

Deterioration and Restoration of Painting

- Bhimbar S. Thapa

In Nepal mostly paintings were done either in paper or in canvas. Very few paintings are available in wooden book covers and in skin parchment. Most of them are being organic material deteriorate after the lapses of time. A number of destructive agencies are noted in Museums and Libraries. Care and preservation of an art object is a never ending process. It needs constant care, physical labour and patience. It should be examined periodically by the concerning experts.

The destructive agencies of objects are natural, as well as artificial. The natural causes are the following:-

1. Temperature and humidity.
2. Bio-deterioration.
3. Light and air pollution.

1. Temperature and humidity

They are very important factors which causes deterioration of painting. Paper and textile (canvas) are hygroscopic in nature. Temperature plays an important role either to increase or to decrease the relative hu-

midity of an atmosphere. When temperature decreases, humidity increases and vice-versa. The paper and canvas shows brittle character in absence of water vapours (moisture) in nature and soften in presence of high humidity.

The suitable condition for fungal growths is easily met in tropical countries with heavy rainfall and high temperature. In more than 70% relative humidity below 18°C heat most of the fungi are restricted. But 25°C to 40°C of heat is very much helpful for rapid growth of the fungi. The hydrolysis done by moulds generate enzyme (amino acids) which helps to break the cellulose molecules of the organic material.

In excessive dryness shrinkage and cracking develop in colour pigment, and in excessive wetness promotes the fibres to swell and softening. This situation is more harmful in skin and painted wooden panel, which may changes its shape and size. Thus the constant change of relative humidity and temperature should be stopped. Otherwise a force imposed by a regular change of temperature and humidity weakens the

fibres of organic material. i. e. paper and textile.

There is no any devices of airconditioning in our Museums and Libraries, which can regulate the favourable conditions to the paper and canvas paintings. If the humidity is controlled other things will be controlled automatically.

2. Bio-deterioration

A deterioration caused by biological agents known as bio-deterioration. There are more than seventy species* of insects are identified as an enemies of cellulose fibres. Even more harmful among them are book-worm, silver-firh, cockroaches, termite, book-lice, mud-wasps, fire-brats, etc. Organic material invites these insects seperately or combinely. Along with these visible insects there are invisible micro-organism which causes painting deterioration. The bad storage system and rough handling-accelerate growth of fungus dryrots and bacteria. During their life-cycle they generate organic acids causing slow damage.

Fungi, algae, lichens, mosses, actinomytes and bacteria are various types of micro-organism which are responsible for great damage to the paintings. These belongs to a major division of plant kingdom. Fungi bacteria and actinomytes has got no chlorophyll. So these micro-organism exist only as a parasite or saprophyte. Paper and canvas painting are being a organic material is good medium for fungal and bacterial growth. These micro-organism causes stain on paper, disfigures the paintings

and changes the chemical and mechanical properties of various types of cellulosic materials. It effects on the strength of the fibers and also is responsible for producing undesirable colour and odour.

3. Light and air pollution

Light is a major factor for deterioration of displayed coloured art objects. The damaging effect of light on the painting is of two folds. In one hand chemical changes take place in the material of the paintings and on the other hand bleaches out the colour. It slowly changes the nature of the paint-medium. This process is known as photo-chemical deterioration.

Light is a form of radiant energy. Thus light X-ray, r (gamma) rays, infra-red and ultra-violet rays are all electro magnetic radiation. Each magnetic radiation is associated with specific wave lengths.

Visible region of the spectrum of natural white light is approximately between 4,000 to 7,000 A°.

The range of ultra-violet rays is 300 to 400 nm, infra-red radiation is beyond 760 nm, and visible light radiation is between 400 to 760 nm.‡ Ultra-violet radiation less than 300 nm cannot penetrate the atmosphere. Shorter is the wave length higher will be the energy of radiation. In light complex, IR-rays and other invisible rays are also present. The damage caused by light depends upon the following factors.

- a. Spectral characteristic of light
- b. Intensity of light

* Accordingly to Waseem Ahmeed- Care and Repair of Archieval Materil, Museology and Museum Problems in Pakistan. (Page 115)

‡ Chemistry of Environment-Bailey R. A., (London Academy Press, 1978).

