2020

Agency for Cultural Affairs Commissioned Project 2020

International Cooperation in Cultural Heritage Institutional Exchange Project

Institutional Exchange Project in Human Resource Development for the Preservation of Cultural Heritage in the Republic of Armenia

National University Corporation Saga University

Faculty of Art and Regional Design

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Agency for Cultural Affairs Commissioned Project 2020
International Cooperation in Cultural Heritage
Institutional Exchange Project

Institutional Exchange
Project in Human Resource Development for the Preservation of Cultural Heritage in the Republic of Armenia
2020 - 2021
Project Report

National University Corporation Saga University
Museums of the Mother See of Holy Etchmiadzin

Agency for Cultural Affairs Commissioned Project 2020
International Cooperation in Cultural Heritage Institutional Exchange Project "Institutional Exchange Project in Human Resource Development for the Preservation of Cultural Heritage in the Republic of Armenia" 2020-2021 Project Report

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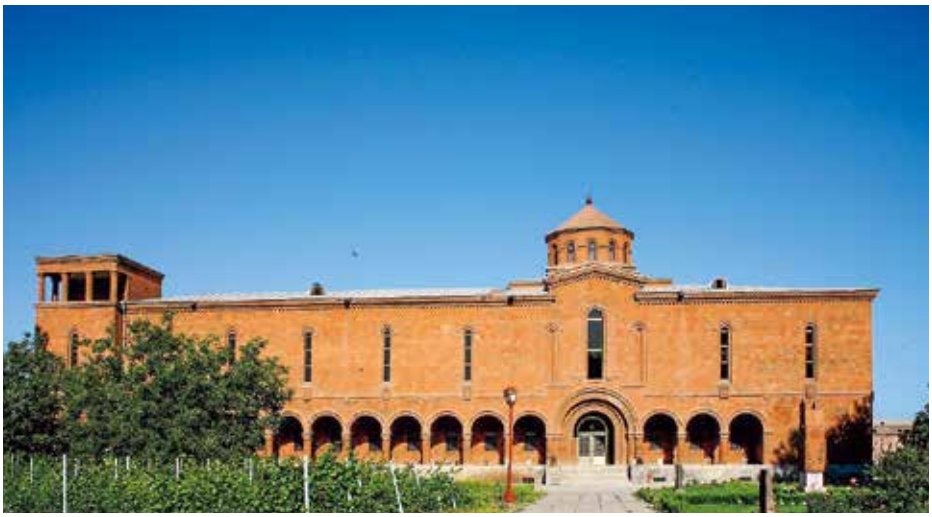
Forward

First of all, I would like to express my sincere gratitude to the people of Armenia and Catholicos Karekin II, Catholicos of All Armenians, for the friendship between Armenia and Japan.

Saga University has been entrusted by the Agency for Cultural Affairs in the institutional exchange project to cooperate in the preservation of cultural heritage. We are fortunate to have the Armenian Apostolic Church Museums of the Mother See of Holy Etchmiadzin as our institutional exchange partner. During a period in which the world faces difficulties with the COVID-19 infections, using online digital technology, we have endeavored to cooperate beyond borders to assist professionals working in cultural heritage preservation. It has not been an easy task but we have been able to work together with hope under a united purpose. I would like to express my deepest gratitude to His Excellency Archbishop Nathan of the Armenian Apostolic Church, Director Asoghik Karapechan of Museums of the Mother See of Holy Etchmiadzin. Ministry of Culture, Republic of Armenia, Armenia National Scientific Research Center for Historical and Cultural Heritage, National History Museum of Armenia, Jun Yamada, Japanese Ambassador to Armenia, Megumi Maekawa, First Secretary, Embassy of Japan in Armenia, Tokyo National Institute for Cultural Properties and everyone who generously supported this project.

