Training Report
on
Cultural Heritage Protection

Training Course for Researchers in Charge of Cultural Heritage Protection in Asia and the Pacific 2009 –Mongolia–

17 November－17 December 2009, Nara, Japan

Cultural Heritage Protection Cooperation Office,

Asia-Pacific Cultural Centre for UNESCO (ACCU)

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Cultural Heritage Protection Cooperation Office,
Asia-Pacific Cultural Centre for UNESCO (ACCU)

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After the opening ceremony, a commemorative picture was taken with ACCU staff

Conservation treatment of wooden objects

Cleaning the metal artefact

Transcription of stratigaraphy in Heijo Palace site

Gilding a frame with gold leaf

Checking the concentration of PEG solution

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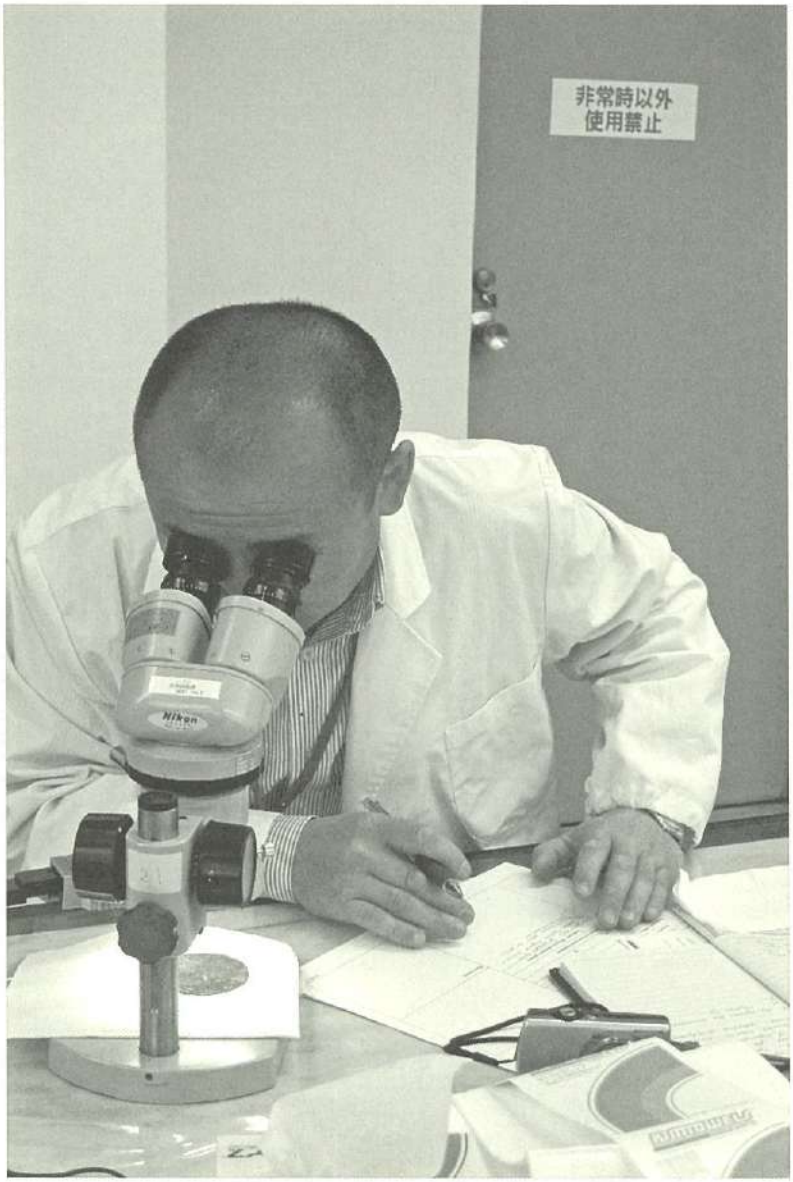

Preface

The Cultural Heritage Protection Cooperation Office, Asia-Pacific Cultural Centre for UNESCO (ACCU) was established in August 1999 with the purpose of serving as a domestic centre for promoting cooperation in cultural heritage protection in the Asia-Pacific region. Subsequent to its establishment, our office has been implementing a variety of programmes to help promote cultural heritage protection activities, in close cooperation with the Agency for Cultural Affairs, Japan (*Bunkacho*); National Institutes for Cultural Heritage, National Research Institute for Cultural Properties, Tokyo and Nara; the Nara Prefectural Government; the Nara Municipal Government; universities; and museums.

The ACCU Nara's activities include, training programmes for the human resources development; international conferences and symposia; the training of young leaders in cultural heritage protection supported by the United Nations University based on Japanese contribution to UNESCO; the website for the dissemination of information relating to cultural heritage protection; and the world heritage lectures in local high schools. In addition to those, ACCU Nara Office offers "Local Training Workshop" which dispatches a group of lecturers from Japan and implements the practical training on cultural heritage protection on sites. Besides, we appoint "International Correspondents" from each country for the purpose of establishing closer ties with the countries in the Asia-Pacific region, who periodically send latest reports on cultural heritage protection in their country.

Our office has been conducting two types of the training course: for the group and for the individuals. The group training course offers the opportunity to 16 specialists for about one month with two themes on alternate year: "Preservation and Restoration of Wooden Structures" and "Research, Analysis, and Preservation of Archaeological Sites and Remains." Meanwhile, the individual training course is organized for a few researchers from one country on the specific theme according to their requests.

According to the survey conducted by JCIC-Heritage researchers, one of the most urgent issues currently facing Mongolia is a shortage of trained experts for cultural heritage protection, and therefore we have decided to invite three researchers into the Individual Training Course 2009 for providing them with basic and practical techniques on conservation science for wooden and metal artefacts. They belong to the Restoration and

Conservation Division, Cultural Heritage Center of Mongolia, being engaged in restoration/conservation of wooden objects and painting. In addition to practical training, this programme is also organised so as to provide them with opportunities to observe as many restored painting works on wooden structures as possible. They saw with their own eyes how the painting restoration was conducted and managed in Japan. It is hoped that their acquired knowledge and experience will contribute to heritage protection activities back in Mongolia.

Finally, we would like to express our sincere appreciation to Agency for Cultural Affairs, Japan (*Bunkacho*); Nara National Research Institute for Cultural Properties; National Research Institute for Cultural Properties, Tokyo; Nikko Cultural Assets Association for the Preservation of Shrines and Temples; Colour Planning Ltd.; and Azuchi Castle Archaeological Museum for their cooperation and support.

NISHIMURA Yasushi
Director
The Cultural Heritage Protection Cooperation Office,
Asia-Pacific Cultural Centre for UNESCO (ACCU)

I . Introduction

1. General Information
2. Programme Schedule

1. General Information

Training Course on Cultural Heritage Protection in Asia and the Pacific 2009 - Mongolia -

(17 November - 17 December 2009, Nara)

1. Organisers

The course is jointly organised by *Bunkacho* (Agency for Cultural Affairs, Japan); Asia-Pacific Cultural Centre for UNESCO (ACCU); and the National Institutes for Cultural Heritage, National Research Institute for Cultural Properties, Tokyo and Nara.

2. Background

The democratisation of Mongolia in 1990 enabled Japanese researchers to continuously participate in archaeological and historical survey in the country. It was gradually revealed through these projects that Mongolia also expected Japanese aid in the field of cultural heritage protection. Accordingly, to explore the feasibility of implementing sustainable and comprehensive international cooperation in the sphere of cultural heritage protection, researchers from JCIC-Heritage (Japan Consortium for International Cooperation in Cultural Heritage) carried out survey in Mongolia as part of its project in 2008. They reorganised and analyzed various challenges currently facing Mongolia in the report and revealed that one of the most serious issues was a shortage of heritage professionals on protection. Related parties in Mongolia expressed high expectation for Japanese support and cooperation in human resource development.

ACCU Nara has just begun accepting nomination by the members of JCIC-Heritage for annual "Group Training Course", and considered the possibility of promoting cooperation with them to the "Individual Training Course" in order to make the best use of their research result. Consequently, the organisers have decided to invite three promising researchers from Mongolia to the above mentioned training course, being highly beneficial to the protection of cultural heritage in the country.

3. Date and Venues

Date: 17 November (Tue.) to 17 December (Thur.) 2009. [31 days]

Venues: Cultural Heritage Protection Cooperation Office, ACCU (ACCU Nara); Facilities and museums of cooperating organisations, etc. Please refer to "Individual Training Course Schedule 2009" for each venue.

4. Objectives

A sequence of the individual training course aims at mainly providing participants with the opportunity to acquire basic knowledge and practical techniques on preservation and restoration of cultural properties such as wooden and metal objects.

5. Training Curriculum

- Introduction to Conservation Science of Cultural Properties: Basic Knowledge on Conservation Science and Conservation Treatment
- Condition Survey and Recording/Documentation of Cultural Properties: Wooden and Metal Objects
- Practical Training on Preservation and Restoration of Cultural Properties: Wooden and Metal Objects
- Methods for Survey, Preservation, and Restoration of Painting on Cultural Properties

6. Participants

SAMDAN Chinzorig (Mr)

Chief Conservator, Restoration and Conservation Division, Cultural Heritage Center of Mongolia
Date of Birth: 23 October 1973 (Age 35)

SUKHBAATAR Davaadari (Mr)

Conservator, Restoration and Conservation Division, Cultural Heritage Center of Mongolia
Date of Birth: 21 July 1980 (Age 29)

DAVGADORJ Nyamdorj (Mr)

Conservator, Restoration and Conservation Division, Cultural Heritage Center of Mongolia
Date of Birth: 9 April 1984 (Age 25)

7. Process of Invitation

Mr G. Enkhbat, Director of the Cultural Heritage Center of Mongolia, recommended three applicants suitable for the above mentioned invitation programme as participants. Then ACCU Nara Office has determined to invite three applicants as participants through close examination.

8. Others (Past achievement to accept participants)

Since 2000 when the above-mentioned invitation programme started, thirty-five participants from thirteen countries have been accepted. This is the first time to invite participants from Mongolia.

9. Certificate

Each participant will be awarded a certificate upon the completion of the course.

10. Language

Mongolian is the main working language of the course.

11. Expenses

Expenses for the training course will be borne by ACCU and comprise the following:

(1) Travel expenses:

Each participant will be provided an economy-class return air ticket between the international airport nearest to their residence and Kansai International Airport, and domestic transportation costs to and from the airports and between the training venues in Japan.

(2) Living expenses:

Participants will be provided daily subsistence allowances during the training course, beginning from 17 November (Tue.) to 17 December (Thur.) 2009. Arrangements for accommodations will be made by ACCU Nara.

12. Secretariat

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Asia-Pacific Cultural Centre for UNESCO (ACCU Nara)
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2. Programme Schedule

Date			Schedule		Lecturer (Venue)
November	17	Tue.	Opening Ceremony	Orientation to the Programme	(ACCU Nara)
	18	Wed.	Introduction to Conservation Science for Cultural Properties		(NNRICP)
	19	Thur.	Practical Training: Preservation/Restoration of Wooden Objects		(NNRICP)
	20	Fri.	Practical Training: Preservation/Restoration of Wooden Objects		
	21	Sat.			
	22	Sun.			
	23	Mon.	On-site Lecture: Historic Monuments of Ancient Nara (World Heritage site)		(Nara City)
	24	Tue.	Practical Training: Preservation/Restoration of Wooden Objects		(NNRICP)
	25	Wed.	Practical Training: Preservation/Restoration of Wooden Objects		
	26	Thur.	Practical Training: Preservation/Restoration of Wooden Objects		
	27	Fri.	Practical Training: Preservation/Restoration of Wooden Objects		
	28	Sat.			
	29	Sun.			
	30	Mon.	*[Travel from Nara to Tokyo]*		
December	1	Tue.	Survey on Painting of Wooden Structures for Preservation/Restoration		(NRICPT)
	2	Wed.	Survey on Painting of Wooden Structures for Preservation/Restoration		
	3	Thur.	On-site Lecture: Painting Restoration of Wooden Structures in Practice		(Nikko Association)
	4	Fri.	On-site Lecture: Painting Restoration of Wooden Structures in Practice		
	5	Sat.	*[Travel from Nikko to Nara]*		
	6	Sun.			
	7	Mon.	Practical Training: Preservation/Restoration of Metal Objects		(NNRICP)
	8	Tue.	Practical Training: Preservation/Restoration of Metal Objects		(NNRICP)
	9	Wed.	Practical Training: Preservation/Restoration of Metal Objects		(NNRICP)
	10	Thur.	Practical Training: Preservation/Restoration of Metal Objects		(NNRICP)
	11	Fri.	Practical Training: Preservation/Restoration of Metal Objects		(NNRICP)
	12	Sat.			
	13	Sun.			
	14	Mon.	On-site Lecture: Practical Survey for Painting Restoration of Cultural Properties		(Saishiki Sekkei Corp.)
	15	Tue.	On-site Lecture: Restoration of Museum Collections in Practice		(Azuchi Castle Archaeological Museum)
	16	Wed.	Writing Final Reports		(ACCU Nara)
	17	Thur.	Submission of Final Reports / Closing Ceremony		(ACCU Nara)

ACCU Nara: Cultural Heritage Protection Cooperation Office, Asia-Pacific Cultural Centre for UNESCO

NNRICP: Nara National Research Institute for Cultural Properties

NRICPT: National Research Institute for Cultural Properties, Tokyo

Nikko Association: Nikko Cultural Assets Association for the Preservation of Shrines and Temples

II. Summary of Lectures

Summary of Lectures

17 Nov. (Tue.)

■ **Opening Ceremony**

The opening ceremony was held at ACCU Nara Office. Three participants from Mongolia, Mr Samdan Chinzorig, Mr Sukhbaatar Davaadari and Mr Davgadorj Nyamdorj, had an orientation on the training schedule.

18 Nov. (Wed.)

■ **Introduction to Conservation Science for Cultural Properties** <TAMURA Tomomi and KUNITAKE Sadakatsu / NNRICP>

- A courtesy visit to the Director General and a facility tour of the Nara National Research Institute for Cultural Properties (NNRICP)
- An introduction of conservation treatment for wooden and metal artefacts in general: a PEG (polyethylene glycol) method and a freeze-drying method applied to wooden tablets (*mokkan*) and fans.
- After having explanations of two representative earthenware unearthed from Heijo Palace sites, *Haji* ware (low fired brown pottery) and *Sue* ware (unglazed stoneware), participants observed the measured drawings of them.
- They also observed how wooden tablets were freeze-dried in the laboratory; microscopes and other equipment at the Conservation Analytical Laboratory; and CT and freeze-drying equipment at the third storage.

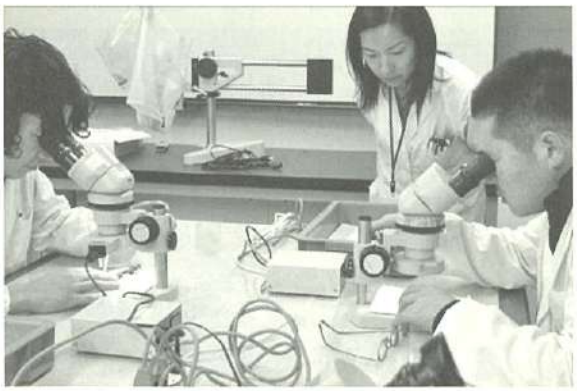
For the practical training, they made wood samples for conservation treatment for the next day.

19 Nov. (Thur.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

- A lecture on conservation treatment of inorganic and

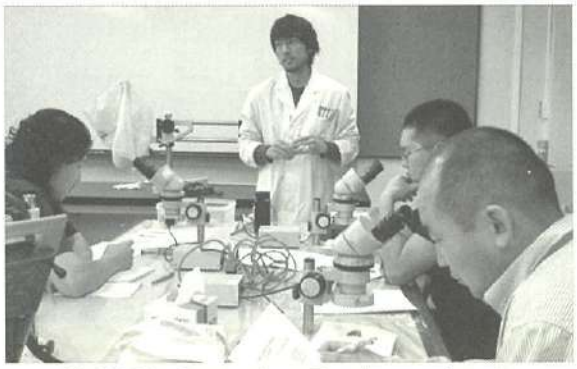
Toured the NNRICP



A lecture by Ms Tamura

Recording the metal artefacts by digital camera

Observing the metal artefacts



Mr Wakiya lectured on Evan's experiments

Changing a concentration of solutions

- organic archaeological materials
- Each participant took photographs of metal artefacts and observed surfaces under the stereoscopic microscope.
- They measured wooden samples across woodcuts and along grains and took photographs to see how much they would shrink when dried without any conservation treatment.
- Preparation of three solutions to compare the differences in conservation treatment for wooden objects:
  - 10 % PEG solution
  - 50 % methyl alcohol solution
  - 50 % tBA (tertiary Butyl alcohol) solution
- Wood pieces were measured and then soaked in each solution.
- They also observed how chemical agents sublimating in freeze-drying treatment

20 Nov. (Fri.)

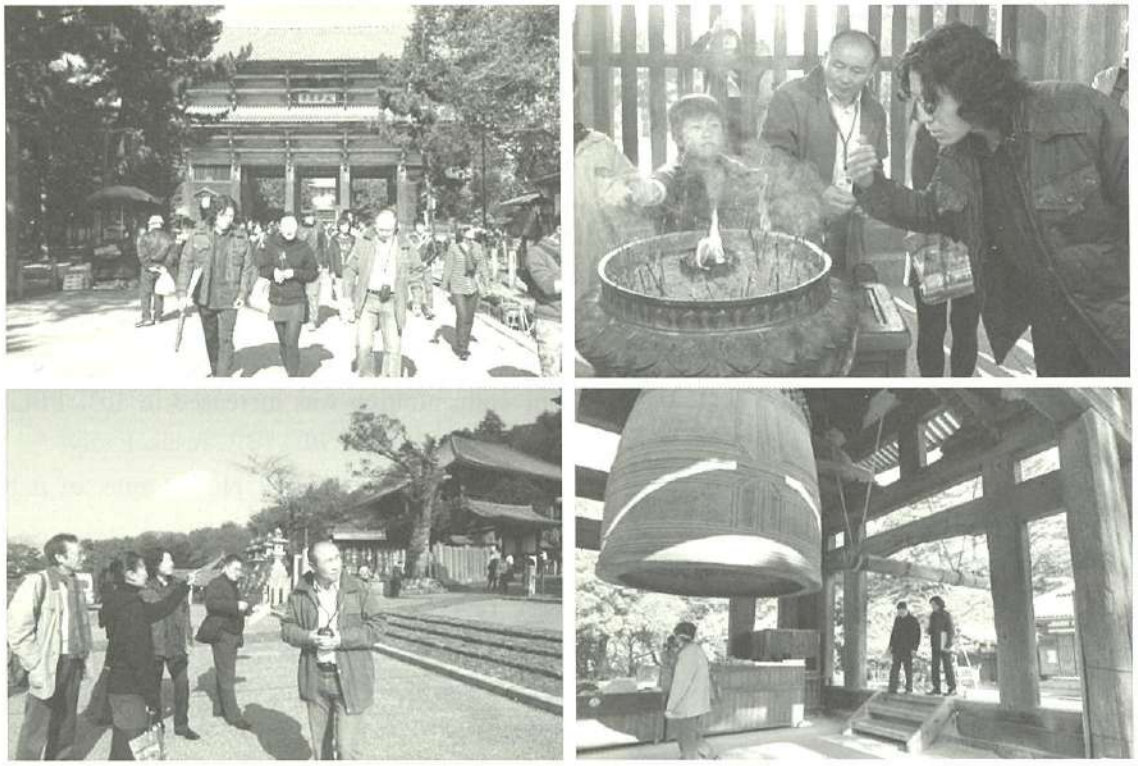
■ **Practical Training: Conservation of Wooden and Metal Objects** <WAKIYA Soichiro and TAMURA Tomomi / NNRICP>

- After performing Evan's experiments (experiments in mechanism of iron rust generation) and observed the corrosion, participants had a lecture on the principle of Evan's experiment.
- A lecture on the general principles and qualities of X-ray
- In order to understand how changes in electric current and voltage affect X-rays, they radiated X-ray on two sets of samples, iron and copper of varying thickness, and aluminium, iron, copper, tin, silver and lead of varying thicknesses, at various irradiation times, and compared X-ray photographs.
- The concentration of solution was increased to 20% PEG, 70% methyl alcohol and 70% tBA, respectively
- They measured and took photographs of naturally dried wood samples.

