were made with various media like stone, brick, stone-cum-brick etc. Each temple or monument faces different type of problems due to various reasons like age, temperature, vegetation as well as human vandalism, natural calamities and environmental pollution.

Conservation of monuments has two aspects. They are,

1. Structural conservation and
2. Chemical conservation

While structural conservation is carried out, the Conservator should know the inherent problem of that particular structure as well as the problems created by other agencies. The monument, which is going to be conserved, should be well documented. Materials used in the original construction, their availability and the knowledge about the percentage of each and every material in the original structure. Proper documentation should be done including photography so that while the reconstruction is made, the monument will have its original appearance.

While chemical conservation is done, the cryptogramic plants growth should be removed. Proper use of chemicals for the

removal of moss and lichen, removal of whitewash oil accretions, should by chosen. For the removal of moss and lichen, detergent solution consisting ammonia is used and rubbed with nylon brush and thoroughly washed. In case of oil accretion, the same procedure should be adapted. In the case of whitewashings on walls and pillars, mechanically, whitewashed layers are removed and the entire accretions may be removed with the help of a 10% solution of glacial acetic acid.

In the case of salt action, paper pulp treatment is given to extract soluble salts from the stone structures. Different types of stones used for building structures are displayed. An ancient brick poulticed with paper pulp is on display.

Museum Theatre before and after Restoration

A Part of the Moss and Lichen Affected Wall at Arulmigu Parthasarathy Temple, Chennai after Chemical Cleaning

Sculpted Stone Pillar with Oil Accretion and After Cleaning

Broken as Well as Restored Sculpture

Moss and Lichen from a Stone Sculpture is being Removed with the Help of Laser Beam

Stone Sculpture Breaks Due to Salt Present in it

Sculptured Stone Wall Affected by Salt Action

Removing Soluble Salts by Poulticing at Shore Temple, Mahabalipuram

Conservation of Stone Objects and Monuments

# Authentication of Objects

Internal Crack in a Copper Coin is Revealed by X-Radiography

Use of Iron Nails and Strips in the Construction of the Wood Carving is Revealed by Radiography

X-Radiography Shows the Defects in a Bronze Image as the Authenticating Mark

Fringe Patterning as a Tool of Authentication

Genuine and Fake Ivory Objects Differentiated by Examination of the Transverse Section

Infra Red Imaging as a Tool of Authentication

Bronze Anklet

Metallography, a Tool of Authenticating a Metal Object

Piltdown Man with Human Skull and Orangutan Jawbone was proved by Chemical Analysis as a Hoax

# IX. Authentication of Objects

There are many well-established methods of authentication. They are iconographic features in the case of sculptures, bronze icons etc. The style is one of the authentication factors of the artefacts. Various paintings can be categorised through the features exhibited by the paintings. Materials used are characteristic of the provenance and date. The technique employed is yet another criteria. For example, before the invention of the potter's wheel, the method of pottery was hand-made. From the type of degradation also, one can understand the type of the object and its authenticity. For example, the green patina is an authentic mark for earlier bronze icons. At present the usual practice of authentication of objects, which are purchased for museums and galleries are based on stylistic, artistic considerations, which is described by the members of the Art Purchase Committee who are mostly Museum / Gallery Directors or Curators. It is not definite whether the objects purchased or objects returned from outside exhibitions are the originals or the faked ones.

**Methods of Authentication**

The methods of authentication are subjective, aesthetic, objective and scientific. Radiology is one of the fundamental non-destructive methods of investigation and examination of works of art such as paintings, paper materials, wooden objects, metal objects, ceramics etc. It has been used in the past and is used in the present in the detection of forgeries of the original works. When x-rays are allowed to fall on an x-ray film through the object to be examined, a shadowgraph is formed on film depending upon the structure of the object. The latent image is developed, like photographic film to obtain the image of the inner structure of the object called radiograph. In the case of painting, the radiograph registers its various parts from the support up to the surface coating. The radiography of bronze icons, coins, weapons, jewelleries etc., will give a radiograph showing the voids and discrepancies inside the metallographic structure. This information is used to conserve and to identify the paintings.

Radiography could help in characterisation of these art works in order to fingerprint them for legal purposes.

Fingerprinting of art objects and antiquities of all materials could be done, if some documentation technique could be used such as Macrophotography, Infrared photography, Radiography. Analysis of elements through classical as well as sophisticated instrumental methods will reveal the composition of the bronze icons. These records should be kept as secret. Otherwise, the culprits will use these data and faked objects will be produced in plenty. Two similar bronze Ganesa images were subjected to x-radiography, but x-radiographs were different. They are displayed.

**Metallography**

Metallography is yet another boon, which characterises the internal structure of metallic objects. In case non-destructive testing should be done, then *in-situ* metallography can be successfully carried out. The surface where the metallographic studies have to be done is polished by a hand polisher or by chemical etching and the microstructure is photographed. The microstructure is different for different bronze icons. The specific locality where the metallography was carried out should be recorded for authentication of the object. A bronze anklet in the collection of the Government Museum, Chennai was subjected to metallography, which revealed the cavity in a portion. This should be recorded for its authentication. Besides authenticating the object, it reveals the method of casting of the object.