Dean Dr. Mako Yoshizumi
Saga University
Faculty of Art and Regional Design



Museums of the Mother See of Holy Etchmiadzin

Museums of the Mother See of Holy Etchmiadzin

Etchmiadzin Cathedral is the headquarter of the Armenian Apostolic Church and is located about 30 minutes by car from the capital Yerevan. "Cathedral and Churches of Etchmiadzin and Archaeological Sites of Zvartnots" was registered as a UNESCO World Heritage Site in 2000. Armenia gained independence from the Soviet Union in 1991, but many of its treasures remain in warehouses due to long-term restrictions on religious activity. The museum was opened in 2014, and its treasures have been opened to the public, but there are many treasures that need to be restored. In addition, there are treasures awaiting restoration in the Armenian Apostolic Churches scattered throughout the country. Therefore, the basement of the museum is being renovated and a storage room and a restoration room are being developed, which is scheduled to be completed in 2021. It is being developed as a base facility to restore all the treasures of the Armenian Apostolic Church.

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Aim of the project

With the Armenian Apostolic Church Museums of the Mother See of Holy Etchmiadzin as its partner institute, and in collaboration with the Armenian National Research Center for Historical and Cultural Heritage Science, Saga University will cooperate in the exchange of knowledge and skills in heritage conservation, especially on historic textiles and archaeological materials. Training will be conducted in three fields: (1) history and philosophy of cultural heritage preservation, (2) inorganic substance analysis, and (3) documentation and photography, with the aim of contributing to the development of young and mid-career heritage professionals.

Background of the project

On December 6, 2019, during a study trip with Saga University students to Armenia, I met with His Excellancy Archbishop Nathan of the Armenian Apostolic Church, escorted by Japanese Ambasador to Armenia, Mr. Jun Yamada, and First Secretary Ms Megumi Maekawa. The Museums of the Mother See of Holy Etchmiadzin was setting up a conservation studio within its premises and he requested assistance in developing the capacity of the conservators and heritage professionals in Armenia. The students had the special experience of being invited to the inner grounds of the church on this occasion. On December 10, I was invited to the construction site of the conservation studios by the museum's director, Asogiku Karpechan to discuss specific cooperation.

In addition, on December 9, I met with Director Tigran Simonyan of the Armenian National Research Center for Historical and Cultural Heritage Science. The institute was being provided with analytical equipment for conservation with a grant aid from the Japanese government and he requested our assistance in training the staff to use these instruments.

These requests to Japan were made following on from the wonderful cooperation agreed between the Tokyo National Research Institute for Cultural Properties and the Ministry of Culture of Armenia to conduct workshops in textile conservation in Armenia during 2017-19 at the two institutions. I would like to thank all those who assisted in these events. (Mie Ishii)

Conducted Project

In the initial plan, two on-site training in Armenia was scheduled but due to the spread of the coronavirus infection, it became difficult to travel. In August 2020, we switched to remote training and produced audiovisual materials and texts instead of demonstrations of practical skills. Online real-time interactive program was conducted using audiovisual materials as well as texts.

Base Institution

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Dean Dr. Mako Yoshizumi

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Armenia Base Institution

Museums of the Mother See of Holy Etchmiadzin
Director: Farther Asoghik Karapetyan

110 Vagharshapat, Repubilic of Armenia
Tel. (+374) 10 51 71 10

Duration

May 1, 2020 - March 31, 2021.

Ambasador Jun Yamada, Mie Ishii, Archbishop Nathan, Midori Yokoyama, First Secretary Megumi Maekawa, Museum Director Asoghik Karpechan

Cooperation between Japan and Armenia regarding Textile Conservation

1. Agency for Cultural Affairs Commissioned Project 2020 International Cooperation in Cultural Heritage Institutional Exchange Project "Institutional Exchange Project in Human Resource Development for the Preservation of Cultural Heritage in the Republic of Armenia."
2. 2017-2019 Tokyo National Institute for Cultural Properties "Workshop on the Conservation of Textile Heritage in Armenia, 2017-2019."
3. 2014 Arts and Crafts Promotion Sato Foundation Granted Research "Investigation and Preservation of Historic Textiles at the Museums of the Mother See of Holy Etchmiadzin, Armenia"
4. 2010-2014 Japan Foundation Cultural Cooperation Sponsored Project "Workshop on Conservation and Restoration of Historic Textiles at the History Museum of Armenia."
5. 2010 Ikuo Hirayama Silk Road Museum Research Grant "Textile Conservation and Restoration Survey in Armenia."