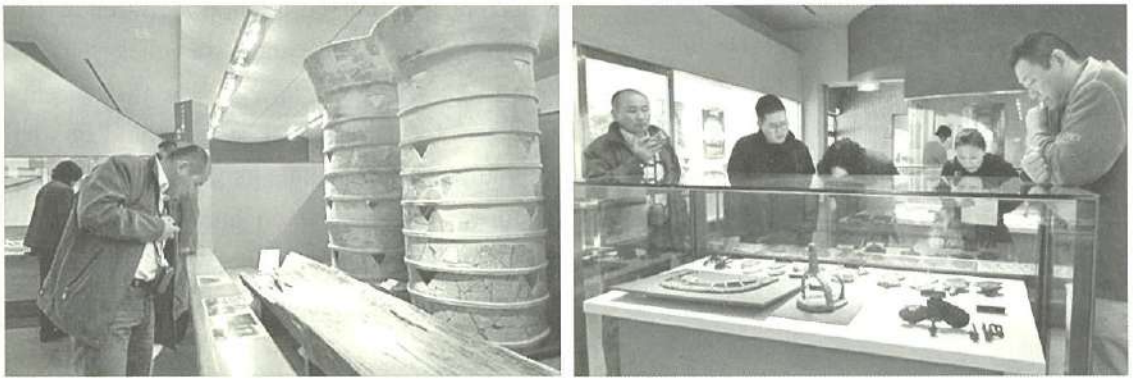
23 Nov. (Mon.)

■ **On-site Lecture: Historic Monuments of Ancient Nara (World Heritage)** <NAKAI Isao and KINOSHITA Wataru / Nara City>

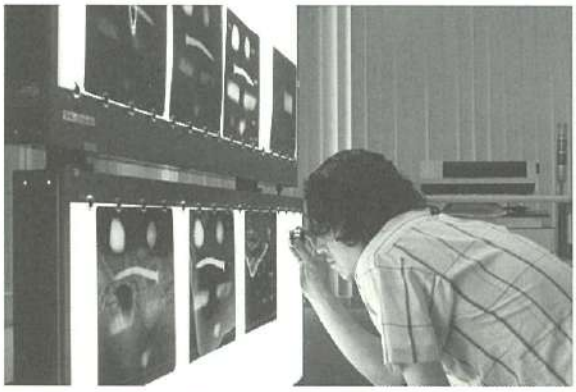
- The religion, history and architecture of Todai-ji Temple: Nandai-mon Gate, Great Buddha Hall and Nigatsu-do Hall
- An on-site lecture was given at the Museum, Archaeological Institute of Kashihara, Nara Prefecture, on bronze bell, *dotaku*, from the Yayoi period (ca. 350 BC to AD 300) displayed at the special autumn exhibit and other artefacts in the permanent collection.



Observing *Todai-ji* temple in Nara



Observing the Museum, Archaeological Institute of Kashihara, Nara Prefecture



Taking X-ray photographs of metal objects

A lecture on the theory of fluorescent X-ray analyzer

24 Nov. (Tue.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

- Participants took X-ray photographs of artefacts under identical conditions using three types of films, IX-80, IX-100 and FR, and observed the differences resulting from film properties.
- They then took more photographs of artefacts based on experience of the first by selecting more effective shooting conditions.
- Information obtained from observation of cracks, fused clay and iron, and other attributes, would be used for cleaning artefacts.
- A lecture on characteristics and principles of WDX (wavelength dispersive spectrometry) and EDX (energy dispersive spectrometry)
- The concentration was increased to 30% PEG, 90% methyl alcohol and 90% tBA, respectively
- They measured and took photographs of naturally dried wood samples.

25 Nov. (Wed.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

- A lecture on the theory of fluorescent X-ray analyzers and the correlation between each metal (iron, copper, tin, etc.) and X-ray energy.
- Practical training on how to use fluorescent X-ray analyzers by using metal samples and on analytical techniques of thin metals like a piece of gold leaf.
- Lectures and practice on analytical techniques for glass and mural pigments, as well as the relationship between colours and ores while analyzing material samples.
- The PEG solution was changed and vacuum freeze-dried wooden tablets were checked.
- Having a lecture on how to clean metal artefacts

with tools and equipment, they cleaned bronze and iron objects.

26 Nov. (Thur.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

- A lecture on desalination and stabilization treatment for bronze artefacts after cleaning
- A lecture on the importance of judgement whether desalination is needed or not, applicable to each artefact while observing and examining artefacts as samples
- Participants practiced desalination treatment to bronze artefacts after the cleaning.

27 Nov. (Fri.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <WAKIYA Soichiro and TAMURA Tomomi / NNRICP>

Conservation treatment of iron object was continued:

- Solution for desalination: benzotriazole (BTA) and sodium tetraborate
- A lecture on how to use high temperature and high pressure desalination equipment and practice
- Microscopic observation of corrosion on the iron artefacts and its mechanical cleaning
- A lesson on how the corrosion was generated and appropriate treatment applied to each type
- They practiced desalination treatment to bronze objects and changed impregnation solution for wood samples.

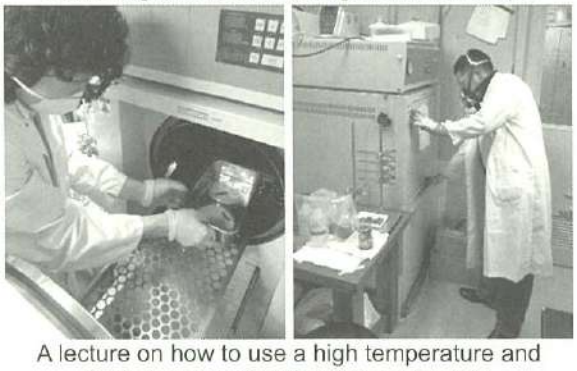
1 Dec. (Tue.)

■ **Survey on Painting of Wooden Structures for Preservation/Restoration** <KITANO Nobuhiko / NRICPT>

Participants paid courtesy visits to Mr SHIMIZU Shin-ich, Director of the Japan Center for International Cooperation in Conservation; and Mr SUZUKI Norio,

Practicing desalination treatment to bronze artefacts

Observing a corrosion through the microscope



A lecture on how to use a high temperature and high pressure desalination equipment

A facility tour of NRICPT

Observing and analyzing the pigments

Director General of the National Research Institute for Cultural Properties, Tokyo (NRICPT)

- A facility tour of NRICPT with explanations of its organisation, roles and activities
  - Japan Center for International Cooperation in Conservation (Mr Okada)
  - Analytical Science Section, Center for Conservation Science and Restoration Techniques (Mr Hayakawa)
  - Technical Standard Section, Center for Conservation Science and Restoration Techniques (Mr Kitano)
  - Libraries, Archives Section, Department of Research Programming (Mr Tsuda)
  - Performing Arts Studio, Audio-Visual Documentation Section, Department of Intangible Cultural Heritage. (Mr Ijima)
- Mr Kitano lectured on "Investigation for the Conservation and Restoration of Paintings on Structures" and on the flow of restoration processes under the title of "Preservation and Restoration of Artefacts and Folk Cultural Properties".
- Participants verified the differences between analysis data obtained from two types of fluorescent X-ray analyzers (in air and under vacuum) by analysing pigments from the Itsukushima-jinja Shrine in Hiroshima; painting of original structural members of Toshogu Shrine in Nikko, Tochigi Pref.; pigments of a Japanese drum; and the pigments of transom at the main hall of Zenpuku-ji Temple.
- By taking X-ray photographs of the transom from Zenpuku-ji Temple, they observed traces of nails and insect damage.

2 Dec. (Wed.)

■ **Survey on Painting of Wooden Structures for Preservation/Restoration** <KITANO Nobuhiko and TAKAYAMA Masaru / Minato City Local History Museum >

- Participants carefully observed two ceiling paintings of Zojo-ji Temple at the Minato City Local History Museum while having a lecture on the history of Zojo-ji Temple and analytical results of two paintings.
- An on-site lecture at the main hall of Zenpuku-ji Temple: its history and colouring restoration principles
- At NRICPT, they closely observed the fragments of the transom from Zenpuku-ji Temple.
- Mr Kitano pointed out the existence of painting underneath the gilded surface and emphasized the importance of careful and multiple observations.
- They were also introduced to the analytical equipment in the laboratory used for organic materials such as oil, pine resin, and Japanese lacquer (*urushi*); and observed the fragments with microscopes.
- A museum visit: *Heiseikan* (Japanese Archaeology) and *Honkan* (Japanese Gallery) in the Tokyo National Museum

Observing ceiling paintings of Zojo-ji temple

Observing the main hall of Zenpuku-ji temple

Observing the fragments of the transom from Zenpuku-ji temple

Mr Sawada lectured on the painting technique

3 Dec. (Thur.)

■ **On-site Lecture: Painting Restoration of Wooden Structures in Practice** <ASANO Kazutoshi, SAWADA Ryoji and SATO Noritake / Nikko Association>

Training was held at the Nikko Cultural Association for the Preservation of Shrines and Temples.

- Introduction of the Nikko Cultural Association: its organisation, project outlines, an annual budget for restoration, and staff members etc. in addition to an overview of cultural properties in Nikko especially on Toshogu Shrine
- Lacquer and painting techniques applied to wooden structures were explained while showing various painting on wood.
- The painting restoration guidelines would be different whether the part was inside or outside of

Observing the gilding technique

Each practiced applying pieces of gold leaf.

Observing the lacquer worksite

A group photo in front of Rinno-ji Temple

the building.

- A lecture with demonstration on two gilding techniques on decorative metal fittings in Japanese architecture: one is with mercury and the other is with lacquer.
- Each practiced applying pieces of gold leaf to lacquered wood.
- Traditional wood joint techniques used in Japan were explained.

4 Dec. (Fri.)

■ **On-site Lecture: Painting Restoration of Wooden Structures in Practice** <ASANO Kazutoshi, SAWADA Ryoji and SATO Noritake / Nikko Association>

Training was continued at the Nikko Cultural Association for the Preservation of Shrines and Temples.

- A lecture on painting processes and observation of the procedures at the painting workshop in the office
- Site visits of Rinno-ji Temple, Futarasan-jinja Shrine and Toshogu Shrine of Nikko, the World Heritage
  - Shin-kyo, or the sacred bridge (Important Cultural Property): its legend, construction method, restoration efforts.
  - The main shrine, the three-tier pagoda, *Kannon* hall and *Sanbutsudo* Hall of Rinno-ji Temple: characteristics of each building, restoration guidelines for wood members, painting and lacquering techniques.
  - The front gate, the sacred stable, middle storehouse, *Yomei-mon* gate, the west cloister and the hall of worship at Toshogu Shrine

After that, they toured and observed the lacquer and paint worksites, and had explanations of the characteristics of carvings and patterns, and restoration guidelines of each structure. Lastly, they visited Futarasan-jinja Shrine where they heard explanations of restoration guidelines for the lattice wall (*Sukibei*) and

its colouring.

7 Dec. (Mon.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <KOHDZUMA Yohsei, TAMURA Tomomi and YANAGIDA Akinobu / NNRICP>

- Five major conservation treatment methods for artefacts used in Japan were introduced.
- General explanations of a flow of conservation treatment; the principle of vacuum freeze-drying and its application examples
- Two methods to confirm PEG concentration: one is to weigh the residue after evaporation and the other is to measure the solution with a sugar refractometer.

They increased the concentrations, prepared each solution for the next day and placed wood samples for a freeze-drying method in the vacuum freeze-dryer.

A lecture by Mr Kohdzuma

Excavation techniques for fragile artefacts

8 Dec. (Tue.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

The training of taking off the stratum from cross section was practiced at the northern excavation site No. 446 in the Eastern Garden (*Toin*) area of the Heijo Palace sites.

- How to handle chemicals (Tomack NS-10)
- Practical procedures for taking off the stratum

Two excavation techniques for fragile artefacts were demonstrated and practiced.

- Artefacts were extracted from the earth while covered with polyurethane (polyol and isocyanate).
- Artefacts were frozen with liquid nitrogen beforehand and unearched.

The training of taking off the stratum

9 Dec. (Wed.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

Washing off excess soil

A consolidation treatment for the artefacts

Weighing wood blocks in the different solutions

Cleaning the surface of the metal object

Finished conservation treatments

The stripped strata were cleaned and washed off excess soil, and finished for exhibition.

- Consolidation treatment for iron and bronze artefacts with impregnation of resin
- Practical training of a temporal storage technique for wooden objects by using packs

10 Dec. (Thur.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi / NNRICP>

- Soaking water-logged wood blocks into 15% PEG solution and 40% PEG solution, and their changes were compared over time by weighing.
- The surface of a metal object after conservation treatment was cleaned with a one-to-one mixture of acetone and toluene, and the object was photographed.
- A lecture on characteristics of adhesives widely used in the restoration of artefacts such as Cemedine C, Araldite, epoxy putty and glass fibre. Then, they glued together broken artefacts with those adhesives.
- Wooden samples impregnated with PEG solution were rinsed with hot water, and those in methyl alcohol solution were rinsed with methyl alcohol. Both samples were dried.
- Lastly, they analyzed pigments of murals, brought from Mongolia to reveal the components.

11 Dec. (Fri.)

■ **Practical Training: Conservation of Wooden and Metal Objects** <TAMURA Tomomi and KISHIYAMA Midori / NNRICP>

- Four conservation treatments were finished: Freeze Drying, Higher Alcohol, PEG Impregnation, Natural Drying.
- The wood samples that had been undergoing treatment were weighed, measured and photographed.

- The shrinkage ratio of each wood sample was calculated by being compared to pre-treatment condition.
- Packaging the artefacts after conservation treatment with RP agent for removing oxygen and water.
- Preparation of records of the artifact observations

Packaging the artefacts

14 Dec. (Mon.)

■ **On-site Lecture: Practical Survey for Painting Restoration of Cultural Properties**
<NAKA Masa-aki / Kyoto>

- Lectures on three types of mural reproductions of Yangsan Tongdosa Temple in Korea
  1. Korean faithful reproduction including damage as it is
  2. Japanese reproduction adding with missing parts and restored colours
  3. Taiwanese reproduction with aged colours
- Participants observed the exhibition at Kyoto Saga University of Arts, "The World of Hidden Miniatures from India: Replica Woodblocks of the Taisho Era" with a lecture of differences and key points of Indian miniatures and woodblock print reproductions.
- They also observed the replica painting of Da-shim Temple doors in Taiwan with detailed explanation of that reproduction process and watched students making reproductions: and the painting process of *mandala* paintings from Kongobu-ji Temple of Mt. Koya.

Observing Kyoto Saga University of Arts

■ **On-site Lecture: Practical Survey for Painting Restoration of Cultural Properties**
<ONOMURA Hayato, HISAYASU Keizo, KITAMURA Ryo and KITAYAMA Jun / Saishiki Sekkei Corp.>

- The explanation covered practical processes of colour restoration and two principle techniques for cultural properties
  1. To stop the paintings from falling off with glue

A lecture by Mr Onomura

Observing Saishiki Sekkei Corp.

A facility tour of the museum

Observing Azuchi Castle Archaeological Museum

2. To strip off the paintings with glue and transfer colours to paper for preservation

- Moreover, they observed the relief build-up process for ceiling paintings and compared restoration materials prepared with wood oil, glue and acrylic.
- They observed a new cleaning technique applied to the decorative metal fittings of railings at Hiyoshi-taisha Shrine in Shiga Prefecture, using a special enzyme solution.

15 Dec. (Tue.)

■ **On-site Lecture: Restoration of Museum Collections in Practice** <NAKAGAWA Masato and HAMA Osamu / Shiga Pref.>

- Ms SHIGENO Mitsuko, Director of the Shiga Prefectural Azuchi Castle Archaeological Museum, welcomed the participants and gave an overview of the museum.
- A facility tour of the museum: artefact storage rooms, drafting studios, storehouses, conservation laboratories for wooden artefacts and so on, under the guidance of Mr Nakagawa
- Mr Hama guided them through the permanent and special exhibits, providing explanations along the way.
- An introduction of conservation treatment for wooden artefacts employed at the laboratory with practical examples.

16 Dec. (Wed.)

■ **Writing Final Report**

17 Dec. (Thur.)

■ **Submission of Final Report / Closing Ceremony** < ACCU Nara>

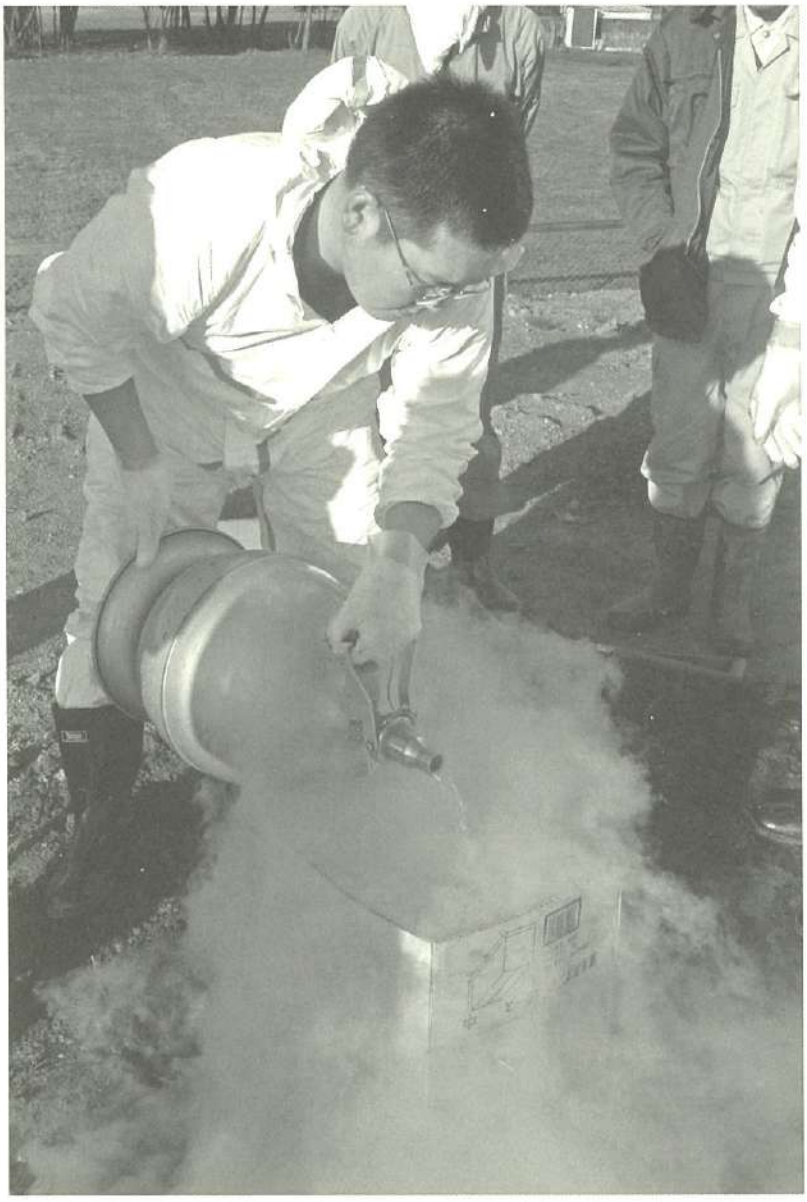
Mr Nishimura, Director of ACCU Nara awarded a certificate of completion to each participant with words of congratulations. He was pleased that all training modules were successfully completed and wished that

participants would utilize what they had acquired in the training course for their work and pass on their knowledge to colleagues in Mongolia. In return, participants expressed the gratitude for ACCU Nara, and wished to promote research exchanges with Japan to protect cultural heritage in Mongolia, although the course had finished.

