Proceedings of the Seminar on

CONSERVATION OF CULTURAL HERITAGE

Conducted as part of the
Silver Jubilee of the Refresher Course on
Care of Museum Objects
30th June 1999

New Series—Chemical Conservation Section, Vol. 6

Editor
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R. KANNAN, I.A.S.,
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FOREWORD

The museum, which had its beginning in 1851 with merely geological specimens, has grown to be one of the largest museums in the country. To day it has got various galleries pertaining to sections like archaeology, anthropology, art, botany, geology, zoology, geology and chemical conservation. This museum has six buildings where all these galleries are located. In order to carry out educational activities, there is an education section. To advise on design and display both in temporary and permanent exhibitions there is a design and display section.

To conserve the museum objects there is a chemical conservation and research laboratory. This is one of the best laboratories in this country. Dr. S. Paramasivan pioneered the electrolytic cleaning of bronze icons in India and became a figure of worldwide renown. In order to disseminate the knowledge in the field of conservation, a training programme *Care of Museum Objects* was started in the year 1974. This is the first laboratory, which started a conservation course in the whole of Asia. Considering the research activities, the University of Madras has recognised this laboratory as a research institution to conduct research leading to Ph. D. Degree.

The 25th refresher course on *Care of Museum Objects* was conducted from 1st to 30th June 1999. Since this is the silver jubilee year of the course, it was decided to celebrate the silver jubilee of the course in a fitting manner. Therefore, many programmes were conducted for the students for creating awareness among the student community. One of the programmes was a seminar on Conservation of Cultural Heritage.

Since documentation is an important aspect of museology, the proceedings of the seminar are published in this small volume for circulation to our counterparts in this field. Dr. V. Jeyaraj, Curator, Chemical Conservation and Research Laboratory of this museum with the cooperation his staff and colleagues, has brought out this publication by name *Conservation of Cultural Heritage*. I thank Dr. Baldev Raj, Director, Material Management Group, Indira Gandhi Centre for Atomic Research, Kalpakkam, Prof. Dr. P. K. Palanisamy, Centre for Laser Technology, Anna University, Chennai, Mr. N. Harinarayana, former Director of Museums, Mr. P. Kalyanasundaram, Head, DPEND, Indira Gandhi Centre for Atomic Research, Kalpakkam and Dr. V. Jeyaraj, Curator, Chemical Conservation and Research Laboratory of the museum for contributing articles in this publication. I commend the efforts of Dr. V. Jeyaraj as Editor in bringing out this book. I hope this will serve to spread awareness on the importance of conservation.

(R. Kannan)

Chennai - 600 008,
10th December 1999.

CHEMICAL CONSERVATION AND RESEARCH LABORATORY

SILVER JUBILEE CELEBRATIONS

OF THE COURSE ON

CARE OF MUSEUM OBJECTS

Dr. V. Jeyaraj

History of the Laboratory

With the valuable collection at the Government Museum, Chennai, it was felt necessary to treat the bronzes disfigured by corrosive crusts in order to expose the decorative details and to eliminate the bronze disease, which brought in added deterioration. As a result of the discussion with various chemists, the electrolytic restoration of bronzes was started in the museum. The Chemical Conservation and Research Laboratory of the museum owes to the scientific vision and foresight of Dr. F. H. Gravely, Superintendent of the Government Museum, Chennai in the early 1930s. Dr. S. Paramasivan was appointed as the Chemist in 1930. Besides the treatment of bronze objects, ethnological, prehistoric and numismatic objects were treated. In 1935, the Government Museum, Chennai was also of help to the Archaeological Survey of India in the examination of wall paintings at Tanjore, Sittannavasal etc.

In 1937, a separate Chemical Conservation Laboratory Block (Old Chemistry Block) was built, being the only one of its kind in India. A two storied building for the laboratory was constructed in 1963. In 1997, the Chemical Conservation and Research Laboratory was recognised as a research institution to conduct research leading to Ph. D. Degree and Dr. V. Jeyaraj, Curator of the Laboratory has been recognised as a Research Supervisor by the University of Madras.

Research Activities

One of the foremost activities of the laboratory is to conduct research in conservation and materials of the past. In the beginning much research was conducted by Dr. S. Paramasivan, the first Curator of the Laboratory on paintings and metallic antiquities. The research findings were published in leading scientific journals both in India and abroad. The research activities continued successfully by the Curators of the Laboratory till date. At present research projects such as Fingerprinting of South Indian Bronze Icons, Holographying Museum Antiquities, Conservation of Metal Objects, Survey of Monuments in Tamil Nadu, Restoration of Paintings of the Madras Medical College etc., Conservation of Paintings in Madras Christian College, Conservation of Heritage Buildings of the Southern Railway, Chennai etc., are under progress.