Lecturers

Mie Ishii, Ph. D., Saga University
Takayoshi Tsuchiya, Saga University
Kazuya Yamauchi, Teikyo University
Makoto Arimura, Ph. D., Tokai University
Hiroo Kansha, Tokyo National Research Institute for Cultural Properties
Midori Yokoyama, NHK Culture Center
Tomohide Matsushima, Kochi University

Project Office

Kazuko Ogata, Saga University

Coordination

IROHA Center: Aremenian – Japanese Center of Educational and Cultural Exchange
Shuuichi Minamie
Rusan Khojikyan

Interpretor/translator (Armenian)
Rusan Khojikyan
Lilit Khansulyan
Zarine Hovakimyan
Shyusyan Hakobyan

Translator (English)
Yuko Furuya

Participants

Armenian Apostolic Church Etchmiadzin Cathedral Museum
Marine Petrosyan（Conservator/Textile）
Maro Harutyunyan（Conservator/Textile）

Armenian National Scientific Research Center for Historical and Cultural Heritage
Meri Safaryan（Archaeologist）
Nanar Kalantarian（Architect-Restorer）
Arina Grigoryan（Conservator/Ceramic）
Yelena Atoyants（Conservator/Metal）
Nona Manaseryan（Archeological and anthropological finds department.Curator）
Siranush Khalikyan（Conservator/Ceramic）
Taguhi Hmayakyan（Painter restorer）
Liana Zhamagortsyan（Conservator/Ceramic）
Anna Torosyan（Coordinator）

History Museum of Armenia
Hasmik Khachatryan（Conservator/textile）
Gevorg Vardanyan（Conservator/Metal）
Tereza Abgaryan（Conservator/Ceramic）
Astghik Melkonyan（Conservator/Ceramic）

Institute of Archaeology and Ethnography NAS RA
Mariam Amiryan（Archaeologist）

Service for the Protection of Historical Environment and Cultural Museum-Reservations
Astghik Simonyan（Conservator/Ceramic）

National Gallery of Armenia
Lilit Ghazaryan（Conservator/Ceramic）
Lilit Aghabekyan（Art critic）

Schedule

May 2020-September

Preparation of texts

September 2020-January 2021

Creation of audiovisual materials (includes the preparation, filming, and editing of materials)

October 2, 2020

1st Remote Programme

"The Operation Training of the X-ray Analyzer X-MET8000"
(Lecturer: Tomohide Matsushima, Ken Kunisada (Hitachi Hightech Science Co. Ltd.)

January 2021

2nd Remote Programme

January 22
"Basic Operation of Single-lens Reflex Digital Camera" "Photography of Archeological Objects"
(Lecturer: Hiroo Kansha)

January 25
"History and Philosophy of Cultural Heritage Preservation" (Lecturer: Kazuya Yamauchi),
"Conservation Science" (Lecturer: Tomohide Matsushima)

January 27
"Textile Conservation: Cleaning" (Lecturer: Mie Ishii)
"Japanese Embroidery" (Lecturer: Midori Yokoyama)
"Textile Conservation: Stitch Support" (Lecturer: Midori Yokoyama, Mie Ishii)

December 2020-February 2021

Preparation of documentatary materials

February 2021

Preparation of a report

First Remote Programme

Online training on the use of portable X-ray fluorescence analytical instrument.

Schedule

October 2, 2020. 14:00-15:30 (Japan) 9:00-10:30 (Armenia)
Tomohide Matsushima, Kochi University
Kei Kunisada (Hitachi Hightech Science Co. Ltd.)
The operation training of the portable fluorescent X-ray analyzer X-MET8000 (Hitachi) was delivered online in real time. The participants were trained in the principles and usage of the equipment through interactive dialogue.

Second Remote Programme

Real-time online training using audiovisual materials.

Schedule

January 2021 Implementation of remote training.