Mr Nishimura awarded a certificate.

A commemorative photo after the closing ceremony (17 December 2009)

Ⅲ. Participants' Country Reports



Country Report

SAMDAN Chinzorig
Chief Conservator

SUKHBAATAR Davaadari
Conservator

DAVGADORJ Nyamdorj
Conservator
Restoration and Conservation Division
Center of Cultural Heritage

The Current State of Cultural Heritage and its Preservation and Protection in Mongolia by the Center of Cultural Heritage

I. Introduction to the activities of the Center of Cultural Heritage of Mongolia

The Center of Cultural Heritage of Mongolia was established in 1988 as a laboratory for restoring artefacts exhibited at museums. It was renamed as it is today in 1996 and, since then, has grown as a national institution with activities to protect tangible and intangible cultural properties, to register cultural assets, to develop a capacity of staff working at national and local museums, and to restore cultural properties.

The Center of Cultural Heritage of Mongolia consists of three divisions.

- Tangible Cultural Heritage Registration Division
- Intangible Cultural Heritage Registration Division
- Cultural Heritage Protection and Restoration Division

Cultural Heritage Protection and Restoration Division:
The Cultural Heritage Protection and Restoration Division preserves, protects and restores artefacts exhibited at national and local museums, and tangible cultural properties of historical or cultural importance.

The division mainly has six responsibilities and is currently staffed by eight restoration specialists.

- Restoration of paintings
- Restoration of textiles and fabrics
- Restoration of metal objects
- Restoration of wooden objects
- Restoration of sculptures and carvings

- Restoration of archaeological sites

In regards to the restoration of cultural heritages, restoration work has been centered on early ethnic and religious artefacts, modern artworks, and the methods and techniques used to make them. The policy of future restoration work is to research technologies used at the time the cultural heritage was made and chemically research concerned materials, then, based on those findings; employ a combination of traditional and modern technologies and equipment to restore them. As of recent, there are plans to build facilities for restoration work, to install latest research equipment and develop human resources to run it.

II. Current State of Historical and Cultural Properties

1. Ancient Stone Statues

For thousands of years, a nomadic lifestyle has predominated in Central Asia due to the fierce climate and environment. Because of this, the nomadic peoples have left very few tangible cultural properties and historical records. One type of cultural property that has survived the harsh climate and various historical crises today are stone statues. Many types of statues associated with the numerous branches of our history remain at present, but we have not yet registered each of them and catalogued them on a unified list.

The following types of stone statues can be found in Mongolia.

- Statues of deer
- Stone figures of people
- Stone inscriptions
- Pedestals
- Statues of animals
- Fences
- *Zel* stone

Zel stone

The oldest of the above stone monuments are the deer statues, with some dating back to the late Bronze Age into the Early Iron Age. They stand on the southern end of the ancient burial mounds that intern the dead, in Mongolia's grasslands, forests and mountains. Currently, about 600 deer statues have been researched and registered.

The majority of the aristocratic burial mounds from the Turkic Period are in Mongolia. A mixture of stone figures of people, stone inscriptions, statue pedestals and *Zel* stones exists from the 7th to 8th centuries. Depending on the social status and personal wealth of individuals, the number of stone figures on the old burial mound changes from one to dozens. So far, about 500 stone figures have been discovered, registered and researched in Mongolia. The inscription on the stone monument of the Turkic and Uyghur Periods bears traditional wisdom of the nomadic peoples of the land, and are of

high historical value. The stone figures were made of good quality stones that could survive the brutalities of Mother Nature such as granite or marble. However, most of the stone figures that have survived till today have not been restored nor protected even once, and the damage has sometimes been caused by human factors and the natural environment.

Damage by the natural environment

- Sudden or seasonal temperature changes in the year (40 °C to -40°C)
- Exposure to the elements (snow, rain, hail, wind, storms, floods, thunder, etc.)
- Industrial pollution (carbon-dioxide emissions)
- Biological factors (fungi, insects, bird droppings, dog urine, etc.)

Damage by man-made and social factors

- Removal for religious purposes (Falling and decapitation of stone figures, coating in oil, wrapping in cloth, relocation, looting to religious sites)
- Graffiti, date inscriptions
- Breaking of hands, feet and heads of statues, shooting with guns, and other damage
- Digging around sites or setting fire by local people
- Moving statues from one place to another without permission
- Destruction of sites for construction of mines, roads or other infrastructure works
- Use of stone monuments as foundations for construction
- Coating in oil or ink for transfer to paper or silicon in the research process and marking for measurement purposes

2. Sites of Old Cities, Temples and Buildings

In Mongolia, the urban sites of nomadic tribes are different from those of settled people who lived in the city for extended periods of time and stably developed. There remains little information about the nomadic urban sites. For this reason, various problems are encountered in researching settlement sites of nomadic Mongolians such as the urban planning of nomads, building design, changes in decoration, production capacity of the past, roles in international relations, etc.

The urban sites discovered in Mongolia can be divided into four categories: military, governmental, commercial and religious functions. There are also those that combine all of these functions to the degree of being called a capital, i.e., Khar Balgas capital of Uyghur, Khar Khorum capital of the Mongolian Kingdom, Avargiin Balgas, etc. After centuries of harsh climates, exposure to the elements and conflicts amongst the peoples of the Central Asia, only debris remains of these ancient capitals.

The current state of Buddhist monasteries:

Buddhism was accepted in Mongolia in 1577 and the Erdene Zuu Monastery was built in 1586, when Buddhist architecture is believed to have begun in Mongolia. Monasteries and temples were increasingly built from that time. Historical records indicate that, around 1930, there were about 4,000 temples and 700 monasteries. However, because of misguided policies implemented in the early 20th century, an innumerable amount of historical and cultural properties of Mongolia and several hundred temples were destroyed and the technology used to build them was threatened with being completely forgotten.

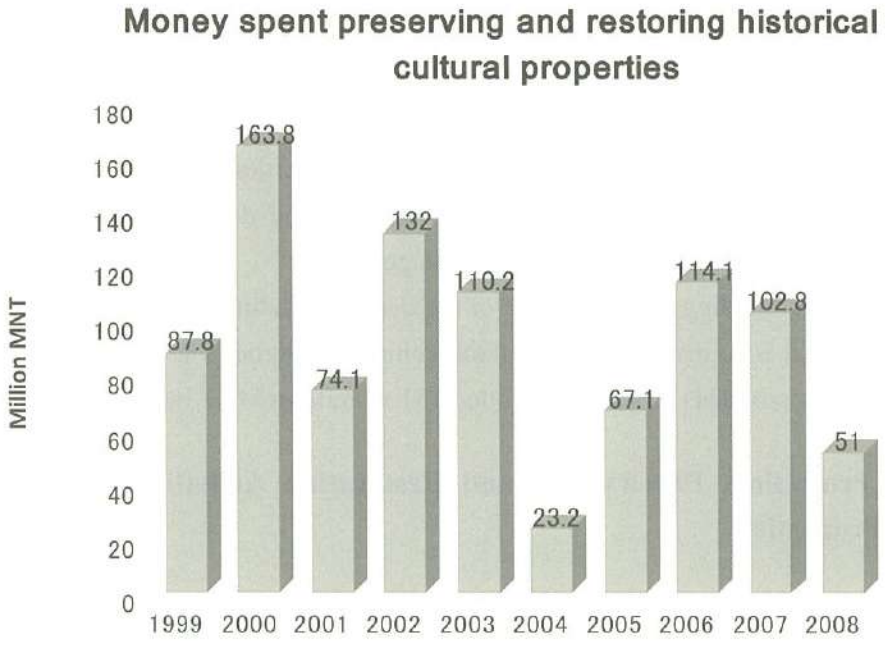
In 1973, an institute was founded to restore historical and cultural properties with national financial funds and a group of experts took steps to restore, protect and manage temples and monasteries. The social structure changed in 1990 with Mongolia becoming a democratic country. Along with democratization, a lack of funding hampers the conservation activities to protect and restore historical and cultural properties.

At present, restoration work on temples and monasteries is outsourced to private construction companies, but they have little knowledge and experience in restoration work. As a result, they use materials of poor quality and lack the skill to handle traditional construction methods. The Mongolian Ministry of Education, Culture and Science has adopted a policy of outsourcing this restoration work to the institutes specialized in the restoration of interiors and exteriors of temples and monasteries. Conservators of the Center of Cultural Heritage started the necessary research alongside.

III. Protection, Preservation and Restoration of Cultural Properties

To protect cultural properties continuingly as a part of national policy, the Mongolian government adopted a "Heritage Project" for protecting, preserving and restoring immovable tangible heritage in 1998, which was then implemented from 1999 to 2005.

During this project, 54 temples, monasteries and buildings were restored, damaged stone statues were repaired and, in order to preserve important inscriptions, monuments were moved, reproduction were made and inscriptions were transferred, registered and preserved. The total budget of 6.829 million MNT was spent on this project.



Approx. 1,600 MNT = 100 JPY

Moreover, funds received from international organizations and foreign investors were spent on protecting and restoring Mongolia's historical and cultural properties as follows.

Project	Sponsor	Donation (MNT)
Restoration of Tsogchin Dugana at Bereeven Monastery	USA Cultural Restoration Tourist Project	1.872 million
Restoration of Kulitegin Bilge	Turkish Cooperation and Development Agency (TIKA)	1.54 million
Restoration of 5 gates and square at Bogd Khaan Palace	Chinese government	960,000
Restoration of library at Bogd Khaan Palace and Naidan Monastery	World Monuments Fund (WMF)	1.434 million

In 2007, the Mongolian government renewed the Heritage Project for the second time and plans were drafted for protecting, preserving and restoring historical and cultural properties from 2008 to 2015.

The program includes the following plans:

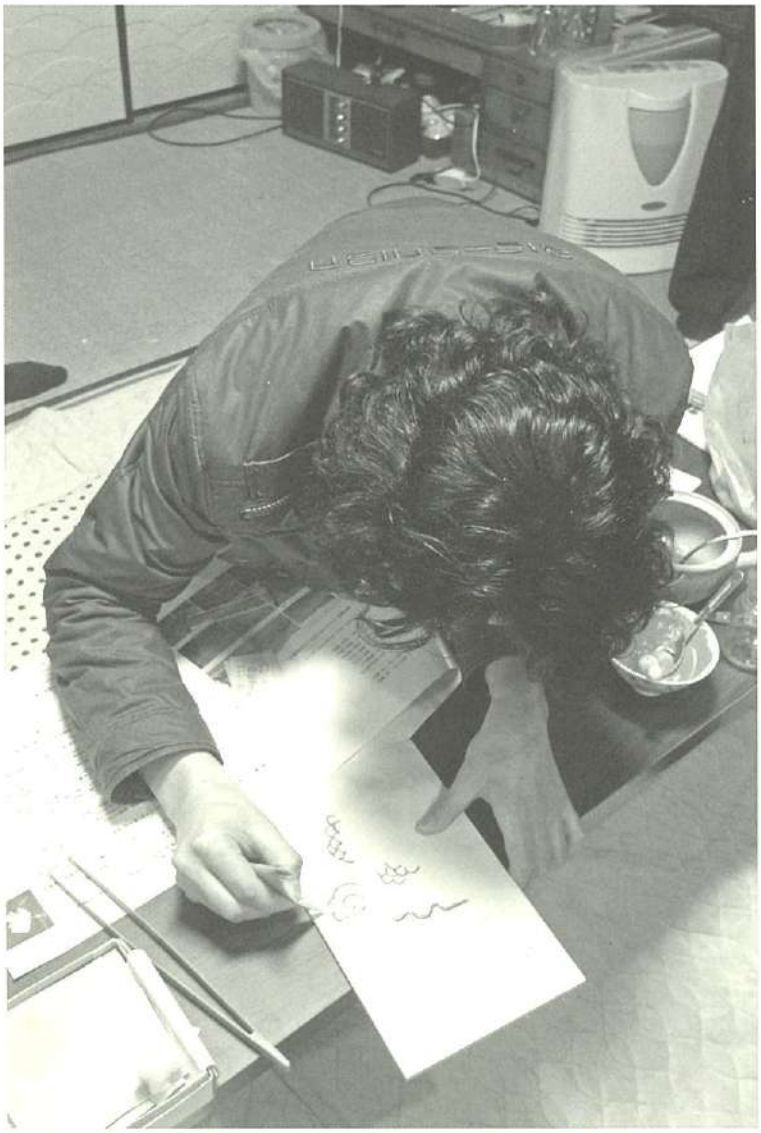
- Restoration of buildings of historical and cultural importance
- Restoration and protection of ancient urban sites and statues

- Reproduction of statues and preservation in national museums
- Relocation of historical and cultural properties threatened by deterioration from current sites to national and provincial libraries for preservation
- Establishment of a dinosaur museum
- Installation of guide signs to historical and cultural properties
- Making of TV programs, commercials, guidebooks and documentaries introducing to all generations on the protection of cultural heritage
- Upgrading the building and equipment of the Center of Cultural Heritage of Mongolia
- The main goal is to manage historical and cultural properties via contracts with individuals and organizations. This project has allotted 131.98 million MNT budget for this.

IV. Issues in Protection, Preservation and Restoration Activities for Historical and Cultural Properties

- The Law on Protecting Cultural Heritage enforced in Mongolia today is recognized as not providing an adequate structure and environment for restoring, repairing, protecting and preserving historical and cultural properties, therefore it must be improved.
- Problems in procuring equipment and materials needed for restoration and conservation treatment must be resolved.
- Calls for cooperation must be made so as to invite foreign experts in large scale cultural property restoration and to learn their research methodology, experiences and technologies.
- Restorers and experts in protection and preservation should be sent to the developed nations for short periods of reeducation.
- It is necessary that Mongolian standards should meet international ones in restoring, repairing, protecting and preserving historical and cultural properties.

IV. Participants' Final Reports

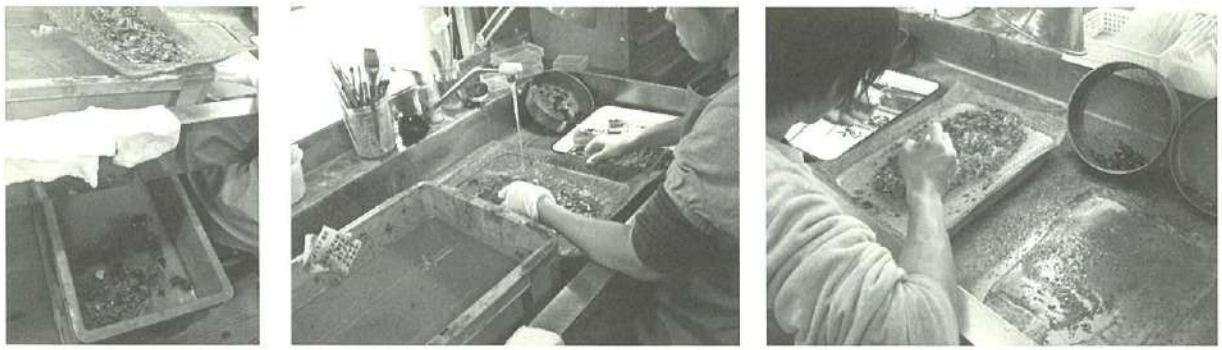


SAMDAN Chinzorig

Mr Yasushi Nishimura, Director of Cultural Heritage Protection Cooperation Office, Asia-Pacific Cultural Centre for UNESCO (ACCU), presented the training objectives, content and flow at the opening of the individual training course. Then, Mr Isao Nakai, Director of the International Cooperation Division, explained the training policy, objectives and flow, and that we would be learning how to scientifically protect and restore cultural heritage. Moreover, he also explained that we would be making a report of the information obtained from this training program and showed us related materials. In the afternoon, we went sightseeing together near our lodgings with Mr Nakai.

Participating in this training program were three restorers from the Division of Cultural Property Protection and Restoration of the Center Cultural Heritage of Mongolia: Chinzorig Samdan, Nyamdorj Davgadorj and Davaadari Sukhbaatar. In Nara where this program was conducted, we visited Nara National Institute for Cultural Properties and we had been trained practically in processes for protecting and restoring cultural properties.

Wooden tablets and metal artefacts subjected to primary treatment.



Showing unearthed soil containing numerous artefact fragments being transported to the institute, and being rinsed with a screen and sorted.

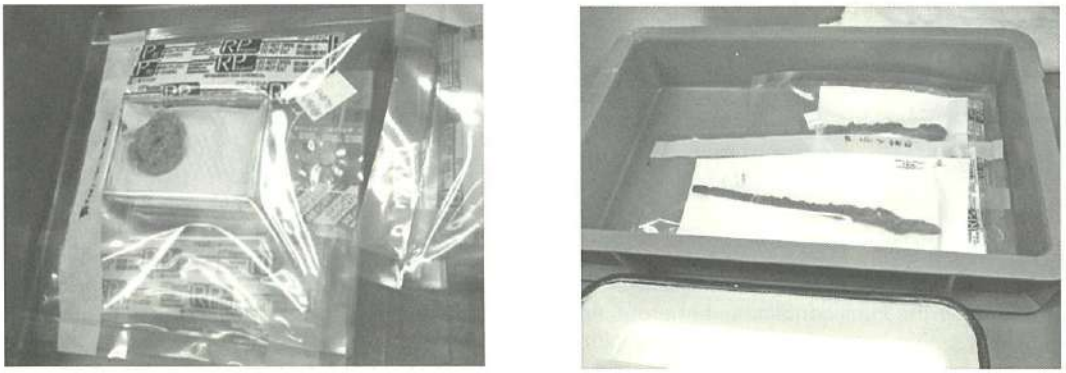
Selecting the important artefacts

Showing the text, pictures, figures and other important elements on the wooden tablets that became visible after washing away the soil, being examined

In Photos, persons in charge of text and pictures are seen reading, measuring and recording text, pictures and figures after being separated.

The text and pictures waiting for preservation treatment in a special solution of 0.1% boric acid and 0.1% Borax

If this waiting period is to be long, the pieces are placed in a bag and stored under vacuum. The solution is then changed from time to time. Some artefacts may be kept in this state for as long as 20 years before being treated for preservation.

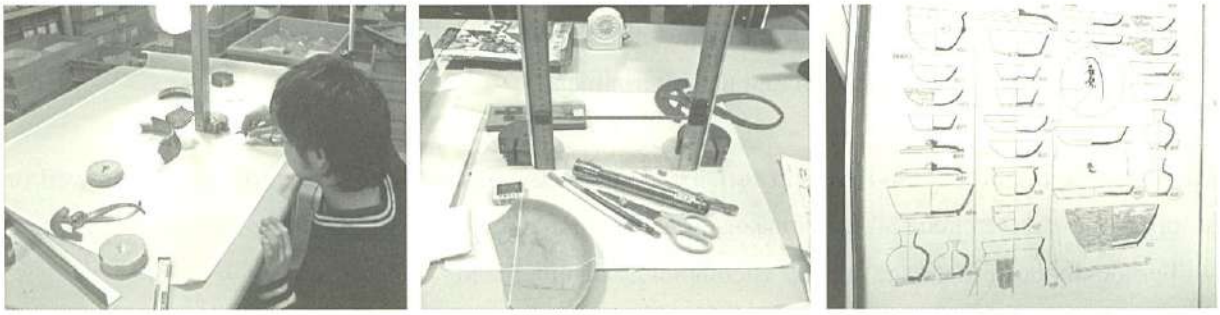


The artefacts have been placed in a vinyl bag and kept under vacuum to seal out humidity and air.