Conservation Research Activities

Dr. S. Paramasivan was the first chemist who did pioneering research work on wall paintings and he was awarded D. Sc. Degree for his research work. 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 was recognised as a research institution in 1997 by the Madras University to conduct research leading to Ph. D. Degree. Dr. V. Jeyaraj, Curator of the Laboratory is a recognised guide. At present only one part time research student is working on a research project on Conservation of Metal Antiquities.

Publications

The publication of this Laboratory from its inception is commendable. Leading national and international journals such as Indian Academy of Sciences, The Current Science, Conservation of Cultural Property in India, Studies in Conservation, Technical Studies etc., published the out come of the laboratory's research works. Besides hundreds of research and popular articles, many books and bulletins have been published from this Laboratory. Handbook on Conservation in Museums, Care of Museum Objects, Conservation of Archival Materials, An Introduction to the Chemical Conservation and Research Laboratory, Care of Archival Materials, Conservation of Temple Objects etc., are some of its publications. Many conservation reports have been prepared by the successive Curators regularly through out the career of this Laboratory. The present Curator has prepared twenty reports.

Training

In order to disseminate the expertise of the Laboratory, in 1974, a refresher course on Care of Museum Objects was started. 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. Another course is planned for 1999. Students from the College of Arts and Crafts were given practical training for a period of 3 months on the *Conservation of Paintings*. 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 services 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. It is proposed to have regional conservation laboratories in various parts of Tamil Nadu in order to help in the preservation of antiquities and art objects of the region.

Conservation Gallery

For the first time in India, the Chemical Conservation and Research Laboratory of the Chennai Museum has set up the Chemical Conservation Gallery in 1996 in order to educate the visitors on the preservation of the cultural and artistic heritage of our country. The district museums in Tamil Nadu is also have exhibits pertaining to the conservation of art objects and antiquities. This Laboratory has conducted over 50 exhibitions pertaining to chemical conservation both in the museum and also out side the museum. Glass, Conservation of Paper Prints, Conservation of Coins, Conservation of Textiles, Conservation of Temple Antiquities, Care of Museum Objects are some of the exhibitions conducted by this laboratory.

Staff

The Chennai Museum is a multipurpose museum having about one-lakh objects on display and about 5% of them are in need of conservation treatment. But, the strength of the staff is very poor. Action is being taken to improve the staff strength in order to cope up with the growing conservation demand and upgrade this Laboratory as an *Advanced Institute in Conservation.* At present only three members of staff man the Laboratory. It was felt necessary to improve the strength of the staff of the Laboratory. Therefore, a scheme of *volunteers* was introduced in the Laboratory after giving sufficient training to those who are interested in the field of conservation. At present two volunteers help in the conservation work, one in the conservation of paintings and the other is in the conservation of textiles.

Silver Jubilee Celebrations of the Course

The year 1999 is the Silver Jubilee year of the refresher course on *Care of Museum Objects,* which was started in the year 1974. It was decided to celebrate the Silver Jubilee of the course involving students and teachers of both school and colleges. An *essay writing* competition on the title *"The Role of Students in Preserving Antiquities"* was conducted for the students from the schools in Chennai. And an *oratorical competition* was conducted for the college students on the same title. The competitions really created awareness among the students' community and the public in an extra ordinary way. Prizes were awarded to the best students who participated in both the competitions.

A seminar on *Conservation of Cultural Heritage* was conducted in the forenoon of 30th June 1999. Experts from scientific research institutions participated in the seminar. In the seminar ex-students and the participants of the 25th Refresher Course were also present. The inauguration of the seminar was presided over by the Commissioner of Museums, Thiru. R. Kannan, IAS., and the keynote address on *Current Trends in Conservation* was delivered by Thiru. N. Harinarayana, Director of Museums (Retd.). Thiru. K. Lakshiminarayanan, Curator for Education welcomed the gathering and Dr. V. Jeyaraj, Curator, Chemical Conservation and Research Laboratory, introduced the activities of the Laboratory. After the tea break, the seminar session commenced. Thiru. N. Harinarayana chaired the session. Thiru. P. Kalyanasundaram, Head, PIE and NDT Division of the Indira Gandhi Centre for Atomic Research, Kalpakkam read the paper entitled *Authenticity in Art* authored by Dr. Baldevraj, Director, Material Management Group of the above Centre. Prof. Dr. P. K. Palanisamy, Centre for Laser Technology, Anna University, Chennai presented his paper on *Holography-Not Merely an Art.* Dr. V. Jeyaraj, Curator, Chemical Conservation and Research Laboratory of the museum presented a paper on *Preventive Conservation of Cultural Property*. The discussion was lively as many participated in the discussion.