**Holography**

Holography is a process of three-dimensional record of an art object. The hologram of an idol is taken with He-Ne laser beam. The hologram can be used as a convenient medium for displaying rare objects on exhibitions while the originals are kept under safe custody. Secondly, the hologram will be of use to authenticate the objects. Fringe spacing is made in the bronze icons of rarity, which characterises the object by forming contour lines, which are specific to each item.

**Fringe Pattern Making**

A bronze image was subjected to laser beam and photographed at a higher temperature, a specific pattern was obtained specific to the tomography of the object. This pattern is one of the fingerprinting techniques of metal objects especially bronze icons.

**Thermal Imaging – Infra-Red (I.R.) Photography**

All objects above absolute zero radiate energy in the electromagnetic spectrum by virtue of the motion of its constituent atoms. The spectrum and intensity of radiation emitted by the object depends on its absolute temperature and the nature of the object surface. At ambient temperatures and above, these radiations fall predominantly in the infra-red band of the electromagnetic spectrum. The infra-red radiations from the object are converted using a suitable I.R. detector and displayed as colour or black and white image. Such an image gives the temperature map of the object surface. Thermal imaging or Infra-red Thermography is the mapping of temperature profiles on the surface of the object or component. It makes use of the infra-red spectral band of the electromagnetic spectrum. At the short wavelength end, the boundary lies at the limit of visual perception that is in the deep red, while in the long-wavelength end it merges with the 'microwaves' in the millimetre range. Infra-red radiations are electromagnetic radiations with properties similar to other electromagnetic radiations such as light. They travel in straight lines; propagate in vacuum as well as in liquids, solids and gases. They can be optically focussed and directed by mirrors and lenses. The laws of geometrical optics are valid for these also. All infra-red measurements are normally made in the wavelength band of 0.75 μm -25 μm. The fundamental equations or laws that link the absolute temperature of the object with the intensity and wavelength of emitted radiation are the Planck's Law, Stefan Boltzmann Law and the Wein's Displacement Law. A detailed description of these laws can be found in any book on IR physics or IR Engineering.

**Thermal Imaging Techniques**

Thermal Non-destructive Evaluation (NDE) is based on the principle that flaws or defects within or on a body exhibit thermal radiation signatures that are different from its surroundings. These thermal signatures can occur naturally due to heat sources present within the body itself or it can be induced/generated artificially through external means. Thus, two approaches or techniques are generally recognised in thermal NDE – (a) passive and (b) active.

Passive technique involves applications where the material already contains its own internal source of heat. Majority of the condition monitoring applications where the component themselves get heated up due to a variety of reasons fall under this category.

Active techniques involve the application of an external thermal perturbation (heating or cooling) to the object as a whole or to a small area of interest within the object. While both heating and cooling can be applied, it is heating which is generally preferred. This can be attributed to the fact that it is easier to heat a body and a wide variety of heating sources are also available. The choice of the heating method is quite critical as this would decide the thermal contrast and hence the detectability of defects. Further, the application of the heat by the source itself should be non-destructive. That is, it should not cause any damage physical or chemical to the object being inspected. A variety of stimulation sources have been used such as hot air guns, incandescent and flash lamps, lasers, plasma arcs, inductive heating, heating strips, etc. Once the heat is input, thermal diffusion takes place and the resulting thermal profiles on the object surface is detected by the I.R. camera.

Once the thermal signatures have been induced, infra-red inspection reduces to the problem of detecting these signatures or differences in emitted thermal radiation and recording the same. Two methods of observation are possible based on the location of the camera and the heat source (a) reflection technique in which the thermal source and the

detector are located on the same side of the object under investigation.

Thermal imaging is an indispensable tool in the field of condition management in electrical, chemical, petrochemical and steel industries. It finds extensive applications in the aerospace industry for the examination of composites and adhesively bonded laminates, materials characterisation and also for the conservation of art objects.

**The Piltdown Man**

An illuminating example of a long-standing controversy settled by the use of scientific authentication is to be found in the case of Piltdown man. A collection of human jawbones along with fragments of brain case bones were found together with bones of various early mammals at a gravel dig at Piltdown in Sussex, England in 1912. At the British Museum, London the human bones were examined and it was concluded that they belonged to a 500,000 year old fossil of a man, which was named Evanthropus dawsonior Piltdown man. Some authorities could not accept that both the brain case and the jawbone belonged to a single individual. The jawbone appeared to be more ape-like and braincase, more human. The controversy over the Piltdown man occupied the Scientific World for over 45 years. Chemical and instrumental analyses revealed that the bones were of recent origin in geological terms. It is possible that the person who contrived the Piltdown hoax obtained the orangutan jawbone from a dealer in ethnographic materials. It is learnt that these bones were stained with chromium and iron salts to look similar to the finds at Piltdown. Thus a large body of scientific evidence established beyond any doubt that the Piltdown man was a bogus human ancestor.