Moreover, a reagent that checks for moisture and air is sealed together in the bag, too. The reagent changes colour if air gets in the bag.

Unearthed ceramic pieces being rinsed and sorted by colour, shape and so forth.

Artefacts that have been temporarily assembled being rechecked and, if everything is correct, bonded together. Holes and dents are filled with plaster, etc.



Reconstructed ceramic works being measured and dimensional drawings of them being made. Before works are measured, analyses are done to identify the original shape so that measurements will be accurate.

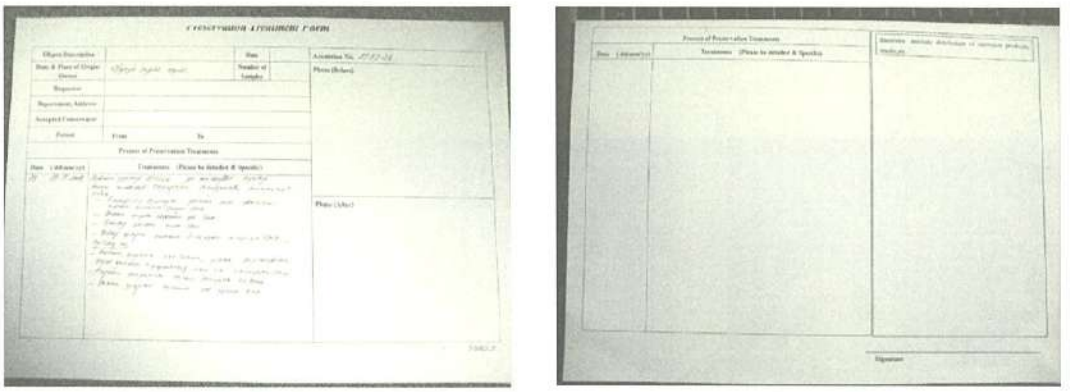
Reconstructed ceramics being affixed with a number by a special machine and registered in a digital system. The works are then moved to a storage place.

In photos, fragments of similar categories being grouped together and temporarily pieced together. The joined pieces are separated again and stored temporarily in a single bag.

Restoration of Metal Artefacts

1. With metal artefacts, the present condition is checked to see how damaged they are and to identify possible causes of the damage.
2. The artefacts are then cleaned, protected and restored.
3. A preservation environment is prepared.

The condition of the artefact is visually observed by the naked eye, then its structure and damage inside and outside are examined by X-ray photography.



A work done everyday is recorded in detail

All metals are found in natural soil in the form of ores. The soil environment can be said the most stable for these metals. It is difficult to unearth metal artefacts just the way they are. Normally, a layer of rust has formed on outside surfaces because of chemical reactions. That surface rust protects the metal. If the metal is exposed by cleaning the surface of the unearthed artefact, the chemical reaction starts again because of humidity, air and the environment.

By preparing the proper environment for storing artefacts, these chemical reactions can be slowed or stopped. Should the chemical reactions occur, the original metal properties will be lost and degradation will gradually occur until the artefact is completely disintegrated.

External Factors

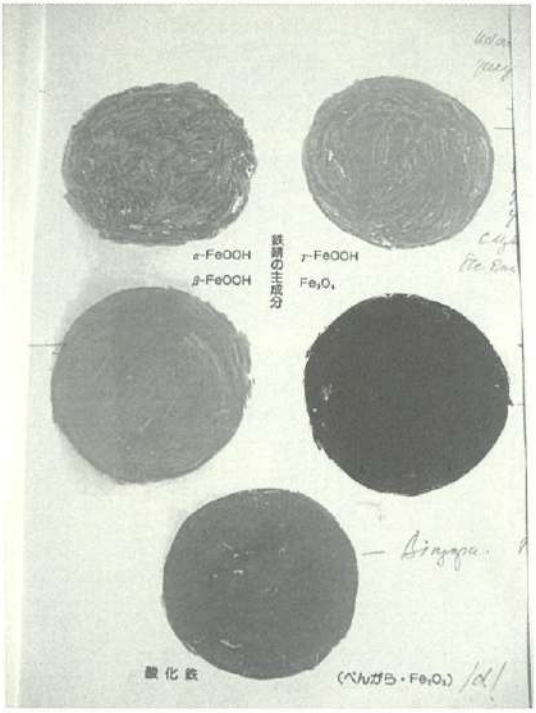
- Water, humidity, air

Internal Factors

- If metals are found underwater or in damp environments, a large amount of chlorine permeates the interior. The chlorine rusts the metal and accelerates its degradation.

To preserve an artefact, these internal destructive factors must be removed and eliminated. Saltwater contains about 3% sodium chloride. If this sodium chloride permeates the metal, the metal may quickly decompose. Compared to other types of rust, that caused by chlorine is of a different colour. In

the initial stage, many tiny pits form. Then, these pits start connecting via white lines. The rust spreads and deepens as these pits connect to one another, until the metal is entirely damaged. Iron artefacts unearthed from digs are cleaned with water, whereas metals like copper are cleaned with alcohol.



The iron rust types

Iron rusts comes in the below types

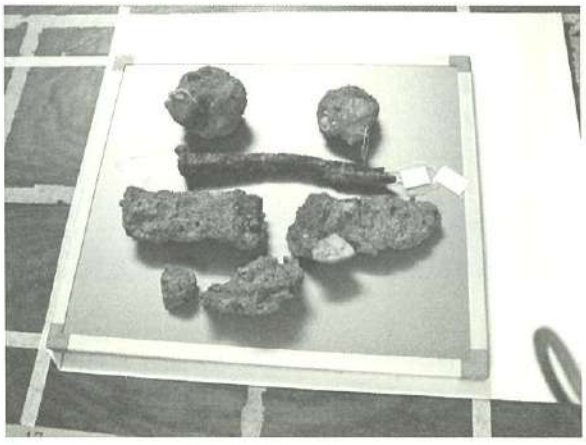
α FeOOH - This type of rust appears on iron surfaces as hard layering rather than a grainy material.

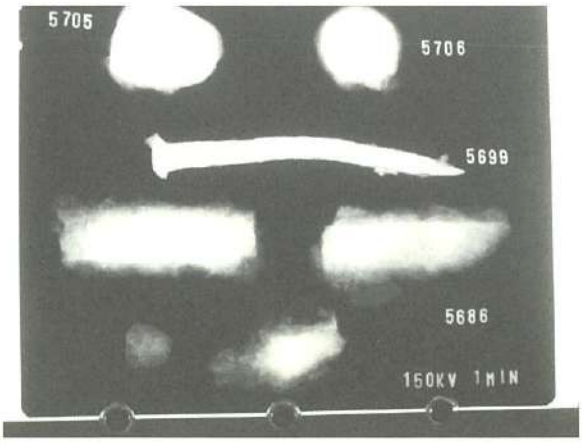
β FeOOH - This type of rust takes on a globular appearance and is filled with liquid. It is yellow in colour.

γ FeOOH - This type of rust readily appears in places like factories, etc. It also appears in environments where SO_4 is found.

Magnetite Fe_3O_4 – This is the safest type of rust. It is either black or reddish black in colour. Iron artefacts are cleaned to this state.

Hematite Fe_2O_3 - This is the main component of iron.

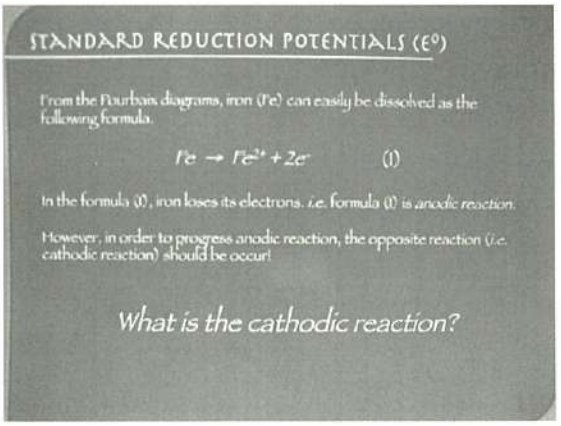


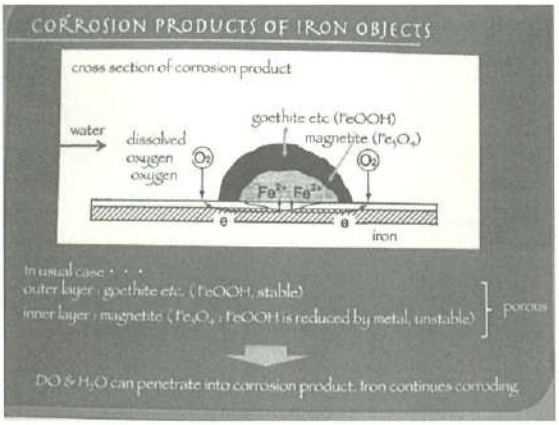


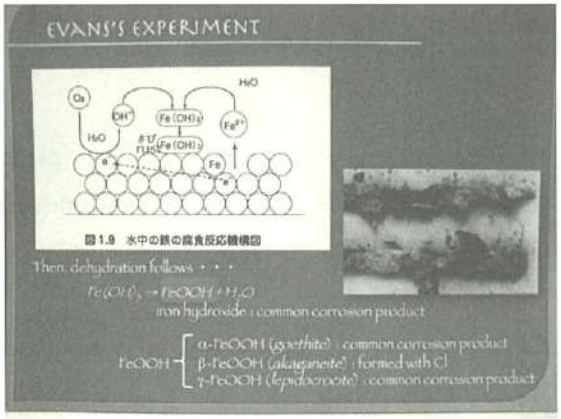
X-ray photos of iron

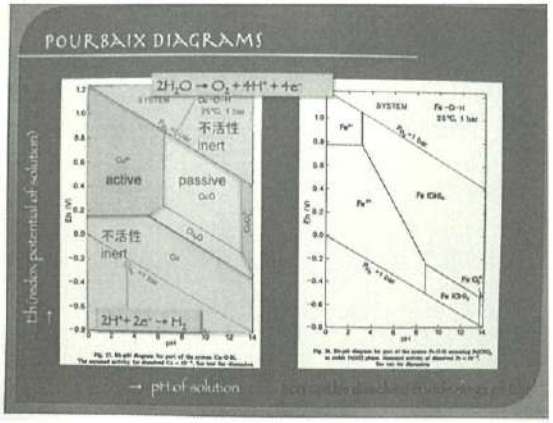
Chemical Process by Which Rust Forms on Iron

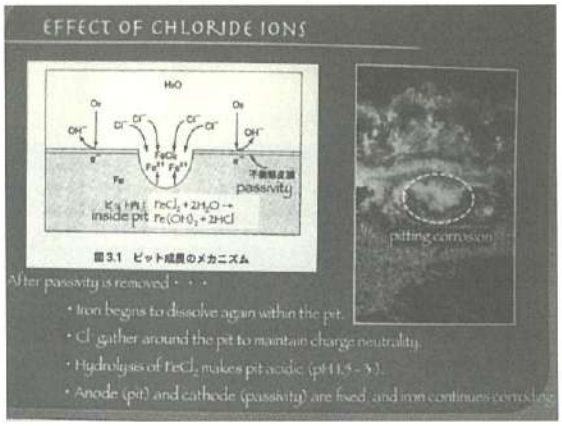
ron produces and receives electricity depending on the environment in which it lies. In the environment where we live, that is to say, an environment with oxygen and hydrogen, iron loses electrons, which speeds up the rust forming process and initiates corrosion. Also, in an environment free of hydrogen and oxygen, iron can lose its electrons. When iron is near to a metal of low charge, it acquires the electrons of the metal, which slows the rust forming process.

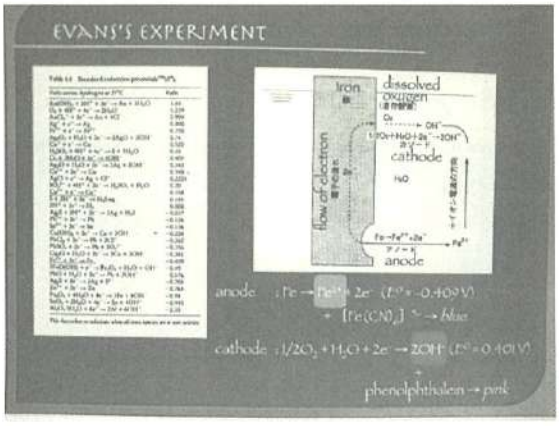






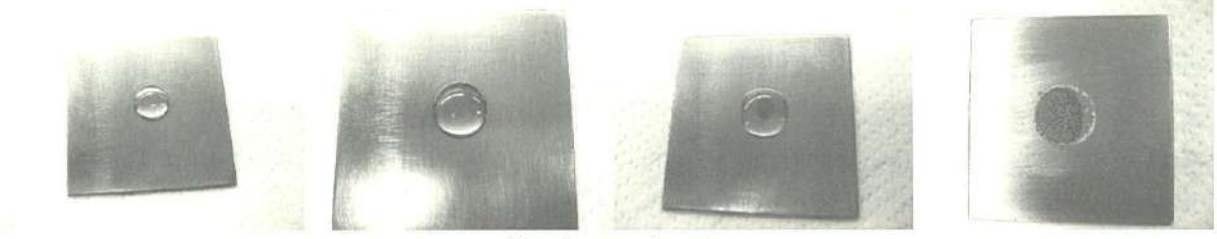






Experiment

Chloride ion (Cl^-) is negatively charged and iron ion (Fe^+) is positively charged. When Fe bonds with Cl, the FeOOH rust formed on the surface of the Fe breaks down and Cl penetrates inside the Fe. In such case, the Fe must be adequately cleaned.



Evan's experiment

Metal products are made in two ways: one is by forging and the other is by casting. About 0.2% of the metal products made by forging are said to be good. That's because the degree to which iron electrons attract to each other varies according to the forging process. The tendency for the electrons to be pulled inward is strong, while the tendency to be pulled outward is weak, therefore the outside electrons are pulled inward, allowing rust to attack from the outside.

In contrast, iron made by casting is about 2 to 6% bumpy on the outside surface. This bumpiness makes the iron readily susceptible to H_2O and O_2, hence accelerating rust propagation. It is better to clean and eliminate this type of rust.

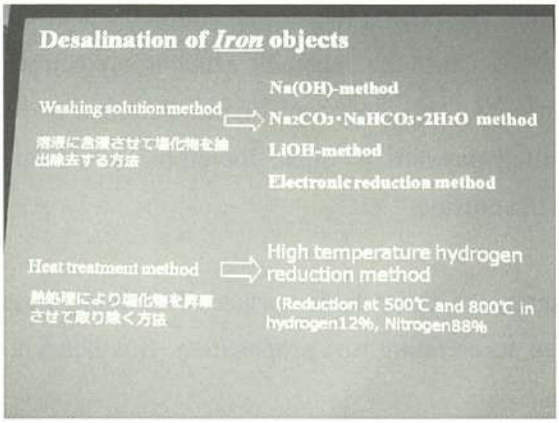
Cleaning of iron artefact by hand

Cleaning of copper artefact by hand

Cleaning of iron rust using the Airbrasive 6500

Meteorite (Good quality iron)

When iron is immersed in liquids 1 and 2, rust stops propagating and starts breaking down. It must be soaked in those liquids for a long period of time, therefore it is necessary to replace the liquids about four times during this process. Chlorides permeate the iron in large quantities, therefore it is necessary to clean iron with water. However, cleaning with water has one setback in that water causes new rust to form.



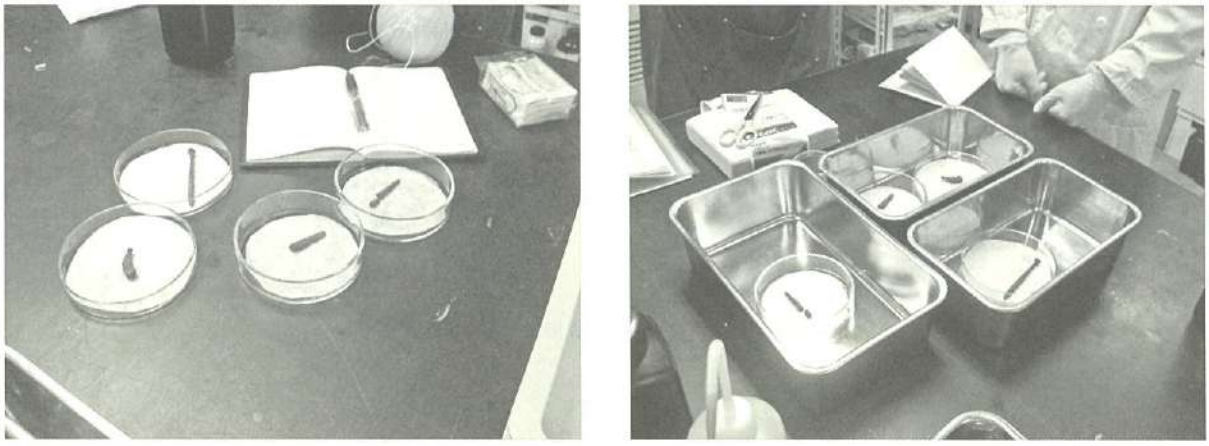
Disalination of Iron objects

The third liquid is a strong chloride and harmful to humans. The soaking time for the 3rd liquid is the same as that for the first and second liquids, but equipment is not needed to clean the iron. The chlorides are washed away with methanol. It has the advantage of new rust not forming during cleaning.

High temperature hydrogen reduction – By heating the iron to 500 ~ 800°C with special equipment, FeOOH becomes Fe_3O_4 and the iron turns black. This method has yet to be proven completely safe, therefore it is permitted to use it to clean iron only if there are no other methods available.

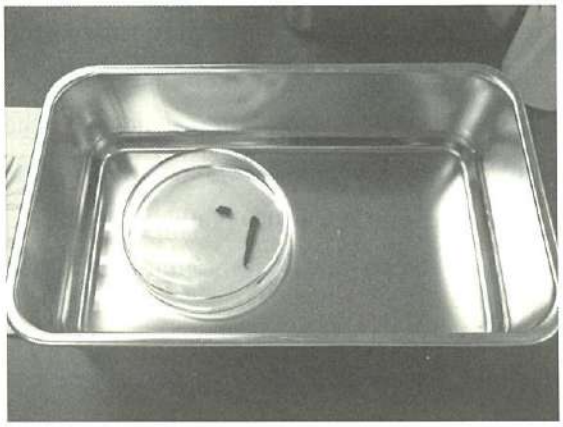
If the damage from Cl is particularly bad, a mixture of 0.2% BTA and 0.1% Borax is used. Iron is washed in water, whereas copper is washed with methyl alcohol. BTA serves to halt rusting and clean the metal. Borax removes any air in the water.

Iron rusted with magnetite cannot be cleaned in this way. Hematite rust forms and the iron turns red if the artefact is put in this liquid. Iron artefacts are placed in stainless steel or glass containers. When using a stainless steel container, a cushion is placed on the bottom of the container. Without a cushion, charges can easily flow between the two metals (iron and stainless steel).



Two metal objects cannot be placed in the same container. Reason being that, when cleaning the objects, it may become impossible to identify where there was damage and to what degree.

Consequently, it is a good idea to place the two objects in separate containers and bind fragile objects with string before adding the liquid.



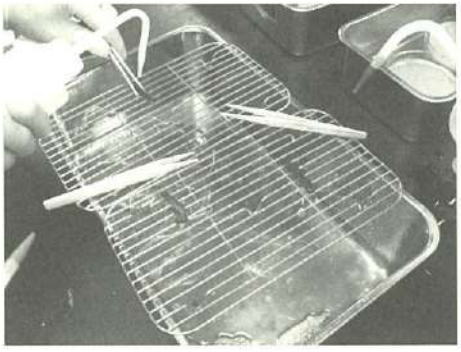
Liquid is added to the container so as to cover the iron artefact by 1 ~ 2 cm.