AUTHENTICITY IN ART

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1.0 Introduction

Of all the metallurgical accomplishments of South India, the bronze icons have been among the finest artistic treasures cherished by national, international and private antiquarians around the world. Famous for their aesthetic beauty, iconometry and iconography, and casting quality of high order, the south Indian icons are excellent examples of the fusion of technology with cultural traditions and are found in practically all the best museums in the world.

2. 0 The Casting Process

The icons (solid or hollow) were made by *'Cire Perdue'* or 'lost wax' process. *Cire* in French means 'wax' and *perdue* means 'lost'. The process in ancient Hindu scriptures, such as *Manasara* described in Section 1.2, has been referred to as *madhuchchista vidhanam* (madhuchchista means bees' wax). The wax model prepared according to the Agamic sastras, served as the core of the operation and was 'lost' or drained out before the actual casting took its form after the model.

The various sequential steps in the lost wax casting, as practiced by the ancient sthapatis are listed below:

- Making of the Odiolai
- Preparation of the wax
- Getting ready the wax model

- Making the mould over the wax model
- Heating the mould, melting and draining the wax
- Getting ready the liquid metal alloy and heating the mould to higher temperature
- Pouring the liquid metal alloy inside the mould
- Cooling the mould and opening it
- Bring the cast icon outside followed by finishing, engraving and polishing and
- Installation of opening of the eyes of the icon.

These ten steps in the making of the cast icon, are exactly the same as practiced in Swamimalai today with minor variations between the methodologies and those prescribed in the *Shilpasastra* texts. These variations are not much in the actual method of casting, but on the rituals to be performed, before, during and after casting.

This method is also called the master technique. Thus, after casting an image, its mould is destroyed (the mould cannot be preserved as it has to be broken at the time of the exposure of the icon), with the result that no two specimens of bronzes are alike even if they are by one and the same person. The making of images in this process is indeed laborious. But the importance of this method cannot be overestimated when it is realised that each item is characterised by a rare individuality and provides the possibility of continuous improvement, aesthetics and technology - a hallmark achieved by ancients as a matter of course and being advocated by modern quality management gurus like "Demming".

3.0 Chemical Composition

Icons were cast using *'Panchaloha'*. This term is derived from Sanskrit in which *"Pancha"* means five and "*loha*" means metal. "Formerly, these consisted of the following metals which were considered to be auspicious - copper, silver, gold, brass and lead. Gradually however, gold and silver were deleted for obvious economic reasons, although even today a client may commission an image to be cast in the original five metals for special devotional purposes". The quantities of metal, wax and other raw materials required for each icon, as we mentioned earlier, depend on the size of the icon. According to the empirical approaches developed by these sthapatis (T), for every gram of various materials required to produce the wax model, 8 grams (gms) of alloy were required (7.25 gms copper, 0.5 gms brass and 0.25 gms lead). The typical chemical composition of some of the icons as investigated in the authors' laboratory is given in Table - I below.

Table – I Chemical Compositions of Some Icons

Elements	9th Century	13th Century (Icon)	13th Century (Prabhavali)	16th Century
Copper (wt%)	95.60	94.50	94.50	89.40
Tin (wt%)	0.88	1.10	1.80	3.40
Lead (wt%)	0.34	1.00	3.35	2.88
Iron (wt%)	0.13	0.05	0.10	0.52
Zinc (wt%)	15.00	40.00	103.00	2646.00
Antimony (ppm)	476.00	1747.00	5309.00	3095.00
Silver (ppm)	541.00	596.00	1659.00	823.00
Arsenic (ppm)	1295.00	1285.00	3341.00	1394.00
Nickel (ppm)	436.00	415.00	552.00	636.00
Bismuth (ppm)	85.00	164.00	503.00	351.00
Cobalt (ppm)	45.30	135.00	100.00	114.00

4.0 Authentication of Bronzes

South Indian bronzes are scientific and art marvels, which reflect the rich cultural heritage of our country. Scientific investigations on objects of cultural heritage are undertaken with a variety of objectives in mind. The most important of these include

- Understanding the style, period, structure and metallurgy of these icons so that India's rich technological history is understood.