**Transverse Section Study of Ivory Objects**

Some of the ivory objects supplied by an art dealer in New Delhi for the National Museum were received on approval basis and there were some controversies on the genuineness of some of the ivory objects. They were subjected to various studies such as Scanning Electron Microscope (SEM) studies,

chemical analysis etc. The composition was similar but the examination of the transverse sections of one of the ivory objects with the help of stereomicroscope in comparison with the original piece revealed that the object under question was fake. The original one was having striations i.e. circles, which were quite natural and the new one was artificially forged, as it was irregular having no pattern, which would match with the genuine ivory sample.

**Study of Wooden Object with X-Radiography**

Radiology is one of the fundamental non-destructive tools of investigation and examination of works of art such as metal objects, paintings, paper materials, wooden objects, ceramics etc. It has been used for ascertaining internal initial subsequent construction scheme, as used by the artists, in the past or subsequent work done on the objects for restoration purposes or to detect forgeries of the original works of some master pieces. One of the painted wood carvings namely, a $19^{th}$ Century South Indian Four-armed Goddess, was subjected to x-radiography, which revealed the use of iron nails and strips used to build up the wood carving. This is the uniqueness of the wood carving, which is the authenticating mark of the object.

A bronze image of the Government Museum, Chennai was x-radiographed. The positive print of the bronze showed the bronze had been made by hollow casting. The radiograph of a Raja Raja Chola copper coin revealed an internal crack in the coin which is other wise not visible to the naked eye.

# X. Publication of This Laboratory

The Laboratory is well known for its publication from its inception (1930). Dr. S. Paramasivan, the first Curator of this Laboratory, got his doctorate for the research he conducted in the field of wall paintings and allied work. His publications in Nature, Technical Studies etc., are worth mentioning. The successive Curators Thiru R. Subramanian, Thiru N. Harinarayana, Thiru S. Thangavelu have contributed a lot in this line. At present many books, booklets, reports, articles, pamphlets both in Tamil and English have been published for the benefit of those who are interested in the field of conservation and they are well received. These books are available in the Sales Counter of the Museum on sale.

**The Usefulness of the Gallery**

This Gallery tries to inform the visitors to preserve our artistic and cultural heritage during their routines and also when they visit museums. Museum is a non-profit making permanent institution in the services of the society and of its development and open to the public, which acquires, conserves, researches, communicates and exhibits for purposes of study, education and enjoyment, material evidence of man and his environment. There fore, it is requested that those who visit the museum may see that the cultural heritage in the vicinity of their stay, work spot etc., are protected, the objects, which they see should not be allowed to be spoiled and if any objects are available with them may be gifted to the museum so that they may be preserved for posterity.

## References

1. Agrawal, O. P. (1993) Preservation of Art Objects and Library Materials, National Book Trust, India.
2. Arun Ghose (1989) Conservation and Restoration of Cultural Heritage, Agam Kala Prakashan, Delhi.
3. Bhardwaj, H. C. (2000)) Metallurgy in Indian Archaeology, Tara Book Agency, Kamachha, Varanasi.
4. Bisht, A. S. (1987) Radiology of Some Painted Wooden Objects-A Preliminary Study, *Conservation of Cultural Property in India,* Vol. XVI & XVII, New Delhi.
5. Bisht, A. S. (1989) Science in the Aid of Fakes With Special Reference to Ivories-A Case Study, *Conservation of Cultural Property in India,* Vol. XXII, New Delhi.
6. Harinarayana, N. (1985) Bronze Casting, Chennai.
7. Jaya Appasamy, Thanjavur Paintings of the Maratha Period, Publihed by Abinav Publications, New Delhi.
8. Jeyaraj, V. (2002) Care of Paintings, Published by the Commissioner of Museums, Government Museum, Chennai.
9. Jeyaraj, V. (1995) Handbook on Conservation in Museums, Published by the Commissioner of Museums, Government Museum, Chennai.
10. Paramasivan, S. (1930) Chemical Investigations on Some Ancient Materials and Industries, University of Madras, Madras.
11. Plenderleith, H. J., Werner, A.E.A., (1976) Conservation of Antiquities and Works of Art, Oxford University Press, London.
12. Thomson, G. 1994) The Museum Environment, Butterworth-Heinmann.
13. Zvi Goffer, (1980) Archaeological Chemistry, John Wiley and Sons, USA.

**A Pioneering Museum Laboratory Committed for**

- Conserving museum objects under the Department of Museums.
- Research in conservation techniques and ancient technology.
- Training people in conserving the art, cultural and natural heritage for posterity.
- Providing research facilities leading to Ph.D. Degree under the University of Madras.
- Internship training.
- Conservation consultancy services.

**Publications of this Laboratory**

Handbook on Conservation in Museums, Care of Museum Objects, Care of Archival Materials(Tamil), Introduction to the Chemical Conservation and Research Laboratory, Conservation of Cultural Property, Restoration of Paintings from Madras Christian College, Care of Paintings, Metal Conservation etc., and brochures.

**Government Museum, Chennai.**
Pantheon Road, Egmore, Chennai 600008.
**Telephone**: +91- 44-28193238
**Fax**: +91- 44- 28193035
**Email**: govtmuse@md4.vsnl.net.in
**Website**: http://www.chennaimuseum.org