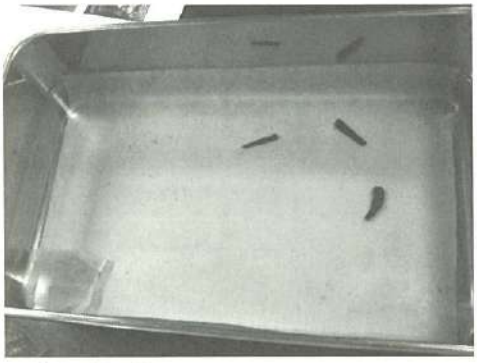
The artefact is placed under vacuum in a machine that heats it using pressure.

The damage to the artefact caused by Cl is then cleaned inside this machine using BTA solution under the heat of the high pressure environment. As the first step to cleaning, the air and oxygen in the liquid are removed by drawing a vacuum inside the machine and heating it. Pressure builds above 90°C and becomes very high at 120°C. Because of the vacuum, there is little chance that pressure inside the machine will cause the metal artefact to float. When temperature reaches 120°C, the clock starts ticking; the artefact is kept at exactly 120°C for 4 hr. When temperature inside the machine drops to 90°C, the door of the machine opens automatically.

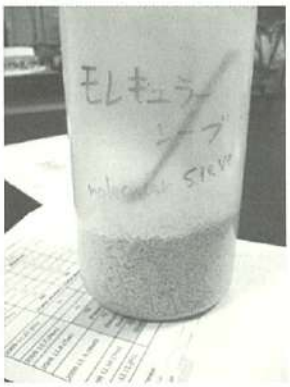
The liquid containers

The containers in which the metal artefacts are immersed are taken out of the machine and the liquids are drained little by little. Then, the degree of contamination of the liquids is measured with a purpose-specific machine. After that, the metal artefacts are placed again in fresh liquids and, as before, placed inside the warming machine. In short, this process is repeated until the liquid contamination is gone. Once finished cleaning the chloride and rust under vacuum, it is time to start removing the water that has permeated the artefacts.





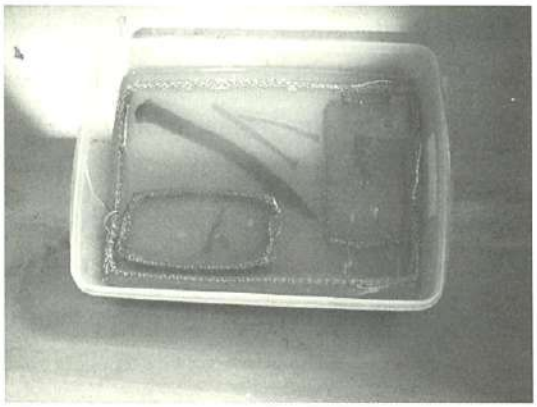
The metal artefacts are taken out of the liquid



Moisture absorbents are added into the bag with the artefact.

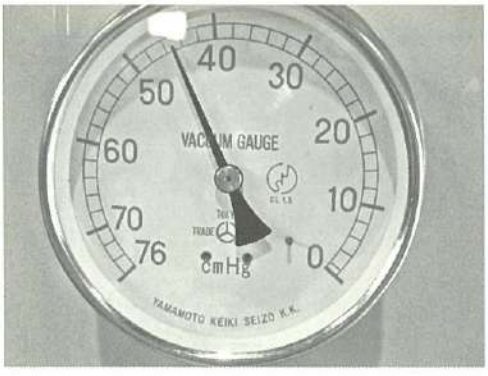
The metal artefacts are taken out of the liquid and thoroughly rinsed with water, then immersed in 100% methyl alcohol for 5 to 10 minitues. Moisture absorbents are added into the bag with the artefact, before placing in the methyl alcohol. This serves to absorb any moisture in the metal. Next, the moisture absorbent and artefact are placed in the 100% methyl alcohol and left for 30 min. After that, the artefact is removed from the liquid and dried at room temperature.

Fe Hardening



The hardening agent Paraloid NAD - 10V which contains emulsions are used to harden iron

Because iron is denser on the surface than other metals, emulsions that contain the hardening agent Paraloid NAD - 10V are used to harden iron. This hardening agent is sold in a 40% concentration version for factories, but also a weaker version, SN-1, is used according to the density characteristics of iron. The target metal artefacts are placed in separate mesh bags, which are then set in a container to which the hardening agent is added. The hardening agent is added a little at a time. In this experiment, a 15% solution was used. The solution was slowly poured over the metal till covering the artefacts. The containers were then placed in a machine where a vacuum was drawn and kept for 5 to 6 hours.



The vacuum is drawn to 40 - 50 Hg.

The hardening agent permeates the metal as air is repeatedly introduced and a vacuum subsequently drawn. This cycle must be repeated a number of times particularly with iron because of its higher surface density. The vacuum is drawn to 40 ~ 50 Hg. This pressure level eliminates air on iron surfaces of low density, allowing instead hardening agent to seep into the metal.

After cleaning has been done, the artefacts are left to dry at ambient temperature for 1 to 2 days.

The artefacts are retrieved from the hardening agent and carefully cleaning by wiping off any lingering hardening agent on the surface of the metal with paper that has been impregnated with a solvent for dissolving the hardening agent.

Metal exhibits a luster if hardening agent remains on the surface, therefore it is necessary to leave some on the surface. If the metal surface is cleaned excessively, all of the hardening agent may be removed from the surface, therefore cleaning work must be done scrupulously.

Machine for drawing a vacuum to harden iron

Packing and Preservation

After restoration work on the metal artefact is done, the artefacts are placed in a vinyl bag specifically for preserving. There are two types of RP-5 chemical for absorbing moisture and air. Whereas that for metals is designed to absorb moisture, that for wood is intended to retain moisture in equilibrium. In other words, it releases moisture to the outside when in excess and draws moisture in when lacking. This chemical must be used within 30 minutes of opening its bag.

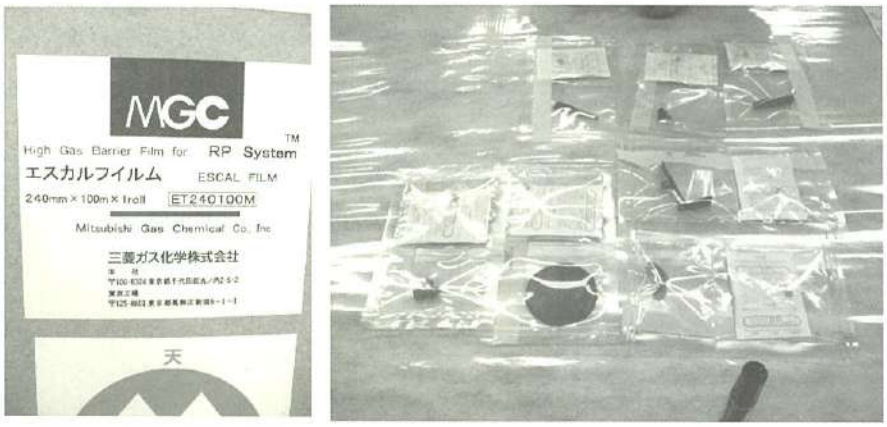
Deoxidizers change colour in the presence of air. Immediately (1 to 2 minutes) after placing the metal artefacts in purpose-specific bags, the deoxidizer is added and the bags sealed. Right after the

RP-5 chemical for absorbing moisture and air.

Deoxidizers change colour in the presence of air.

deoxidizer is put in the bag, it turns a deep pink, but its original colour returns after 7 to 10 days.

If the colour does not come back, then something was done wrong in preparing the bag. Therefore, the bag needs to be checked and repackaged. The deoxidizer turns pink because oxygen infiltrates the bag, therefore presumably there is a small pinhole somewhere in the bag. The bag needs to be checked in storage from time to time as well. The bag must also be of a size to accommodate the metal artefact it is meant to hold.



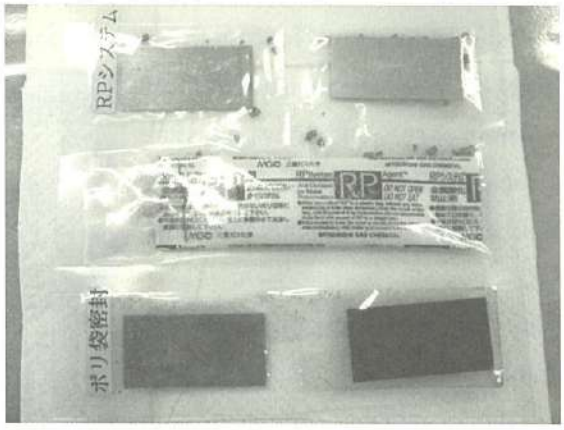
The RP Kit is made for placing in purpose-specific bags.

The RP Kit is made for placing in purpose-specific bags, i.e., for metals, and stored as such. Size and type differ according to objective, i.e., use of special vinyl bags, moisture absorbents, etc.

Procedure for Packing Purpose-Specific Bags

- Select a vinyl bag of a size that can accommodate the metal artefact.
- Open the bag widely so that the artefact can be easily placed inside.
- Reinforce the bottom of the bag by sealing twice in a width of 0.5 mm using sealer (that seals under heat).
- Place the metal artefact, moisture absorbent and deoxidizer in the bag. Space the artefact and deoxidizer slightly apart and carefully close the bag.
- Vacuum moisture and air to the bag and seal it like the bottom using the sealing machine.

All metal artefacts should be placed in purpose-specific bags to preserve



Colour of metal placed inside the bag with the RP and changed colour of the metal after removing the RP

Also, a stand of some sort that allows the metal artefact to move freely should be made and placed inside the bag, and the artefact set on it. All metal artefacts should similarly be placed in purpose-specific bags to preserve them.

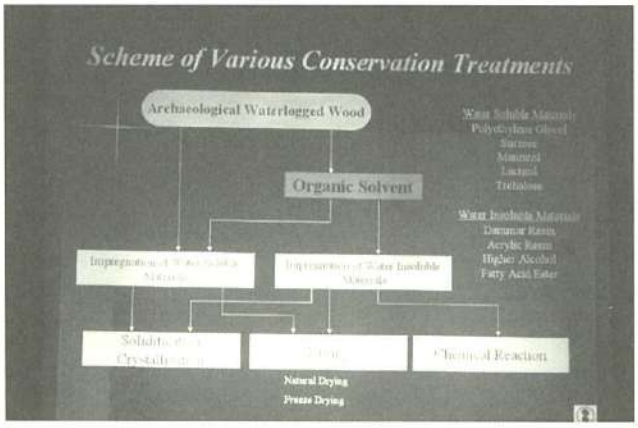
Temporary Preservation

An outdoor pool is prepared for preserving large wood artefacts.

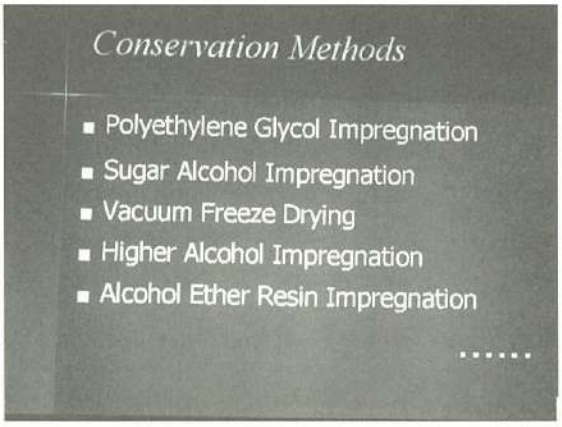
An outdoor pool is prepared for preserving large wood artefacts. With smaller wood artefacts that can be preserved indoors, containers of a suitable size are prepared and the artefacts stored inside. When using a large pool, the water should be replaced periodically, which eliminates the need to add preservatives to the water. However, with small wood artefacts, preservatives must be added to the water in plastic containers.

With purpose-specific plastic bags, preservation solution is added, air purged and a vacuum drawn to preserve the artefact. This kind of temporary preservation is used to prevent unearthed artefacts from drying out or deteriorating until restoration work can begin.

The international standards have been created for preservation methods so that unearthed wood artefacts can be preserved in the same way worldwide.



The international standards have been created for preservation methods



Aforementioned standards

Water-Soluble Hardening Agents

- **PEG**
- **Sucrose:** This method is often used in Europe.
- **Lactitol:** Can be used in 100% concentration. When removed from the solution, the artefacts are externally coated in dried lactitol and dried in an environment where the temperature is a minimum 50°C.
- **Mannitol:** Mannitol remains in a solid state no matter how much it is heated. It requires special

handling more so than other hardening agents.

- **Trehalose:** Type of sucrose solution.

  Inexpensive.

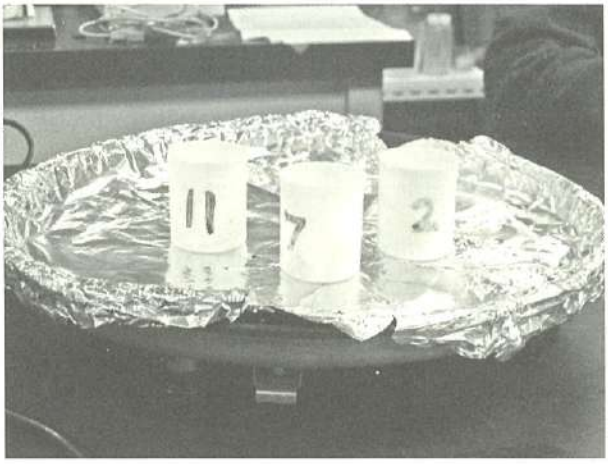
Insoluble Hardening Agents

Dammar resin; Acrylic resin; Higher alcohol; Fatty acid ester

Method for Measuring Hardening Agent Concentration

Method 1: Method for Measuring Hardening Agent in Liquids

When placing large wood artefacts in a tank under vacuum and hardening with PEG, the concentration of the liquid can change. Throughout the entire impregnation process, the liquid must be kept at 50 to 70°C, therefore the concentration changes due to liquid evaporation. Accordingly, small quantities of liquid should be sampled from various points and checked. First, the container that will hold the sampled liquid is weighed. Next, take out 100g of low concentration liquid and 100g of high concentration liquid. If the liquid is heated until all water is lost, only hardening agent remains. This remaining hardening agent is then weighed to determine the concentration.



A method for measuring hardening agent in liquids

Example

Weight of container: 59.35 g

PEG solution: Weight of liquid with water (and container): 77.19 g

Weight of container with PEG and no water: 62.26 g

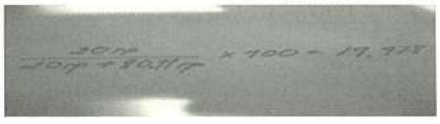
62.26 – 59.35 = 2.91 g Net weight of PEG

77.19 - 59.35= 17.84 g Weight of liquid PEG and water

2.91:17.84 × 100= 16.31% (Concentration)

Method 2:

Mixtures of 10%, 20% and 30% PEG. PEG - 20 g, H_2O – 80.11 g



Concentration is determined using this formula.

10% PEG – 9.996 g. 9.6

20% PEG – 19.98 g. 18.2

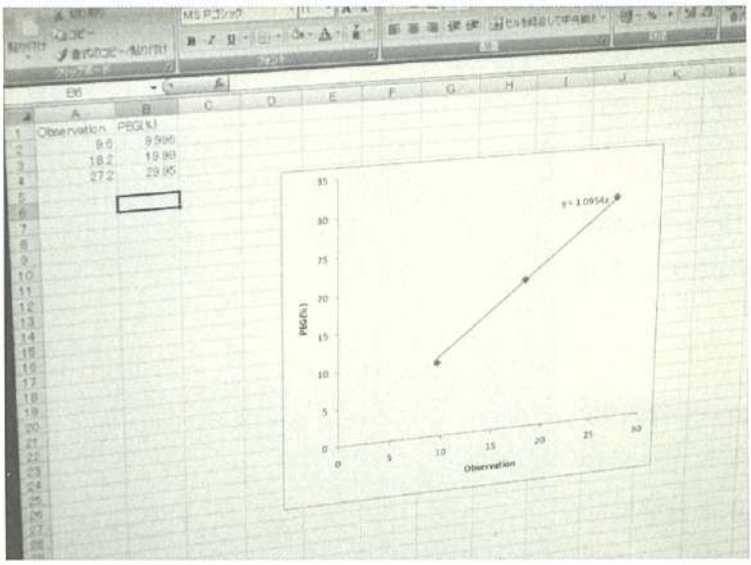
30% PEG – 29.95 g. 27.2

Fig. 1 shows the formula.

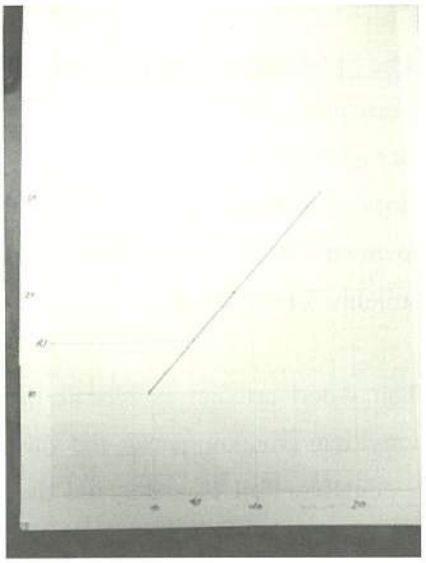
Fig. 2 is the mathematical formula shown by the machine.

The machine displays the mathematical formula when the above liquid is placed in it and measured. The graphs are drawn after inputting the above two formulas into Excel.

The machine displays the mathematical formula



y- 1.0954x results as shown by this graph

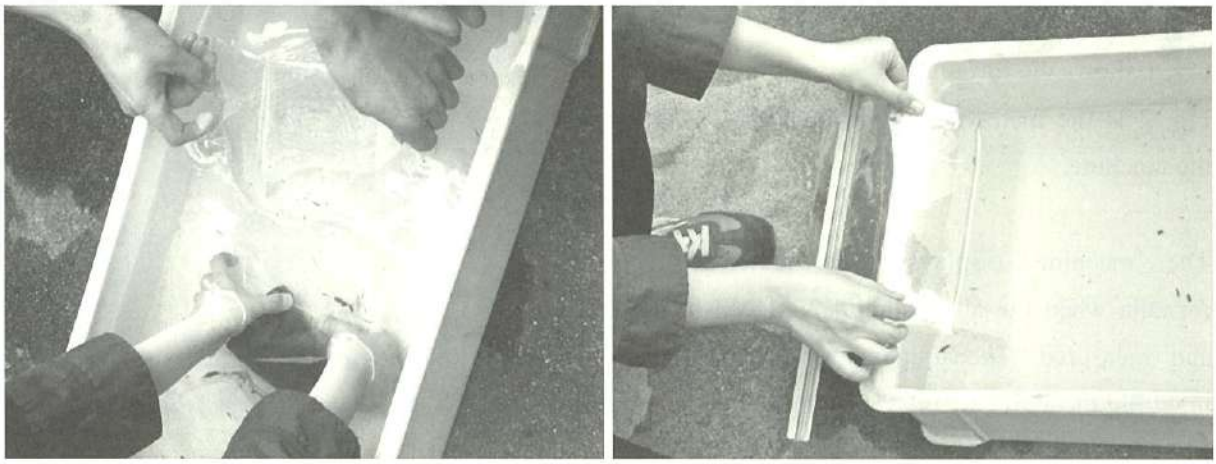


The graph is drawn on graph paper

y- 1.0954x results as shown by the left graph. First 4 digits. The concentration of liquids can be known by meausring them with these machines. Example answer is 14.1, therefore, the liquid concentration is 15.4% (14.1 × 1.095). The graph to the right is drawn on graph paper and checked to verify the 15.4% concentration.