- Assess the condition of the icon to help in restoration and conservation

- These bronzes famous for their aesthetic beauty and excellent craftsmanship are prone to thefts. These investigations help in scientific and comprehensive fingerprinting of icons needed for documentation and authentic identification when they are retrieved.

Authentication of bronzes requires an integrated approach. The most appropriate approach, which can give solution to all the requirements indicated in the figure, is through the use of Non-Destructive Testing (NDT) techniques. NDT techniques as the name implies are techniques that have been developed to determine the quality of components without causing any harm to them. A variety of NDT techniques are available today, which are being successfully employed in various industries to assess the quality and ensure the integrity, safety and reliability of plants and components. A few of these techniques have also been successfully applied for the investigation of objects of cultural heritage such as sculptures, paintings, monuments etc., world wide. Table - 1 below lists some of the major NDT techniques used for investigations on objects of cultural heritage and their capabilities.

Table - II Major NDT techniques used for authentication of art objects

Sl. No.	Techniques	Capabilities
1.	Precision Photography	Dimensions, measurements and record of intricate details
2.	Holography	3 – D Characterisation
3.	Moiré Fringes	Contour Mapping
4.	Laser Excited Emission Spectrometry	Chemical Assay
5.	Mass Spectrometry	Chemical Assay
6.	Activation Analysis	Trace Analysis of Elements
7.	X-Ray Energy Spectrometry	Chemical Composition
8.	In-situ Metallography	Microstructural Characterisation
9.	Radiography / Tomography	Internal Defects, Joints, Repair Regions
10.	Physical Parameters Thermal emf, Electrical Conductivity, Hardness	Characterisation of Material and Thermo-mechanical Treatment

In India, as part of the DST project on fingerprinting of ancient South Indian *panchaloha* icons, a number of icons pertaining to the period between 9th century and 16th century AD belonging to the Pallava, Chola and Vijayanagara periods have been studied. Of the above mentioned

NDT techniques, four have been identified as the major ones to be used for investigation, namely precision photography, X- and gamma radiography, X - ray emission spectrometry and in-situ metallography. While precision photography maps the overall icon and its intricate external features, radiography records the internal details, typical flaws and also provides information on the constituent and morphological elements and sequence of fabrication and repair. X - ray emission spectrometry provides information on the chemical composition of the icon while in-situ metallography characterises its microstructure. Thus on the whole, an icon is fingerprinted by the use of these techniques such as conductivity and hardness measurements lend a supporting hand in the investigations and lead to a better understanding and appreciation of the technology.

This talk would provide with a complete overview of the NDT methodologies used in the authentication of Bronzes. Typical features detected and the results of the analysis carried our at the author's laboratory would be presented.

X- Ray Equipment Set up to take an X-Radiograph

Photograph of the Bronze Icon

X-Radiograph of the Bronze Icon

HOLOGRAPHY - NOT MERELY AN ART

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Although Dennis Gabor (who received the 1972 Nobel Prize in Physics for his work) invented holography in 1943, the requirement of high degree of temporal and spatial coherent source restricted the development of holography.

Holography is not merely an art but a very useful tool for non-contact, non-invasive but highly sensitive optical technique. When an object is illuminated with light, the scattered/ reflected light is modulated both in amplitude and phase of the wave from the object. A reference wave coherent with the object wave is added at the plane of the recording medium. Both the amplitude and phase of the object wave are recorded as irradiance variations due to interference. Such interference recorded by photographic emulsion is called a hologram. The exposed holographic plate is developed, dried and then reilluminated with the same reference beam called reconstructing beam. This beam undergoes diffraction and the diffracted beam appears to an observer as though it were coming from the object itself. The hologram serves as a window through which the object can be viewed from different elevation and angles just as though the object were still present i.e., it gives 3-D image. Viewing a well-made hologram, the observer experiences a strong urge to reach behind the plate and touch an object that is not there. The recording of a hologram involves the phenomenon of interference while the reconstruction of the object wave involves the diffraction phenomenon.

It must be noted that no lens is used to image the object on the recording material at the time of recording. The scattered waves from each and every irradiated part of the object reach everywhere on the recording medium. Therefore, when the recorded hologram is cut into any number of pieces, each piece, carries the information about the entire object.