- c. Duration of exposure to light
d. Susceptibility of the object to light

The supports of painting are mostly organic in nature and are made of groups of small molecule (Polymeric compound) is well known from polymer chemistry.†



The strength of the organic material depends upon the extent of polymerization present. In photo-chemical action light breaks down the molecule of polymeric compound. Polymerization takes place in photo-chemical action. The cellulose oxidised leading to degradation by exposure to light. Photo-chemical degradation is apparently due to oxidation of cellulose by oxygen present in the atmosphere, the reaction is accelerated by humidity. Simply we can say that the photo-chemical reaction starts by the absorption of UV-rays. Shorter wave length radiation makes the paintings weak and brittle. The colours fade away by light and changes the nature of the binding material. It deteriorates the starch, resin, glue and alum, etc. Most of the water colour exposed to light tend to lowered down in tone.

It is widely understood that day light is more dangerous to painting than the incandescent light. The flouroscent tubes are also dangerous but less than day light. The photo-chemical effect can be controlled by using the proper light filter.

The following suggestions are given to control the effect of light on paintings :-

1. By minimizing the intensity of light

falling upon the paintings.

2. By reducing the time of exposure on the paintings.
3. By eliminating the photo-chemically active radiations from the light.
4. The distribution of light on painting should be as uniform as possible.

For all paintings the intensity of light should not exceed more than 50 lux‡ and UV radiation 75 m w/lumen,

To cut the direct day light through the window shaded curtain and plastic covers can be used. It can be controlled by the use of diffusing glass on the window. To protect the painting from UV-rays, UV filters such as Plexi glass 201 or, Plexi glass UF 3 and Perspex UE are recommended. They are thick as well as thin shape. They can be used in windows and in show-cases which are easily available in India.

Reflected light from a painted surface containing Titanium white or Zinc white also absorbs the UV-rays. It is preferable to use translucent or transparent glass in front of the light source.

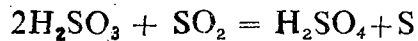
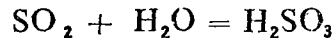
The photo-chemical effect and the gaseous pollution of air like SO_2 (Sulphur dioxide), CO_2 (Carbon dioxide), H_2S (Hydrogen sulphide) and O_3 (Ozone) and dust particle causes a great damage to the paintings. It is rather a very slow and unseen reaction. It crackled down whole the paintings into a dust in future.

Sulphur dioxide is generated due to the combustion of hydrocarbon i.e. coal, burning of petrol and fuels in domestic purposes, power station and automobiles. Sulphur di-

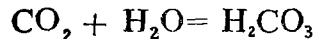
† Care and Repair of Archieval Material. Waseem Ahmeed (Pakistan).

‡ Measurement unit of light intensity.

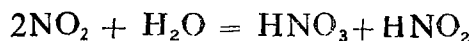
oxide in contact with moisture yields sulphurous acid and finally sulphuric acid.



In the same way carbon dioxide forms carbonic acid.



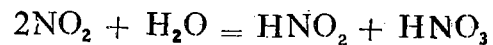
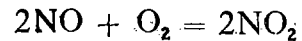
And nitrogen dioxide with moisture yields nitric acid.



All these inorganic acids though forms in a negligible quantity has a strong reactive and damaging effect on painting.

The most dangerous and damaging oxidant pollutants are ozone and sulphur dioxide. Ozone is a poisonous gas found at the highest concentration in polluted cities. It comes into contact with painting in following ways-

1. From the natural production in the upper atmosphere.
2. From the effect of sun light on automobiles exhaust gas known as photo-chemical smog.
3. From certain kinds of lamps and electrical equipment, which might be used in Electrostatic filters, copying machines, etc. They throw out a lot of ultra-violet rays. The series of chemical reaction which results in man made ozone starts with nitrogen oxides from automobiles exhausts. The reaction starts the process by breaking up of nitrogen dioxide by sun light to form nitric oxide and atomic oxygen. This oxygen atom thus created had a great tendency to combine with nitric oxide to form again nitrogen dioxide, then to nitrous acid and nitric acid.



The dust particles suspended in air when falls upon the painting surface gives abrasive effect. It also effects chemically on the painting material. When moisture content is high in atmosphere the dust particles settled down and stick on the painting surface. The gaseous pollutants can be reduced either by water spray or activated carbon filters in the air conditioning system. Plain water spray and active carbon filters are effective against sulphur dioxide and nitrogen dioxide. But it is not effective against ozone. Ozone is removed with high efficiency of activated carbon not by absorption but by destruction.