On This Graph: Lines are drawn so that the vertical axis is 14.1 cm and the vertical axis is 15.4 cm.

Placing Wood Artefacts in Purpose-Specific Bags for Temporary Preservation



Until restoration work can begin, wood artefacts must be temporarily stored in water to prevent deterioration.

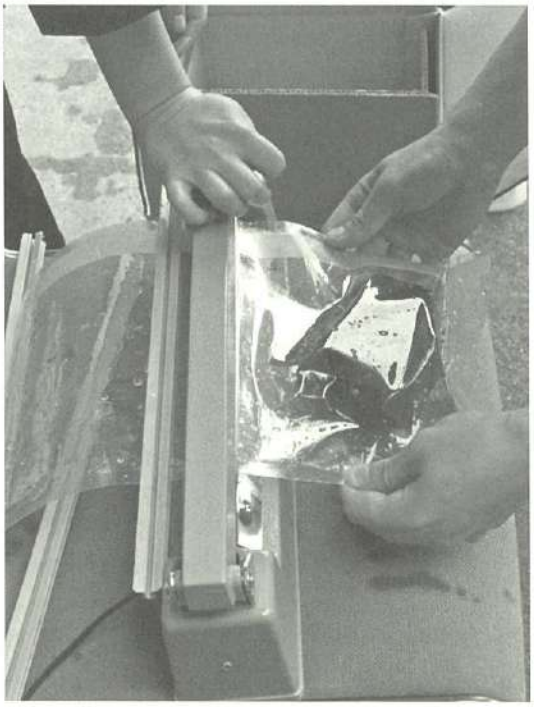
The following is added to 100 g of water.

Boric acid: 0.09 g

Borax: 0.01 g

Boric acid keeps the wood from rotting. Borax is used to lower the acidity of boric acid. A pH of 6 to 7 is suitable for the liquid.

The wood artefact is placed in the purpose-specific vinyl bag (vacuum pack), the vacuum pack is placed in a container full of water and the opening is sealed to prevent air from entering. The seal is heated to seal completely. Any excess vinyl flap is trimmed off. The longer the vacuum pack, the less likely air will penetrate and the easier packing is. Inversely, the vacuum pack is harder to pack when it is short in length.



The seal is heated to seal completely.

In this way, wood artefacts can be preserved in water for one year. It is also possible to preserve artefacts for longer than one year. In this example, the water must be checked from time to time.

Cleaning Bronze Artefacts of Fouling

Before cleaning bronze artefacts, photos and X-rays photographs are taken to identify and record the degree of rusting and damage. Whatever can be removed by hand is cleaned using ethyl alcohol.

CuO

Cu_2O – There is no need to remove this type of rust, because it is not harmful nor affecting the bronze.

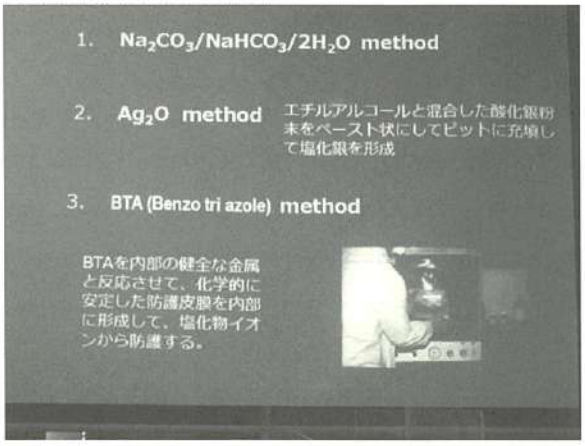
The following three methods are available for cleaning bronze artefacts.

Cleaning Bronze Artefacts of Fouling

1. The bronze artefact is immersed in a cleaning solution that decomposes the chlorine in CuCl. The only setback is that this method does not remove all chlorine.

2. Only pieces of the bronze artefact that have been damaged by chlorine are immersed in a cleaning solution. This method also does not completely treat fouling.

3. Damage and fouling are treated under vacuum. CuCl2-3Cu(OH)2 rust is harmful and must be removed. The solution adds 2% BTA to methyl alcohol. Moreover, the method is more effective if done under vacuum.



Three methods are available for cleaning bronze

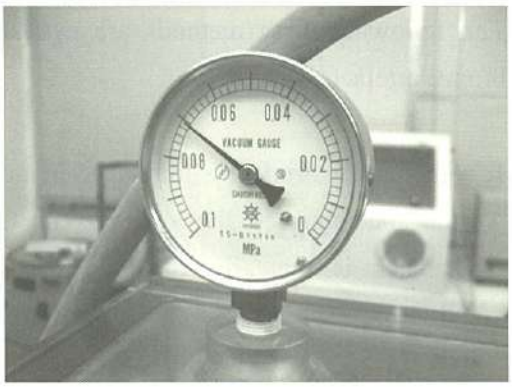
The vacuum must be carefully drawn by absorbing air a little at a time. During the vacuuming process, it is necessary to check whether bubbles are being produced by the bronze artefact or not. If produced, vacuuming should be stopped. When bubbles are not detected coming from the bronze artefacts, vacuuming should be started.

In the air absorption process, bubbles rise from areas of low copper density hence ridding the artefact of air. As a result, the preservation solution fills those places, hence reinforcing the artefact. The artefact is soaked in the preservation solution for 24 hr.

The vacuum is drawn to a pressure of 007 MPa, at which point the valve is closed, the hose pulled out and the compressor power shut off. At this time, it is necessary to loosen the latches of the vacuum box door.

Damage and fouling are treated under vacuum.

The artefact is removed from the solution and rinsed with pure methyl alcohol. Unless done so, the BTA on the surface of the artefact will turn white. Then, the artefact is dried at ambient temperature. Damp places should be avoided.



The vacuum is drawn to a 007 MPa,

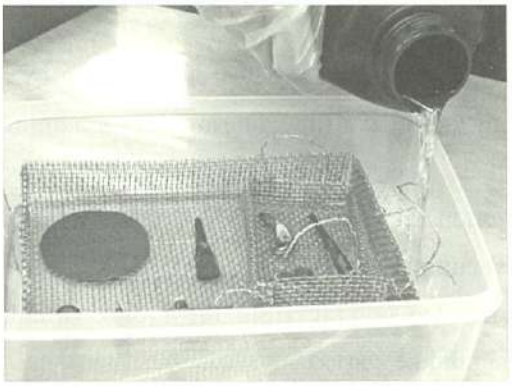
Reinforcement of Unearthed Bronze Artefacts

Bronze artefacts are reinforced by using a solution of 50% toluene and 50% acetone, and 5% B72. As with the vacuum method of cleaning, the artefact is soaked in the solution for 5 to 6 hours.

Reinforcement of unearthed bronze artefacts

The artefact is removed from the solution and dried at ambient temperature. After 24 hours, if the bronze surface is shiny, a 50/50% solution is brushed on it for cleaning. Broken pieces are glued together using a solution of 5% B72.

The adhesive solution must be of lower concentration than the hardening agent. If done incorrectly, pieces will separate even after hours of being stuck together. Before gluing large pieces of metal, soak the broken part in 5 to 10% B72, then glue it on using a thermosetting adhesive. For long-term preservation, the artefact is placed in a purpose-specific vacuum pack. Copper artefacts are packaged in the same way as iron artefacts.



The artefact is soaked in the solution for 5~6 hr.

Methods for Extracting Buried Artefacts

Method for extracting buried artefacts

Method 1: Freeze-Drying Artefacts with Liquid Nitrogen

The ground around the artefact is dug out following the shape of the artefact. The hole should be dug at an angle towards the bottom to make lifting easier. The entire block is wrapped in purpose-specific gauze for reinforcing.

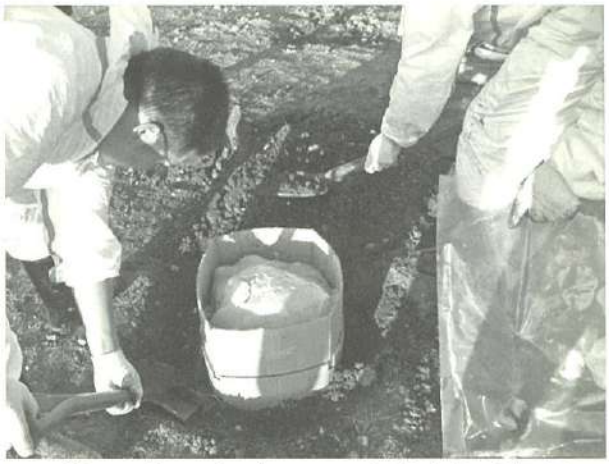
The artefact is enclosed in fiberboard placed at a distance from the artefact and then freeze-dried by pouring liquid nitrogen over the entire artefact from above. After the ground freezes and solidifies, it will maintain that state for 30 min. Therefore, lifting must be done within that time span.

In 30 min, the frozen ground will start to thaw.

The artefact is placed inside a crate together with the soil. In 30 min, the frozen ground will start to thaw.

A hole is dug around the artefact according to its shape.

Method 2: **Enclosing Artefacts in Urethane**



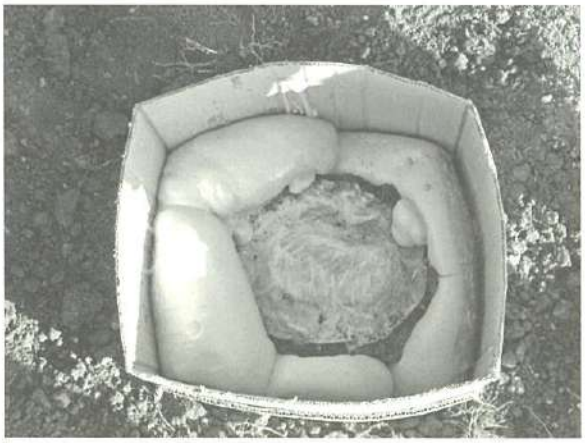
The urethane hardens completely in 5 ~ 6 hr. From that point, the artefact together with the soil can be transported. After that, the urethane is removed from the artefact a little at a time.

As in Method 1, a hole is dug around the artefact according to its shape. The hole is sloped inward towards the bottom to make it easier to cut the urethane away. As such, the ground and artefact are cut away as one. The artefact is wrapped in damp paper. Paper should also be wrapped around the bottom edges on sides where there are gaps to make it easier to pull off. Then, the artefact is enclosed in fiberboard positioned at a discrete distance from the artefact. Polyurethane foam is then poured into the space between the artefact and fiberboard a little at a time, but bearing in mind to pour all of the foam as quickly as possible. The polyurethane foam must be used immediately after it has been mixed.

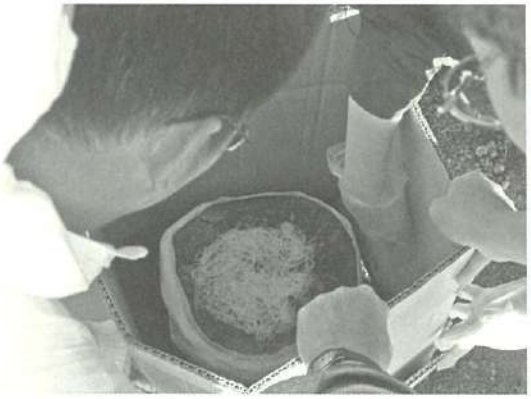
Urethane is made by mixing two liquids. Those two liquids are added to a vinyl bag in equal proportions and the bag shook well. Urethane foams and solidifies to 10 times its original volume.

Taking Off Stratum

The target area is selected and the surface is smoothed. The area is checked for large stones and difficult to remove objects, which are left where they are. These objects are covered in damp paper. Before applying the scraping solution, it is necessary to wet the soil. For large areas, the area can be wet and covered in a vinyl sheet the night before. The ground will be in suitable condition for scraping the next day.



Urethane foams and solidifies to 10 times its original volume.



The artefact is enclosed in fiberboard.

Freeze-dried by pouring liquid nitrogen over the entire artefact

The gauze should be carefully laid out

To remove a stratum, carefully scrape from above

Excess soil is washed from the removed stratum

NS-10 is a solidfying agent that chemically reacts to water. It is applied to the surface of the target area by brush in one pass as best possible. If applied in two or more coats, it can clump and dry out, making it hard to work with.

After a short amount of time elapses, the solution reacts with the water in the ground, starts bubbling and eventually dries. The soil should be dried to the point that it can be disturbed by hand and then covered with gauze to hold the soil together.

If dried excessively, the gauze will not stick. The gauze should be carefully laid out so as to follow the undulations. Another layer of gauge is laid on top of that and another light coat of the solution is applied. For small areas, one sheet of gauge can be used, but larger areas should covered with 2 to 3 sheets.

It takes 7 to 8 hours for the solution to dry completely. Once it dried, large areas are subdivided into sections for lifting, while small areas are removed as is. To remove soil from cross-sections, carefully scrape from above and, when the damp paper is reached, remove that section from the ground.

Excess soil is washed from the removed soil layer with water, then cleaned with a hard bristle brush and dried. Once dried, the cut-away soil blocks are rejoined and fit back in the original location. Of the five methods of hardening and preserving unearthed artefacts, we studied the following three in detail and performed related experiments. Each of these methods has good points, bad points and characteristics that set them apart from one another.

Hardening with PEG

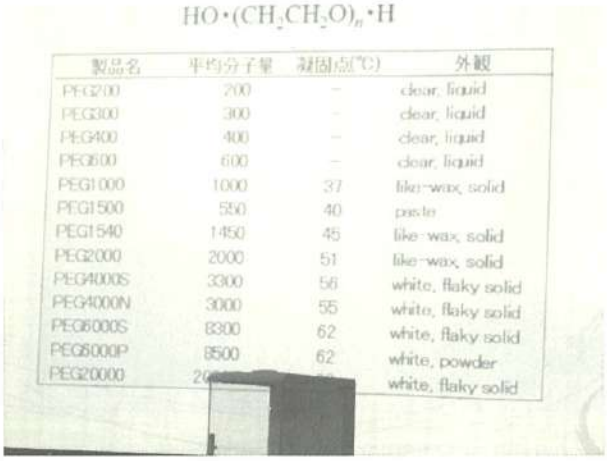
There are various types of PEG, which differ amongst themselves by molecular structure. They range from PEG200 to PEG20000.

PEG4000

- Readily dissolves in water.
- Dissolves at room temperature.

Wood artefacts can be soaked in solutions of 10 to 100%. When soaked in solutions up to 40%, changes occur in the wood, therefore the artefact must be checked from time to time. In any case, these changes hardly occur with solutions over 40%.

The higher the PEG concentration, the slower the permeation speed, therefore PEG concentration is gradually incerased from 10%. Decayed wood artefacts are soaked in 100% PEG, whereas wood artefacts that are not decaying are soaked in 80% PEG. Large artefacts soaked in 90 ~ 100% PEG can take as much as 1 ~ 2 years to harden.



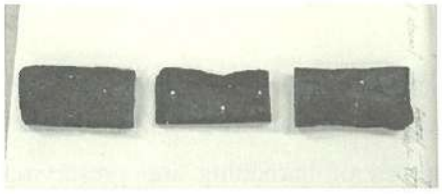
There are various types of PEG.

Merits

- Safe
- No changing once hardened
- Applicable with large artefacts

Demerits

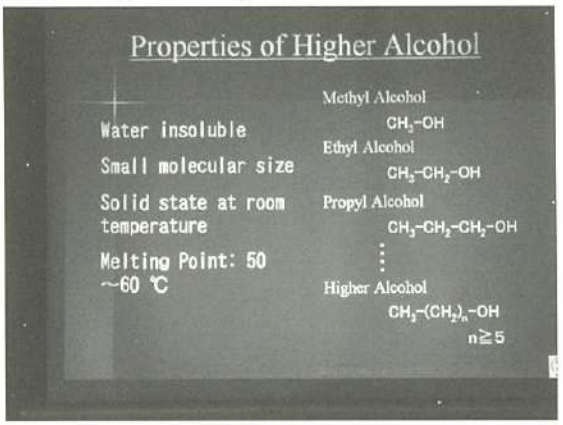
- Permeation is slow. Requires time to harden.
- Artefact turns block when finished.
- Increases artefact's weight.
- Wood artefacts lose their shape if kept in damp environment, therefore suitable environment must be maintained.

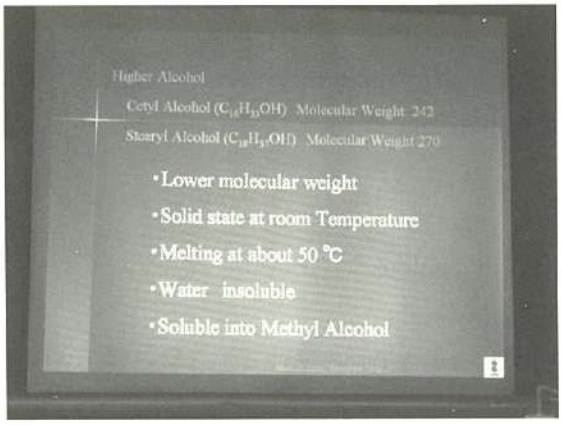


Hardening with PEG

When using PEG solutions in concentrations of 50% or higher, the solution is heated to 60°C and the artefact is removed from the solution when the artefact is infused to 80 to 100%. Then, any PEG remaining on the surface of the artefact is wipped off with gauze and warm water. The artefact is then dried at ambient temperature.

Hardneing with Higher Alcohol





We practiced with hardening wood artefacts using cetyl alcohol.

We practiced and experimented with hardening wood artefacts using cetyl alcohol.

Merits

- Bright colour
- Artefact's weight is unaffected.
- Fast permeation
- Applicable with hard wood artefacts

Demerits

- Flammable
- Not applicable with large artefacts

Moisture in the unearthed wood artefact is removed using methyl alcohol. The wood artefact is immersed in 40 to 50% methyl alcohol and the concentration is raised a little bit everyday until reaching 100%. At that point, a molecular sieve of moisture absorbing capability is added. A day later, the alcohol is changed and newly immersed in 100% methyl alcohol.

Hardening with higher alcohol

The wood artefact is impregnated with cetyl alcohol starting with a concentration of 30% and gradually increasing it to 80%. From a 40% concentration, the temperature is raised to 50 to 60%, therefore the container is enclosed in a bag and the opening firmly sealed. The wood artefact is removed when cetyl alcohol concentration is 80%. Any cetyl alcohol remaining on the surface is wiped off with

methyl alcohol, then the artefact is dried.

Hardneing by Vacuum Freeze-Drying

We did experiments using cetyl alcohol.

Merits

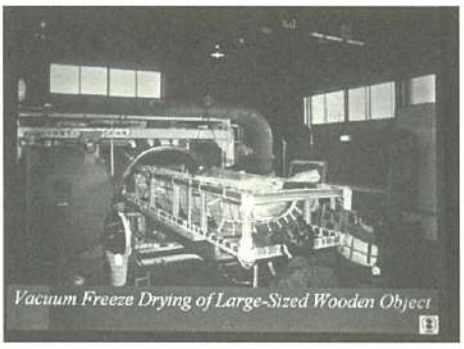
- Bright colour
- Lightweight
- Fast permeation
- Applicable for soft wood artefacts

Demerits

- Requires special equipment.

Moisture contained in unearthed wood artefacts is removed by wiping with butyl alcohol. The artefacts are then immersed in 40 to 50% butyl alcohol and the concentration is increased a little bit everyday until reaching 100%. A molecular sieve of moisture absorbing capacity is added to the bag and the bag is placed in the alcohol.

A day later, the alcohol is changed and 100% butyl alcohol is added. Unless the temperature is kept at 50 to 60°C, the butyl alcohol may coagulate.