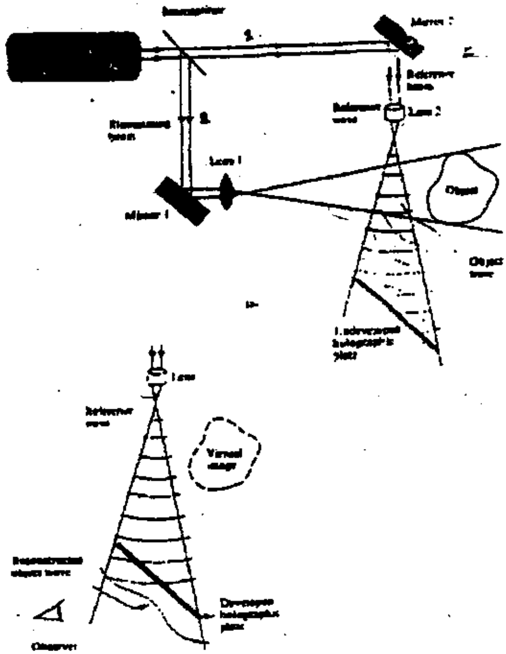

Fig. 1. Basic holographic principle.

a) Recording the interference pattern produced by interfering object and reference waves.

b) Reconstructing the object wave by illuminating the hologram with the reference wave.

Recording of a Hologram

There are many ways to record a hologram. Various optical components are mounted on the holographic (vibration isolation) table. The beam-splitter divides the beam into two parts: the beam 1 is used as shown in the Figure 1. Care should be taken to match the path length of object beam and reference beam. The room is kept dark. Laser beam is switched off and the photographic plate is inserted in the plate holder, which is rigidly mounted on the table. Allowing few minutes for the vibrations to subside, exposure is made. Then the plate is developed and processed. After processing the hologram is mounted back where it was recorded. The object is removed and the beam 2 is blocked. The hologram is now illuminated only with the reference wave. On looking through the hologram in the direction of the object, one sees the reconstructed image exactly same as the object.

Holographic Interferometry

Holography has found application in a number of areas, and new users are being developed all the time. The novelty and attractiveness of full perspective, three-dimensional displays have inspired the limited use of holography in the advertising business. Of greater interest has been the use of holography in the field of interfero-metry.

One of the most important applications of holographic interferometry is in non-destructive testing. It can be used wherever the presence of structural weakness results in localised deformation of the surface when the specimen is stressed either by application of a load or by a change in pressure or temperature. Crack detection and the location of areas of poor bonding in composite structures are fields where holographic interferometry has been found very useful. Holographic interferometry has also proved its utility in aerodynamics, heat transfer and plasma diagnostics. Yet another field of application has been in solid mechanics, where it has been used to evaluate the stresses in complex structures, as well as to measure changes in shape due to corrosion or absorption of water. Since mechanical contacts are not involved, measurements can be carried out even in hostile or corrosive environments. In addition, this is a whole-field technique thus enabling one to study each and every part of the object under study simultaneously with only one recording.

Double Exposure Holographic Interferometry

In this process, the object to be tested is recorded on the holographic plate giving one exposure. The object is now stressed slightly by heating or loading with weights, for example and another exposure is given. This doubly exposed holographic plate is developed and processed. When the hologram is reilluminated with the reference wave we get two reconstructed virtual image waves simultaneously and the interference pattern representing the differences in the two-recorded light distribution appears in the form of fringes localized on the object. If the object has changed shape during the two exposures, even microscopically, the change manifests itself as a system of closely spaced fringes in the reconstructed image.

A common application is illustrated in Figure 2, which shows the double exposure hologram of a portion of the interior of an aircraft tyre. In the preparation for the hologram recording, the tyre is placed in a chamber. After the first exposure is then made with the vacuum applied. If there is a local separation between the tread and the outer piles of the tyre of between the various piles, both potentially dangerous flaws, air entrapped in the separation will cause a minute local expansion, a microscopic bulging, in the vicinity of the flaw. This bulging is readily discerned in the reconstructed hologram as a series of closely spaced fringes. Commercial holographic testing systems developed for this purpose are able to test one tyre every several minutes.

Fig. 2. Double holographic interferogram of an inside portion of an aircraft tyre. Circular interference pattern indicates locations of tyre ply separations.

Real-time Holographic Interferometry

In Double exposure technique, after both the exposures are made, the processing of the exposed plate takes some time. Therefore, there is few minutes of time delay between the time of deformation of the object and time of reconstruction to observe fringes. This problem is overcome in the process of real time technique. In this process, a conventional hologram of the object to be tested is first made. The hologram is developed in the normal manner and then returned to the exact position it held during exposure. (There are special types of plate holders designed either to develop the hologram in place or to place it back after developing without even micron displacement). The object and the hologram are now illuminated just as they were during exposure, so that reconstructed holographic image falls exactly on the object itself. If the object is now stressed slightly fringes appear on it. These fringes result from the interference between the light waves from the now-object. On continuous stressing of the object, fringe pattern changes continuously and for permanent recording, we have to take photographs.