Vaccum cleaners are advisable for the floor cleaning. The slow and natural deterioration of the painting is unavoidable in under-developing country due to lack of man-power and necessary equipments. Besides the natural way there are certain artificial ways which may damage the painting. The ways are:-

1. Accidents
2. Mishandling
3. Wrong method of carrying
4. Fire, flood and ravages of war
5. Bad storage system

Few general rules are given below to protect from artificial damages

1. The painting is a very delicated material and always should be handled with care. A soft nylon brush can be used to remove dust and dirt. The support of the painting should be straight and rigid. Painting never should be folded or scrolled.

2. Painting on mount or stretcher must be carried from one place to other one by one.
3. Before sending out the painting must be well examined whether the symptoms of danger is there or not.
4. A periodical inspection of the painting should be done.
5. To carry a painting never use one hand. One hand must be under the frame and the other at the side.
6. The painting surface should be protected from abrasion.
7. Hand should not be allowed to come in contact with the painted surface.
8. Prints, drawings and miniature paintings are always be kept in between a flat hard board.
9. Scotch tape or other type of commercial adhesiva tapes are very injurious to the paintings.
10. A painting never sent out with glass frame or covers.

The extent of damage due to internal factors depends upon the properties of the material and how the material have been used for paintings. The falls technique of painting invites, various deteriorating agencies. There are certain natural radicles in colour pigments which can not be controlled or avoided. The pigment like Verdigris has a very dangerous damaging effect on the painting support. The portion to the painting with this pigments are easily changes into brown and a eventually lost due to the acidic character of the colour pigment. The acids through many sources are very dangerous to the paintings. Even a small quantity of acid present in the paintings tends to break the fibres of cellulose and the painting looses its strength. Deterioration of

a painting is a complex phenomenon. Only a constant efforts can minimise the damaging agencies whether it is natural or artificial.

A demonstration of painting restoration was shown at Central Chemical Conservation Laboratory at Patan. Restoration is a process which helps to live long the objects without disturbing its asthetic values.

The Central Chemical Conservation Laboratory received forty-two pieces of canvas oil painting from Narayanhiti Palace. The religous arts belonging to worshipping room of the Palace indeed is not very ancient work but much valuable in the point of Hindu religion.

When the objects were at lab., the stretcher were broken and were affected badly by the wood termites. Regarding the paintings, the colours were flaked and faded away. Some of the paintings were almost invisible, and difficult to trace out the original drawings. Many holes on canvas were observed here and there. The paintings were completely covered with dust, dirt and shoots. They were tore out from the edges to different places.

Treatment

The paintings were brushed with a dry and soft brush to remove the dust and the shoots layers as much as possible. Then broken stretcher were removed completely. Then the paintings were washed with the following solution.

Preparation of solution

The solution containing the following organic solvents were used separately or in a mixture form.

- a. 20% Rectified spirit.
- b. 50% Distilled water.
- c. 2-3% Ammonia.
- d. 3% Thymol.
- e. 20% Ab. alcohol.
- f. 5% Benzene.

With the above prepared solution the paintings were thoroughly washed in enamel tray. In the unaffected parts cotton swab was dipped in the solution and was swabbed lightly without disturbing or introducing any external force to the paintings. After this treatment the paintings were dried in absorbant sheets and was mounted to a newly prepared canvas to give support to the paintings.

Preparation of canvas

A thin cotton cloth to the required size of the painting was taken and placed on a smooth and plain table. The adhesive paste was applied uniformly with a flat brush. Sheets of Nepalese tissue paper (Hand made fine paper) was overlapped up to the required thickness. The whole thing was pressed well. When it was about to dry the newly prepared canvas was rubbed with a roller or with a smooth object just to avoid the shrinkages and the unlevelness. Then it was kept for more than a week for natural drying.

Preparation of paste

Arrot powder mixed with water, well stirred and heated in a oven to get thick paste. In the prepared paste, mercury chloride about 2-3%, penta-chlorophenol 5%, alcohol and glycerin was added which work as an insecticides and fungicides.

Fixing of the painting

The newly prepared canvas was coated with the paste and the painting were mo-

unted very carefully with several hands. Special care was given at that time to remove the shrinks and the air bubbles. When the work was completed the painting was left for complete drying.

Lacuna filling

A paste or Putty was prepared by mixing a powder of Zinc oxide and polyvinyl acetate emulsion (mobicle). With this paste all the lacunas were filled.