Vacuum Freeze Drying of large-sized wooden object

The wood artefacts are placed in 20% cetyl alcohol and the concentration is gradually increased to 40%. From a 40% concentration, the temperature is raised to 50 ~ 60%, therefore the container is enclosed in a bag and the opening firmly sealed. The wood artefact is removed when cetyl alcohol concentration is 40%. Any cetyl alcohol remaining on the surface is rinsed off with 100% butyl alcohol, and wiped with paper. The artefacts are then wrapped in gauze and placed in the vacuum freeze-drier, where left for 24 hr. Once completely frozen, air is removed to draw a vacuum. The artefacts are kept under vacuum for 4 ~ 5 hr. After that, power to the drier is shut off and air is introduced when the drier internally returns to room temperature. The white surfaces are dried with a fan.

Conclusion:

In this training program, we visited many sites in Japan and conducted detailed experiments with how historical and cultural properties are restored and protected in Japan. The fact that the historical

background and traditional techniques are researched as a part of restoring and protecting cultural properties is testimony to how well the legal systems for restoring and protecting cultural properties is developed in Japan. I would like to research in greater detail laws on protecting cultural properties and particularly regulations on restoring, protecting and preserving cultural properties, and then to apply them to those of Mongolia. This training program was held with the objectives of supporting activities for protecting the historical and cultural heritages of Mongolia. We learned in practical training about methods for restoring and protecting diverse cultural properties made of metal and wood, and painting temple interiors and exteriors from the initial to the final stages. It has proven to be a big help in solving a host of problems/challenges we are dealing with.

We had a Mongolian interpreter with us, which allowed us to freely ask any questions. I want to introduce equipment necessary for restoration to our laboratory in the near future and work hard so that we can use it to our benefit.

I would like to express my sincere appreciation to the following persons: NISHIMURA Yasushi, NAKAI Isao, KINOSHITA Wataru and YOSHIDA Maki from ACCU Nara; KOEZUKA Takayasu, KOHDZUMA Yohsei, WAKIYA Soichiro and TAMURA Tomomi from NNRICP; all the staff of NRICPT; and GANBAATAR Zayasaikhan from the Honorary Consulate of Mongolia in Osaka, working as an interpreter.

SUKHBAATAR Davaadari

17 November: Opening Ceremony

A commemorative photo with ACCU staff

Observing the Heijokyo Sakyo Sanjo Nibo Palace Garden

Mr NISHIMURA Yasushi, Director of the ACCU, gave a welcoming speech. Mr NAKAI Isao, Director of International Cooperation Division, explained the training program and handed out important materials. Then, we toured in the Heijokyo Sakyo Sanjo Nibo Palace Garden.

18 November

We visited the NNRICP. We heard an outline of the NNRICP, saw the laboratories and training rooms, and were explained in detail what equipment was used for and how to use it.

Facility tours through NNRICP

19 November: Conservation Science for Metal Artefacts

Work was done in the below three areas.

1. Diagnostic investigation
2. Conservation and restoration
3. Storage environment

Metal artefacts unearthed from the ground transform because of chemical reactions. They start transforming anew under the new environment after being excavated. The artefacts undergo reactions both inside and outside. Metal artefacts buried in damp ground rust. Chlorine and moisture are the primary causes of rust. Soil and sand adhering to the outside of artefacts are removed to prevent rusting. There are four types of rust. Actual metal artefacts were used as samples in training. We began by taking photographs of the artefacts to record their initial appearance. Observations were done both with the naked eye and under microscope.

In the afternoon, there was an explanation of wood artefacts. Because they are very unstable when unearthed, wood artefacts must be treated cautiously so that their size and shape do not change. There are basically two methods to preserve wood artefacts.

1. Impregnating the artefact with required chemicals to strengthen the material
2. Natural drying or freeze-drying

Liquids are added during the preservation process of wood artefacts. PEG, cethyl alcohol and other solutions are used to replace the water in the artefacts. Wood artefacts contain large quantities of water immediately after being unearthed. The wood material is strengthened by replacing that water with solvent. During that process, the concentration of the preservation solution is gradually increased.

With natural drying, the artifact is coated with PEG and ultimately soaked in a 100% solution. PEG4000S is mainly used. PEG is a safe water-soluble chemical widely used in cosmetics. It works well with large wood artefacts as well.

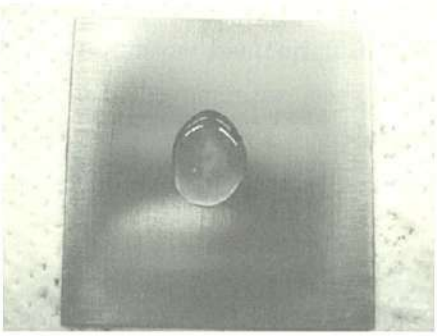
Immersing wood artefacts in higher alcohol has the advantage of drying them quickly and easily without discoloring. For the higher alcohol to permeate the wood, the water is exuded first with methyl alcohol and then it is soaked in higher alcohol. Freeze-drying in a vacuum is fast, easy and does not discolor the wood artefact. It is very effective for strengthening soft fragile wood.

Practical Training in Conservation of Wood Artefacts

We stuck pins into a thin strip of wood and measured the dimensions between the pins, and prepared a solution of 50% TBA, 50% metahnol and 10% PEG solution. Each solution permeated it into the wood samples, while another wood sample was naturally dried at room temperature.

Training Work in Wood Artefacts

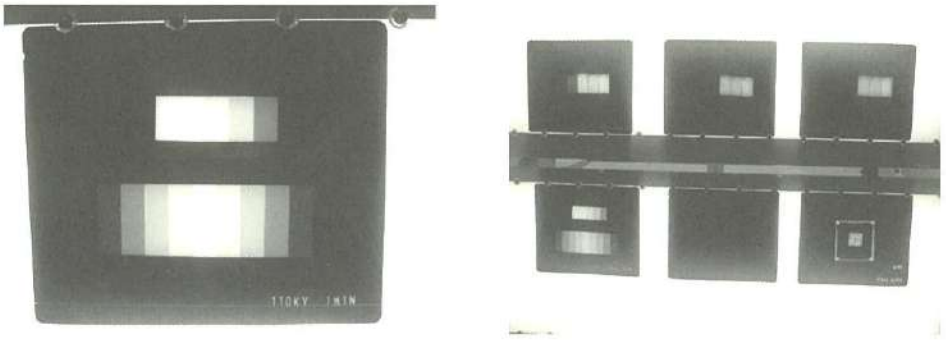
20 November



The Evan's experiment

A lecture on the condition of unearthed metal artefacts, environments that promote rusting, methods for halting rust propagation and other subjects were given with detailed explanations and research results. Moreover, explanations were given as to the causes of rust in metal artefacts and the chemical reactions of rust, using graphs that illustrated rust propagation and photographs of rust. In the Evan's experiment, we conducted, a 13% NaCl solution that contained some phenolphthalein was dripped onto a thin iron panel, and the ensuing rust propagation was observed.

X-ray radiography makes it possible to see parts of artefacts that cannot be seen with the naked eye, therefore it provide us with useful information for conservation treatment. It was explained how to use the machine, its capabilities and so forth using samples. Pictures were taken under various conditions, i.e., different pressures, exposure times, etc. Above-mentioned wood samples were moved in to a solution of 70% BTA, 70% metahnol and 20% PEG respectively.



X-ray photos taken under various conditions

23 November

We toured in Todai-ji Temple, a famous temple in Japan. Everything was wonderful and I was deeply moved by the great Buddha. Then, we went to the The Museum, Kashihara Archaeological Institute, Nara Prefecture in Kashihara.

Observing Todai-ji temple

24 November

A lecture was given on how to use X-ray radiography and the types of films. We learned what types of film should be used to photograph specific types of material. Moreover, we had a lecture on the features of X-ray fluorescence analysis. This equipment also uses light beams to identify materials. It produces two types of light called WDX and EDX. The beams of EDX are used to observe cultural properties. Wood samples were moved into a solution of 90% BTA, 90% metahnol and 30% PEG.

Lectures on the features of X-ray fluorescence analysis and its various conditions

25 November

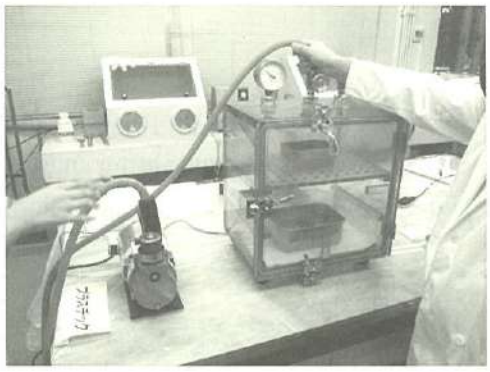
We continued practical training in X-ray fluorescence analysis. We did training with different samples and different machine settings, i.e., light intensity, etc. Thin, lightweight objects are first placed in a vacuum to measure because the beams otherwise pass through it, whereby producing incorrect results.

We prepared a solution of 100% BTA, 100% metahnol and 40% PEG and transferred the wood artefacts to it. We placed a molecular sieve in the 100& solution to slowly remove water contained in the wood. In the afternoon, we cleaned metal artefacts.

26 November

The following methods are used to stop rust on bronze artefacts.

1. Desalination
2. Stabilization
3. Impregnation



A decompression equipment

First, the bronze artifact is cleaned by hand and then placed in a solution of 2% BTA (benzotriazol). This solution permeates artefacts very slowly, therefore the artefacts are placed in a special machine that draws a vacuum so as to accelerate the permeation process. It is commonly used in Japan to remove rust from bronze artefacts by boiling off the water under high heat. The water in the 0.2% BTA solution is boiled off at a temperature of 120°C and pressure of 1.2 atm. Boiling is done for 6 hours. Wood samples were moved to a solution of 100% BTA, 100% metahnol and 50% PEG.

27 November

The metal artefacts were soaked in a solution of 0.2% TBA and 0.1% Borax, and placed in a high pressure chamber. They were unloaded from the chamber in the afternoon, rinsed with water and soaked in a methyl alcohol solution for about 5 min. The types of rust were then observed under

microscope. We prepared a 20% solution of cetyl alcohol from 100% TBA, a 30% cetyl alcohol solution from 100% methanol and a 60% PEG solution, and placed the wood samples in each solution.

The metal artefacts were placed in a high pressure chamber

1 December

We visited the NRICPT. We had lectures about the facilities and activities of the institute, and observed the research laboratories under the guidance of its staff.

3 December

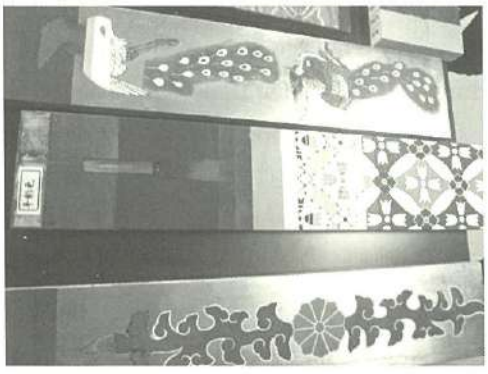
At the Nikko Cultural Assets Association for the Preservation of Shrines and Temples, detailed explanations were given of the culture and history of Nikko, the system used by the association, their activities, budget, etc. An explanation was given by Mr. Sato, an expert in lacquer, about where lacquer comes from, processes for properly applying lacquer, etc. Another lecture was given on types of colours, painting methods and restoration techniques by the painting specialist, Mr. Sawada.

Work Environment for Applying Gold Leaf to Ornamental Metals

We observed the work that experts were gilding with lacquer on cultural properties and gilding with Hg and removing Hg with a fire.

4 December

There are 103 cultural properties in Nikko that are registered as World Heritage. We toured Futarasan Shrine, Nikko Tosho-gu Shrine and Rinno-ji Temple, where we observed restoration work in progress and heard brief explanations of the applied restoration techniques.

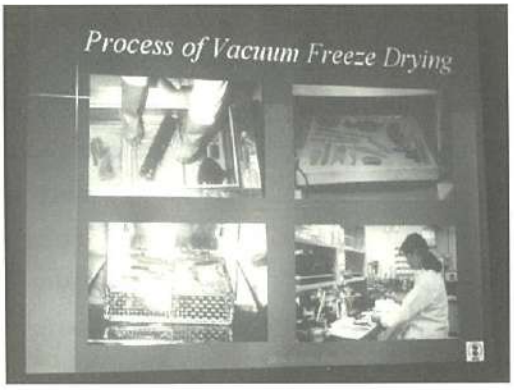


Detailed explanations were given of the culture and history of Nikko

We observed restoration work in progress at Nikko.

7 December

A lecture was given on preservation methods for wood artefacts. Wrapping is required to temporarily store wood artefacts. An explanation was given on the vinyl bags and chemicals used to wrap artefacts. We also heard explanations on how to preserve artefacts for long periods of time, the chemicals used for that and quantities.



Lectures on preservation methods for wood artefacts

Training Work in Wood Artefacts

Wood that had been treated in a solution of 40% TBA (cetyl alcohol) was placed inside of a freeze-drier. Then, wood samples were moved to a solution of 70% PEG and 60% cetyl alcohol. We practiced two methods for measuring the concentration of PEG solutions.

8 December

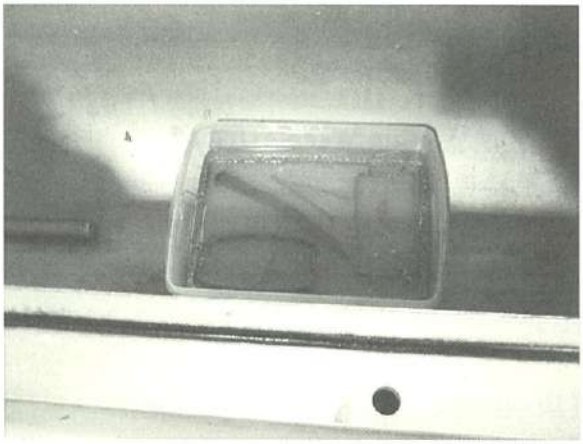
We had practical training on the transcription of stratigraphy. First, NS10 is coated over the target surface and, once slightly dried, gauze it attached. This makes it possible to remove the soil surface. After drying adequately, we successfully took the stratum off under the direction of researchers. Moreover, there was a lecture on how to transport unearthed artefacts from excavation sites. We heard explanations and did practical training in two methods for transporting artefacts from the sites.

Applying gauze to the stratum

Practical training on how to unearth artefacts (left); a stratum was successfully taken off (right).

9 December: Practical Training on Conservation of Metal Artefacts

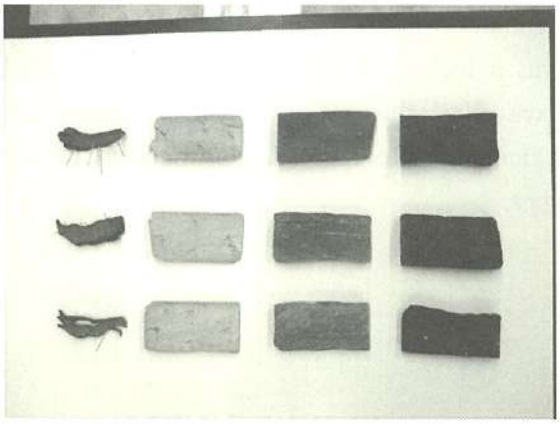
There was a lecture on strengthening and preserving cleaned metal artefacts. One of the most important things in preserving cultural properties is to use methods that easily restore the properties to their original state without any adverse affects and allows chemicals to be replaced even if better chemicals are newly discovered in the future. A detailed explanation was given on chemicals that fit this general concept. One such chemical is NAD10, which is used for specific metal artefacts. We boiled off water under a vacuum and placed metal artefacts in a solution of it. Because NAD10 readily permeates metal, we placed artefacts in a vacuum and removed the air. Moreover, we placed cleaned bronze artefacts in a solution of 5% B72 and sucked out the air with a vacuum machine. Then, a lecture was given on the chemicals used to temporarily preserve wood artefacts, the concentrations they are used in, how concentration is measured and how to use related equipment. We practiced putting wood artefacts into preservation bags and packaging them.



Training Work in Metal Artefacts

10 December: Practical Training on Conservation of Wood Artefacts

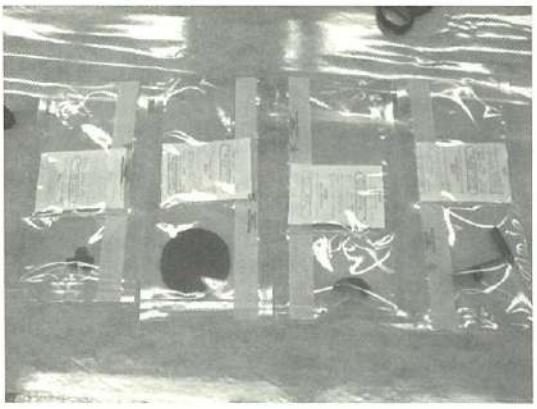
The weight of wood artefacts changes when PEG is used for preservation treatment. We practiced measuring that change and measuring how much PEG has been absorbed by the wood. Wood samples were taken from solutions of 15% PEG, 40% PEG and 80% cetyl alcohol, washed with water and methyl alcohol, and dried using cold air from a drier. Pieces of advises were also given on how to piece back together broken metal artefacts using adhesives.



Wood artefacts after conservation treatment

11 December

We removed wood samples from the freeze-drier when the internal temperature was equal to the room temperature. We then measured the shrinkage and weight of the freeze-dried samples and the samples naturally dried with 80% PEG and 80% cetyl alcohol. This completed our training in conservation treatment of wood artefacts.



Placed bronze and iron artefacts into each bag

Training Work in Metal Artefacts

We placed bronze and iron artefacts into individual bags, added PR5 and an oxygen indicator to measure moisture, and sealed the bags on a sealing machine. This completed our training in metal artefacts.

14 December

Training was done in Kyoto. We toured in the research laboratory for paintings and carvings at the Saga University of Arts, and heard an explanation of university activities. In the afternoon, Mr. Onomura of Saishiki Sekkei Corp., explained about his work and experience, and gave us advice on painting work.

15 December

We visited the Azuchi Castle Archaeological Museum and saw how they proceeded excavation, restoration and preservation of archaeological sites. Though short, Mr NAKAGAWA Masato of the museum explained about their restoration workshop and preservation equipment in it. This brought to an end the one-month training program.

I am very grateful to have participated in this training program organized by Cultural Heritage Protection Cooperation Office, Asia-Pacific Cultural Centre for UNESCO (ACCU). The programme provided a very broad range of content and should prove very useful to our activities for protecting cultural properties in Mongolia. I would like to take the information and experiences we have gained from this program and apply them to protection of cultural properties in Mongolia and adapting them to the environment of Mongolia. I was greatly impressed by the Japanese attitudes toward protecting cultural properties and traditions. I want to express my heartfelt appreciation to the instructors and staff who arranged this training programme specifically for us from Mongolia and provided us with the opportunity to learn on actual equipment and in practical technologies, as well as to all of our colleagues at the Cultural Heritage Center of Mongolia.

I would like to thank the following persons from the bottom of my heart and wish everyone the best of success in your work: Mr Nishimura Yasushi, Mr Nakai Isao, Mr Kinoshita Wataru and Ms Yoshida Maki at ACCU Nara; Mr Koezuka Takayasu, Mr Kohdzuma Yohsei, Mr Wakiya Soichiro, Ms Tamura Tomomi and all the staff at NNRICP; and Ms Ganbaatar, Zayasaikhan, an interpreter from the Honorary Consulate of Mongolia in Osaka.