Time Average Holographic Interferometry

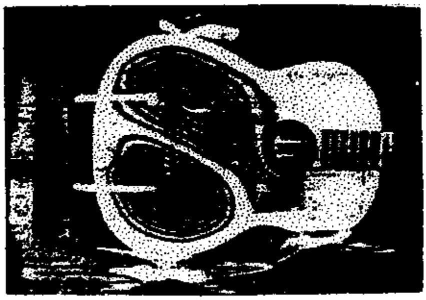

Fig. 3 Photograph of a time-average holographic image of a guitar. The fringe pattern shows the vibrational mode of the guitar at a particular frequency.

Closely related to single and double-exposure holographic interferometry is a technique known as time average holographic interferometry. This technique allows the spatial characteristics of low amplitude vibration of an object-for example a drum head, speaker cone or metal diaphragm-to be mapped out with great accuracy. Figure 3 shows a vibrational mode of a guitar. The fringes represent contour lines of equal amplitude of the vibrating object surface. The brightest contour occurs at the nodes, or stationary points, of the vibrating surface. This is to be expected, because light reflected from these points, always interferes with the reference wave. For other regions of the vibrating surface, however, the corresponding interference pattern is moving and, for long exposures, produces a pattern of reduced or even zero reconstruction efficiency. From the fringe pattern we can calculate the mode of vibration and amplitude of vibration.

Holographic interfermetry is used in plasma experiments associated with the laser-fusion program and has served to increase understanding of the mechanics of hearing, to measure relaxation rates of structural materials, to observe the vibration of turbine blades in operating jet engines, to design musical instruments and to detect subsurface damage in fifteenth-century panel paintings.

In western countries, holographic art galleries are very famous. They are attracting many visitors everyday. Using tricolor holographic technique, it has become possible to record and reconstruct the objects with their real colours. Very rare specimens of the museum could be recorded holographically and exhibited without any fear of theft.

Holography is not merely an art. It is a very useful scientific tool, which can be used for protecting and hologroaphically labeling the very rare idols of museum. Recording double exposure hologram at two different temperatures recording depends on the material of the idol and defects such as blowhole, irregularity etc., in the idol. No other idol can give rise to the same pattern as that of the original. This can therefore be called as *'fringes printing'* since fingerprints of no two persons match. Thus rare specimens can be holographically labeled.

It is believed that the growth in the importance of holographic interferometry as a scientific and engineering tool will continue as specific application for which it is uniquely suited or recognised.

CURRENT TRENDS IN CONSERVATION

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A topic titled like this sounds attractive. It seems to update us with what is happening now in conservation. But conservation is a discipline, which relies heavily on developments in other fields of science, which absorbs new ideas cautiously because it deals with the upkeep of precious heritage and cannot afford to apply any new idea without checking whether it will have any unexpected reactions or long-term effects.

Still it has to be admitted that conservation has been evolving steadily over the period from the end of the nineteenth century when it was found desirable to replace the rule-of-thumb methods followed till then by methods, which were scientific and come to applied in a routine manner. Obvious of why they were applied. The first new hand in conservation was the realisation that each object had to be cared for on its merits and that a detailed examination of the object to discover the why and wherefore of damage and decomposition and the nature and composition of the material affected was important. Without knowledge of these facts, it was realised that conservation would not be comprehensive and effective.

Another important realisation was the primacy of the original look of the object. Conservation came to be summed up as the process of preserving or restoring the original appearance of the art object. If extraneous crusts have covered the surface of an object and concealed artistic details and disfigured it these crusts had to be removed. But they had to be removed without touching the original surface of the art object. The crusts were not always of dust and dirt, which could disappear, with a simple wash of soap and water. These were crusts, which were hard, more firmly locked up with the surface.

The hard links could be broken with chemicals or more sophisticated means like suitable solvents or electrochemical processes worked at an ionic level: the reactive negative hydrogen ions released in these processes termed up with the oxygen ions of the oxide crusts and thus broke up the chemical entity of the oxide crusts, there by realising metallic ions. This was expected to be very sound way of breaking up the corrosion crusts on valuable metallic objects. In course of time, it was found that the metallic ions released in the process were deposited on the surface and gave it a dark look because of their very fine particle size.