Framing

Required different sizes of wooden pieces were taken and was coated with Xylophene and kerosene mixture in 1:3 ratio to prevent from the termites. Then the canvas paintings were stretched and stapler pins were used to give strong rigidity.

Retouching

After the whole procedure explained above was completed, the paintings were taken to retouch with different colours.

Colours used for retouching

(a) Zinc white, (b) Ivory black, (c) Red, (d) Yellow, (e) Blue (f) Green.

Preservative treatment

The paintings were coated with the solution of 5% paraloid B-72 (methyl methacrylate) in sulphur free toluene as a preservative coating after the finishing touch.

A final photograph was taken after completing the whole process.

Work performed

The chemical treatment was done by B. S. Thapa (Chief) and S. Panday and the retouching and other works was done by S. R. Tamrakar and R. Jyapoo (Artist as well as chemical assistant to the lab).

The conservation record which was

kept in conservation lab is given in the next page.

Selected bibliography

1. Agrawall, O. P., Care and Preservation of Museum objects (N. R. L. C., New Delhi, 1977)
2. Agrawall, O. P., An Introduction to Preservation of Paintings. (Baroda, Dept. of Museology M. S. University of Baroda 1967)
3. Agrawall, O. P., A Major Problems in Museums. (International Centre for Conservation, Rome 1979)
4. Sharma, V. K., Trainee (80-81) N. R. L. C. Pahari Miniature Painting.
5. Rayamaji, Hem Nar Singh, Technique of Nepalese hand-made paper.
6. Jespertrier. -Ancient paper making in Nepal.
7. Bailey, R. A., Chemistry of Environment. (London Academy Press 1978)
8. Bakshi., B. K., - Fungi in relation to termites. (UNESCO). Termites in the humid tropics (P: P. 117-120).
9. Plenderleith, H. J., - The Conservation of Antiquities and works of Arts (Indeed Oxford University Press, London 1971).
10. The conservation of Culture Property (UNESCO) Paris 1968, p. p. 41-42.
11. Museology and Museum Problems in Pakistan. Edited by Dr. Saifur Rahman DAR, (Lahore Museum, Lahore, Pakistan, 1981).

CONSERVATION RECORD

Laboratory No. P -- 60 *Museum No.*
Owner's Name NARAYANHITI ROYAL PALACE
Location
Designation of the object Radha Krishna *Period* 20th Century
Material-Technique Canvas Painting
Function or use Religious Purpose
Present conditions

- (1) The Painting was completely covered by dust, dirt and shoots.
- (2) The Painting was badly damaged due to nailing and malhandling.
- (3) The colour was flaked away here and there.
- (4) The old frame (stretcher) was broken into several pieces.

*Museum Photo No.**Laboratory Photo No.* P -- 60*Correspondence**Conservation Officer*

B. S. Thapa

Work done by

R. Jyapoo, S. Tamrakar, S. Panday

Date received 4/4/37*Date returned* 10/8/040.

RECORD OF TREATMENT

Material used

(A) For cleaning:-

- 1) Rectified Spirit 25%
- 2) Distilled Water 50%
- 3) Ammonia Solution 3%
- 4) Absolute Alcohol 20%
- 5) Benzene 5%

(B) New Canvas:-

- 1) Nepalese Tissue Paper
- 2) Nepalese Handloom Cloth

(C) For Adhesive Paste:-

- 1) Wheat Flour
- 2) Mercury Chloride
- 3) Penta Chlorophenol
- 4) Glycerine

(D) For Lacuna Filling:-

- 1) Kaolin Powder or Zinc Oxide Powder
- 2) Mobicol (Polyvinyl Acetate Emulsion)

(E) For New Stretches or Framing:-

- 1) Soft Wood (Utish) (Uddist in Nepali)
- 2) Iron Nails
- 3) Mobicol
- 4) Xylophene - One Part
- 5) Kerosene Oil - Three Parts

Method-Used

Signature B. S. Thapa

PHOTOGRAPHIC RECORD

Laboratory No. P.- 60
Material Canvas paintings

Museum No.
Designation of the object
Radha Krishna

Owner's Name
Narayanhiti Royal Palace.

...Before Restoration



Observations

...After Restoration



Signature B. S. Thapa

Negative No.- P-60
Photo No.- P-60
Date- 10/8/040
Taken by R. Jyapoo