DAVGADORJ Nyamdorj

Three conservators from the Cultural Heritage Center of Mongolia's Ministry of Education, Culture and Science, namely Mr. Chinzorig Samdan, Mr. Davaadari Sukhbaatar and Mr. Nyamdorj Davgadorj, participated in training on the theme of cultural properties protection at Cultural Heritage Protection Cooperation Office, Asia-Pacific Cultural Centre for UNESCO (ACCU) from 17 November to 17 December 2009.

The program began with greetings from Mr NISHIMURA Yasushi, Director of ACCU Nara and got straight into training. The programme was presented under the theme of painting restoration and management methods for archeological artefacts of wood and metal, etc. It additionally offered lectures and practical training in how to unearth and transport artefacts and relics at the excavation sites, what kind of environment is best for storing them and restoration work. Practical training involved hands-on experiences with tools and devices used at the sites.

How to Handle Fragile Artefacts

Often, unearthed artefacts are fragile and cannot be transported as they are. It is very important to take them out and transport them carefully. There are two methods to unearth artefacts from sites.

1. Use of liquid nitrogen

This method is best applicable to artefacts buried in the wet ground. The soil around the artefact is dug out and injected with liquid nitrogen. After about 20 to 30 minutes, the liquid solidifies, and the artefacts and surrounding blocks can be transported as a whole. The block is placed in a crate with sand on the bottom to prevent breaking from vibrations during transport.

2. Use of polyurethane

Use of liquid nitrogen

Use of polyurethane

The ground around the artefact is prepared as above, then the artefact is wrapped in paper for protection. Polyurethane made from polyol and isocyanate is poured around the artefact and the whole block is lifted from the hole.

Method for Taking off a Stratum

For this experiment, a material known NS10 was used. NS10 chemically reacts with water, therefore the ground surface must be appropriately wet before use. This method had been shown early in Mongolia by Ms. Tamura. Having been able to experiment with the method she had discussed was a very good learning experience.

Practical training was done in scraping away soil layers.

Methods for Protecting and Storing Metal Artefacts

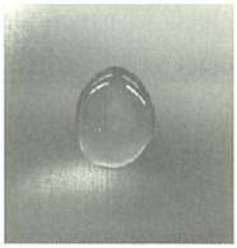
Mankind discovered metals in the natural environment and extracted their impurities to use them. In that moment, the metal started returning to its initial stable state. These changes were manifested as corrosion because of the effects of water, air and so forth. Metals stop corroding the moment they attain the stable state of the natural world. Our objective was to slow the corrosion process that returns metal to this stable state and store them that way.

Corrosion differs according to the type of metal. There are four types of iron as follows.

- Alpha α FeOOH
- Beta β FeOOH
- Gamma γ FeOOH
- Fe_3O_4

While there is rust that decomposes metal, there is also rust that covers and externally protects metals. These types of rust differ by colour and contained elements. In treating metals, the worst rust is beta because it contains chlorine ions. The Fe_3O_4 that covers the surface of iron is good rust.

We conducted Evan's experiment, which makes it easy to identify the type of rust corrosion. We dripped a 3% NaCl solution containing tri-potassium hexacyanoferrate and phenolphthalein onto an iron plate and observed the rust (FeOOH) forming process. The FeOOH that formed in this corrosion



The Evan's experiment

process is classified into the above three types: α, β and γ. Iron is in the most stable state as initially found in the natural world at the end of this process.

Depth-wise, rust is classified as follows.

- Surface: Goethite
- Interior: Magnetite

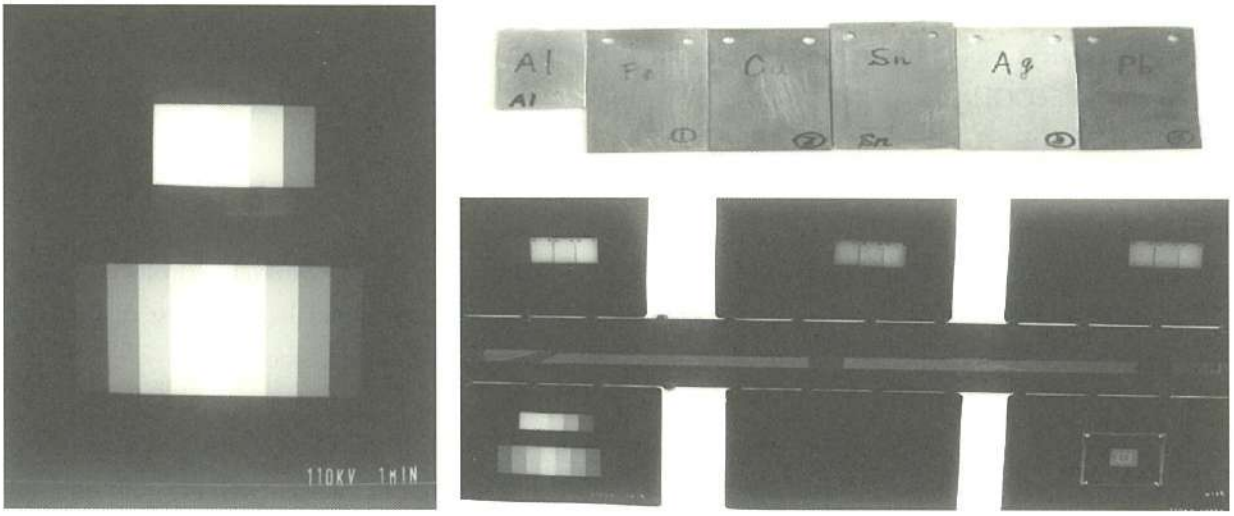
In storing artefacts, magnetite areas are cleaned, but, if damaged, the iron starts changing back to its initial state found in the natural world. To prevent that from happening, it is important to identify the type of rust, leave rust that protects the surface and remove only rust that promotes corrosion. This is done by looking with the naked eye and, for areas that are too difficult to determine as such, making observations using microscopes and X-ray photographs. What methods of cleaning and storage will be used are determined from these results.

X-Rays

X-ray photographs are an important tool for obtaining detailed internal information that cannot be observed with the naked eye. X-rays are electromagnetic waves and the same as orindary raidation, only that the wavelength is 0.01-100A.X-rays are used at the following two wavelengths.

- Continuous X-ray
- Line X-ray

The voltage of continuous X-rays is 69.3 KeV, whereas for line X-rays, it is 12.4 KeV. The wavelength of an electromagnetic wave does not get longer as the voltage increases, but the wave gets stronger. If the distance between the object and the X-rays from the electromagnetic wave is doubled, the force of the electromagnetic wave passing through the object is halved; if the thickness of the object is doubled, the force of the electromagnetic wave passing through the object is reduced to one-fourth.



X – Ray photos in different conditions

X- Ray photography uses three types of film: IX-100, IX-80 and FR. The "100", "80" and "FR" indicate the film's sensitivity, with sensitivity decreasing in the order of 100→80→FR. To take X-ray photographs, it is necessary to weigh the film sensitivity, voltage of the electromagnetic wave, thickness of the target object and other factors, and determine the best combination of parameters. Also, the force of the electromagnetic wave passing through the object changes according to the material of the target object.

Cleaning of Bronze Artefacts

How to Clean by Using Tools

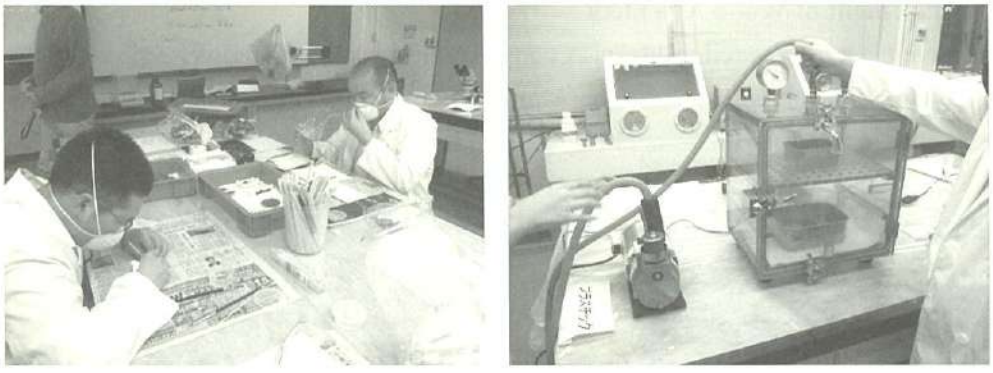
- Hand tools
- Grinding device
- Ultrasonic grinding device

Bronze artefacts are cleaned by using the above three types of tools, micro-blasters like the Airbrasive 6500 and methyl alcohol. Work is done in the following three stages to prevent rust that contains chlorine from newly corroding the bronze artefact.

- Corrosion stopping
- Corrosion stabilization
- Material strengthening

For cleaning of bronze objects, 2% benzotriazole is used. It is good to do this work in a vacuum environment.

Any benzotriazole adhering to the bronze surface after cleaning is wiped away with methyl alcohol. Strengthening is done by soaking the artefact in organic solvent (1:1 acetone: toluene) to which 5% Paraloid B72 has been added.



Cleaning the bronze

For Iron

- Washing solution
- Heat treatment

The corrosion process is halted and prevented with the above two methods. A new method that includes washing solution has been developed and is being used in Japan. It is called the "AC method". This AC method uses deionized water to which 0.2% benzotriazole and 0.1% sodium tetroborate

(Borax) have been added. The artefact is immersed in the solution and placed inside of a special machine where the pressure is raised to 1.2 atm and the temperature is heated to 120°C. Heating the solution enhances permeation. Compared to other methods, the AC method takes less time with treatment usually complete in 6 hr. The cleaned iron artefact is then placed in a 20% solution of Paraloid NAD10 and kept at a vacuum to strengthen.

A treatment for the iron artefacts

Bronze Artefact Wrapping

After the cleaning and strengthening work is complete, the bronze artefact is wrapped and stored. Wrapping is done with a preservation kit called "RP5". In order to manage the storage environment of the artefact, an oxygen indicator is placed inside the wrapping kit.

When wrapped, the artefact and indicator must be spaced apart to prevent direct contact. Once wrapped, the oxygen indicator is checked for colour changes. If the colour changes, the artefact was not properly wrapped and must be rewrapped from the beginning.

Preservation and Management of Wood Artefacts

Many wood artefacts have been discovered in Japan. A considerable amount of time is needed to clean and treat (preserve) them to a storable condition. A number of wood artefacts are waiting for preservation treatment. These artefacts are temporarily treated using a quick and simple method that maintains them in the same state in which they were first discovered.

Packaging the artefacts

Preserved wood artefacts

There are various ways to temporarily preserve wood artefacts.

- Large pool
- Container
- Packing in purpose-specific bag

0.01% Borax (sodium tetroborate) and 0.1% boric acid are added to water. A pH of 7 is appropriate here. The artefact is placed in a purpose-specific vynil bag with the solution, wrapped and stored. This temporary treatment lasts one year and, when that time expires, the solution can be changed and the artefact stored still longer. The following three methods are used to preserve and strengthen wood artefacts: PEG (Poly Ethilene Glycol), Higher alcohol and Freeze drying.

PEG Method

There are diverse types of PEG (Poly Ethilene Glycol), PEG200 to PEG20000, which differ by molecular wieght. Often used is PEG4000S. This PEG4000S dissolves well in water up to a 40% concentration. Higher concentrations require heating to 60°C.

Natural drying method

There are two methods for strengthening wood artefacts using PEG.

- Freeze drying
- Natural drying

Freeze drying: The wood artefact is soaked in a 40 ~ 60% PEG solution. Natural drying: The wood artefact is soaked in 80% PEG solution. When adequately impregnated with the liquid, the wood artefact is removed and dried by naturally means.

The PEG method works well for strengthening large artefacts. The method presents little danger and is very convenient. The demerits are that the wood turns dark and becomes heavy. And, treatment takes a long time.

Higher Alcohol Method

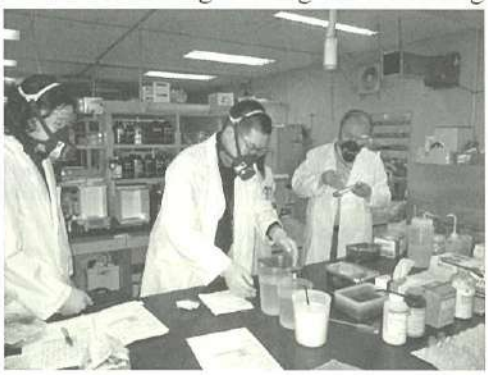
High alcohol and alcohol are used to strengthen small wood artefacts. There are two methods that use alcohol.

- Cetyl alcohol
- Stearyl alcohol

Organic solvent is dissolved using methyl alcohol. This method replaces the water contained in the wood artefact with methyl alcohol. Alcohol gradually replaces the water without altering the shape of the artefact. To do this, the water is removed from the wood artefact in stages using the following solution sequence.

50% methyl alcohol and water
70% methyl alcohol and water
90% methyl alcohol and water
100% methyl alcohol
30% cethyl alcohol and methyl alcohol
60% cethyl alcohol and methyl alcohol
80% cethyl alcohol and methyl alcohol

After the water has been removed, the wood artefact is quick-dried using cold air.



Changing the dense of alcohol

Vacuum Freeze Drying

Vacuum Freeze drying

Freeze drying freezes the water in the wood artefact under a vacuum, thus drying the artefact. This method uses butyl alcohol to do this. Freeze drying raises the alcohol concentration to 40%.

The wood artefact is carefully wiped with methyl alcohol before soaking in alcohol (to replace water) and placing in a purpose-specific machine. When placed in the machine, the artefact is kept at -40°C for one day. After that, it is kept under vacuum for one week. After the one week, when taken out of the machine, the artefact is white over its surface. This means that alcohol still remains in the artefact. It can be removed by blowing the artefact with hot air.

Using vacuum freeze drying to strengthen wood artefacts

Using vacuum freeze drying to strengthen wood artefacts shortens the treatment time, but the wood changes colour, turning white and losing weight. The method is suited for soft wood artefacts such as wood strips. Because we practiced the aforementioned methods at sites as opposed to hearing about them in a classroom environment, I was able to better absorb the information.

Todai-ji temple

Zenpuku-ji temple

The World Heritage: shrines and temples of Nikko

Colour Restoration of Wooden Structures

To learn about colour restoration of wooden structures, we visited the National Research Institute for Cultural Properties, Tokyo, the Nikko Cultural Assets Association for the Preservation of Shrines and Temples, and Saishiki Sekkei Corp. in Kyoto, and observed their activities. Moreover, there had been a seminar on the colour restoration of wooden structures at the Baldan Bereeven Monastery in Khentii, Mongolia in July 2009. During the tour, we learned about the components of paints used to restore the colour of wooden structures and were blessed with the opportunity to hear about traditional techniques used in Japan to restore colour to damaged surfaces and visit some famous traditional places in Japan.

Lacquer

Lacquer is a traditional technology of Japan. Lacquer itself is the liquid that exudes from a wound when its bark has been cut. Lacquer is spread with water. It is mixed with colcothar to turn it red, and reacted with iron to make it black. Black has been used to paint temples and shrines since long ago. This lacquer is used to paint wood structures. The process includes several base layers.

Lacquer

Gilding process

- The surface is scuffed and fabric is applied.
- Lacquer is applied three times.
- Lacquer mixed with colcothar is applied two times.
- The surface is coated with lacquer.
- Gold leaf is stuck to the surface.

Work is performed in the above sequence. Lacquer is used for red lacquer, black lacquer and as a base for gold leaf. After affixing the gold leaf, painting is done.

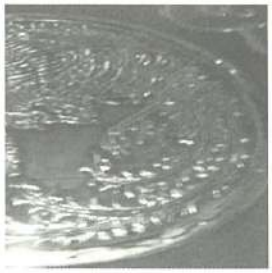
Painting

Three places are painted.

- Doors and walls
- Patterns
- Carvings

Worksite at Toshogu Shrine

Transom at Toshogu shrine



Ceiling picture of Zojo-ji temple

The most commonly painted objects are patterns. The pattern is made, decorated with gold leaf and then painted. Over time, the pattern changes colour. It is necessary to watch this discolouring carefully. Surface paint can flake and peel.

Mr Onomura presented a number of painting methods that he researched when in Mongolia.

- A large area may peel.
- The colour may become grainy and flake.

In the above cases, the paint is anchored with glue. In this method, paper is laid over the object,

impregnated with liquid glue and peeled off before the glue dries. Another method is to attach paper to the peeling colour and pull it off the structure. The peeled areas are then repainted and then transferred to a new sheet of paper. If most or all of the object's colours has peeled off, the original colours can be examined with a special light.

Impressions

I realized how different Japan and Mongolia are in terms of climate and geography, hence the condition of unearthed artefacts is quite different. Nevertheless, there are many similarities in that both have cultural heritages of Asia.

In the brief amount of time I was here, I was able to research the time-honored methods of protecting and managing artefacts suited for the characteristics of the particular country, and how to mix them with modern technologies so as to pass them on to the next generation. I was also shown how to do restoration work for those artefacts.

Our instructors emphasized the significance of resurrecting those methods peculiar to my country, which have been forgotten by today's world. The lectures, tours and practical training provided in this program helped me to deepen my knowledge.

Without a doubt, what I learned from this training program will prove useful in my work from here out. Moreover, I firmly believe that the good relations between our two countries will continue on into the future and we will have opportunities to combine our strengths in protecting and managing cultural properties.

Acknowledgements

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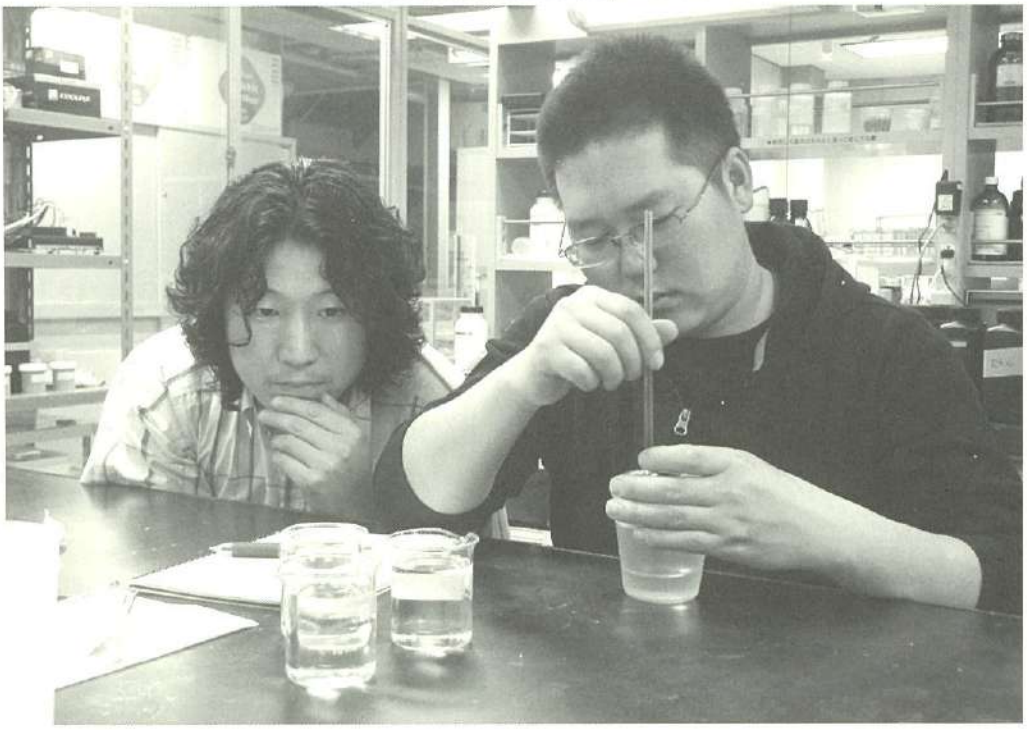
V. Appendix

1. List of Participants
2. List of lecturers and Interpreters
3. Staff Members, ACCU Nara



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