Moreover, though a measure of control of the reaction was possible with the electrolytic and electrochemical processes, still the surface was exposed to the chemical or electrolytic action and was deemed to be affected. Emphasis came to be laid on the use of nonchemical means for removal of the crusts. The simplest and the most frequently used method is the use of fine chisels. I have seen Chemists of the National Research Laboratory for Conservation, Lucknow, use this method on bronzes in the Thanjavur Art Gallery. They achieved a remarkable cleansing of the bronze surface, and no trace of the crust was visible to the eye. It is a most point whether all traces of reactive crusts were removed. Molecular quantities are enough to set off fresh outbreak of corrosion products. Observation of the surface periodically has to be made to establish whether such removal of crusts through the use of chisels is effective.

Mechanical methods continue to be employed for a variety of materials. The trend is to apply sophisticated methods from other fields. Dental drills have been effective for removing crusts of earthy matter from porous ivories dug up in excavations. Micro sand blasting has been used for ridding marbles off caked up deposits of dirt and dust. The latest method of surface cleaning is the use of lasers, which could be controlled with precision to knock off only the extraneous layers, leaving untouched any patina, which may adorn the mortal of the figure. Ultrasonic is another sophisticated method for cleaning coins. All such cleaning invariably brings our artistic details, which had been concealed earlier by crusts of extraneous matter.

In the world, of art critics and art connoisseurs, patina is by word for aesthetic appeal. According to them, patina gives art objects an antique look, which boosts their value. The best of patina is itself only a crust but a crust, which is the transparent, smooth and shining. Fortunately it is a crust, which is so densely formed that it seals off the surface from further action by damaging agents. It acts as a protective layer too. Thus even conservators accept it as worthy of preservation. But, art lovers extend the definition of patina to include even patchy scattered layers of products of damage, which, according to them, gives the object an ancient look. It is here that the art connoisseur and conservator differ. But the outcry raised by the connoisseurs has been such that conservators have looked for methods that would precisely control the extent of the layers to be removed, leaving behind chemically nonreactive deposits that would give the object the much required patina. Laser cleaning has come in for attention since removal of extraneous matter can be so well controlled by it that even on a marble calcareous deposits are removed, leaving behind a layer called *patina*. This is also liable for bronzes and for spots of rust on a burnished sword.

This concern for patina on bronzes has also led to decisive processes for breaking conservation effort on a superbly patinated bronze. Sometimes here and there, spots of porous greenish matter erupt on a bronze with an impeccable velocity green sheet. Even use of local electrochemical action may yet spirit the appearance of the object. In the Government Museum, Chennai an electrochemical action may yet spirit the appearance of the object. In the Government Museum, Chennai an electrolytic pen like instrument has been developed for removing the green patches. The more acceptable process in the application of neutral chemicals which react with the chloride component of the disfiguring patch and convert in into an unreactive almost inert patch. In this method, a little silver oxide moistened with water is applied to the offending patch.

This reacts with the chloride of the corrosion patch, forms silver chloride, which is inert and stable and thus offsets further chemical reaction.

Another advance has been in the field of consolidation and preservative coatings and adhesives. Advances in polymer science provided conservation with materials, which answered to a test, many requirements for different purposes. The preservation of waterlogged wood gives a telling example of the finding of suitable consolidant. The characteristic of a waterlogged word in object is that it retains its shape only so long as the water lasts. Evaporation of water leads to the shrinking of the object and loss of shape. A consolidant had to be found which would not shrink once it dries up. Such a one was carbowax. The whole range of epoxy resins provides instanus of adhesives, which stick surface to surface to the best possible extent. The rector is an epoxy resin does not dry up like starch by losing a constituent part of it but undergoes a chemical change, which resists in no change of volume. So there is a uniform adhesive layer bonding two surfaces, which means good bonding strength. Cellulose acetate is another adhesive that fitted in excellently the process in rope when solvent lamination came in. But ordinary lamination require the use of heat and pressure, which would ultimately tell on the durability of the document to the preserved, solvent lamination avoids the use of heat and pressure and thereby ensures the durability of the material of the document or manuscript.

Apart from lamination, there is another area in which a significant trend was set. Old paper gets discoloured and brittle, and this is attributed to the rise of acidity in it. The acidity was removed by immersing such paper in alkaline solutions in water. This is cumbersome process involving elaborate precautions for the safety of the treated paper. Vapour phase de acidification with ammonia is a development, which is easy and neat.

It is a well-known fact that ambient conditions of temperature and humidity play a great role in the preservation of materials. Similarly in the case of sensitive objects like paintings and textiles, controlled lighting is desirable. Control of ambient conditions and lighting for objects on display is nothing new. But are some cases, modern techniques are employed to ensure rigour in such control. The most notable example of this is the display of the famous Leonardo da Vinci's *"Mono Lisa"*. Earlier it was displayed in the Grand Gallery of the Louvre Museum, Paris behind a frame of special glass. Now it is put up in a separate room and kept inside a panel in which humidity and temperature are controlled. More over it is not continuously exposed to light. It is lighted up at regular intervals so that damage due to light is avoided.

PREVENTIVE CONSERVATION OF CULTURAL PROPERTY

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India is a vast country with a wealth of cultural heritage, which need to be conserved for posterity. Without proper up keeping knowledge our cultural heritage has been damaged to some extent in some areas of our country. Since the conservation activity is to be carried out by each and every one of our country, it is necessary that an awareness of conservation should be available at every level in the society. With this intention the Chemical Conservation and Research Laboratory of the Government Museum, Chennai is conducting many conservation awareness programmes in Chennai and other mofussil areas in Tamil Nadu. This seminar is also one such awareness programme and therefore the preventive conservation is dealt with.

Cultural property in our country is ancient and is different in varieties and materials. One must know the type of materials and their constituents before entering into their conservation and restoration to bring the damaged cultural property to its pristine state.

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

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

There are three types of work in the museum. They are:

1. Preventive Conservation
2. Curative Conservation
3. Restoration

1. Preventive Conservation

All the collection in a museum are sound, stable and some are damaged. What ever may be the condition of the objects preventive conservation is essential. A team of people in a museum may do this.

2. Curative Conservation

In a museum about 2% of the collection may be in need of Curative 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/restorer.

3. Restoration

About 10% of the objects in the collection of a museum are in a damaged condition. The priority of the treatment is secondary. A trained conservator-restorer may do Restoration. Some objects are in need of only conservation. Some objects are only in need of restoration. There are objects, which are in need of conservation and restoration.

Museum

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, communicate and exhibits for purposes of material evidence of man and his enjoyment.

The sources of the cultural property are varied. The objects may come through exploration, excavation, treasure-trove finds, through purchase, gifts, transfer etc. Once the objects were taken care off by their own environment/owners. When they are brought to the museums, a very few members of staff manage a large number of objects. The aggression due to nature and human beings is high. In order to control the deterioration of the cultural property,

1. We must be aware of the factors of deterioration or dangers.
2. The museum personnel should be competent to handle the problems and
3. The conservators-restorers and the museum staff should be good communicators.

The message from an object should be communicated to the onlookers and also they should be protected.

The curators of the collections in a museum are not much aware of the damaging factors of the objects. There are very few cases, where objects are miraculously protected without the help of any direct or indirect action. If the conservators discuss the problems with the curators most of the objects will be better preserved.

In order to increase the life of an object, one must know the life history of the object. Before an object comes to the museum, it has experienced various environments. An individual or a group of people would have attended the object before it reaches the museum. There are a lot of differences in the type of attention given to the object at these-places. There fore proper care should be taken to increase the life of the object in the museum.

The physical integrity of the object is 100% at the time of its creation. The time taken to completely disappear is called the life expectancy. For example an iron object at the time of its making has 100% physical integrity. When it completely corrodes, there is no metal core but the form of the object is maintained. Even though there is deterioration, the life expectancy is maintained further.

The history of an object, which comes as a treasure-trove, excavated object, at the time of excavation it is found under a deteriorated condition. By the application of three acts, the life expectancy may be improved, reduced or will reduce at the rate at which it originally deteriorates.

Aggressions of Cultural Property

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

Immediate Destruction

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

The man made aggressions are classified as public aggression and professional aggressions.

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 property.

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, transport, storage, exhibition, support, lighting, handling, maintenance etc.

Strategy for Conservation

For better conservation of the cultural property, 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.

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.
2. Well-planned storage areas.
3. Protection from light: correct levels of light; blind and curtains.

4. Use of conservation technique and materials for housing.
5. Full instructions to the users of collections; that is 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.

Conclusion

Preventive conservation is a must for any object on display or storage. Preventive conservation does not require any specific chemical or physical knowledge to handle. Anybody can handle preventive conservation. There fore it is a must to know the basic principles of conservation by those who are interested in the preservation of antiquities for posterity.

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