January 22 15:30-17:00 (Japan) 10:30-12:00 (Armenia)
"Basic Operation of Single-lens Reflex Digital Camera"
(Lecturer: Takayoshi Tsuchiya)
"Photography of Archeological Objects"
(Lecturer: Hiroo Kansha)

January 25 15:00-17:00 (Japan) 10:00-12:00 (Armenia)
"History and Philosophy of Cultural Heritage Preservation"
(Lecturer: Kazuya Yamauchi)
"Conservation Science"
(Lecturer: Tomohide Matsushima)

January 27 15:00-18:00 (Japan) 10:00-13:00 (Armenia)
"Textile Conservation: Cleaning"
(Lecturer: Mie Ishii)
"Japanese Embroidery"
(Lecturer: Midori Yokoyama)
"Textile Conservation: Stitch Support"
(Lecturer: Midori Yokoyama, Mie Ishii)

Produced Audiovisual Programmes

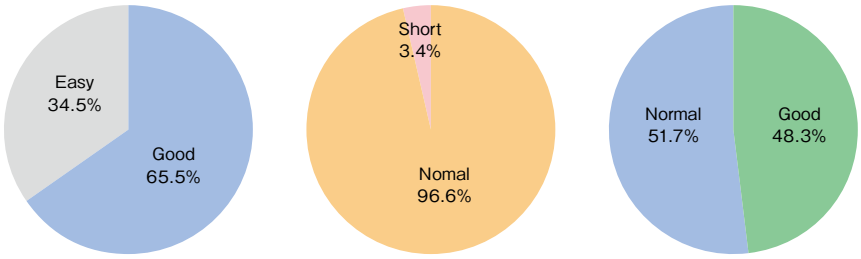
Five videos were made with accompanying text.
1. Textile Conservation: Cleaning
2. Textile Conservation: Stitch Support
3. Japanese Embroidery
4. Photography of Archaeological Objects
5. Basic Operation of Single-lens Reflex Digital Camera

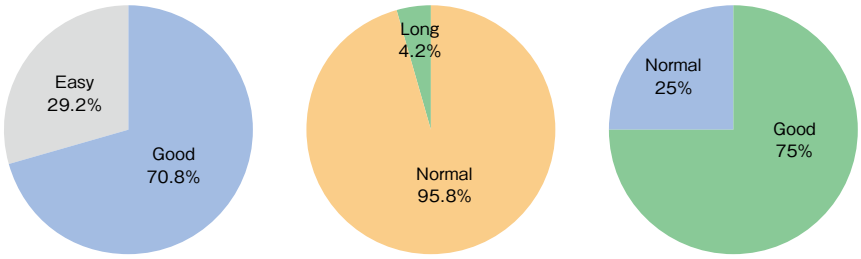
Audiovisual Production Toppen Co., Ltd.
Ami Muto
Tomotaka Jinnai
Kohsuke Amadera

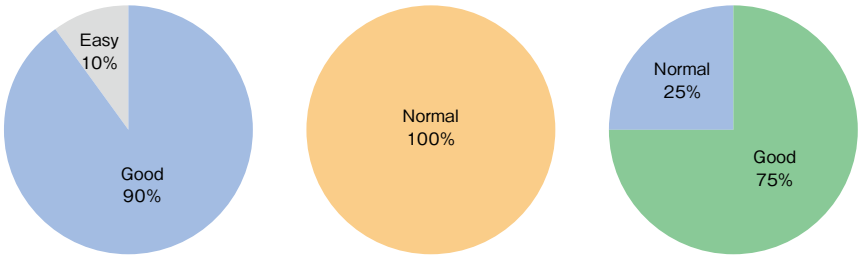
Result of the Questionnaire on the Programme

19 Participants

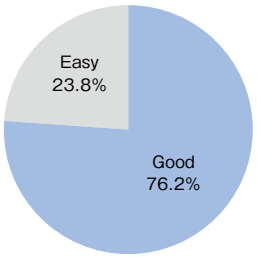
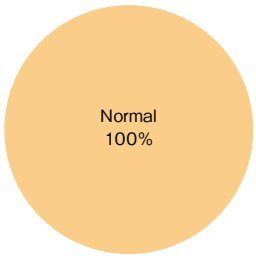
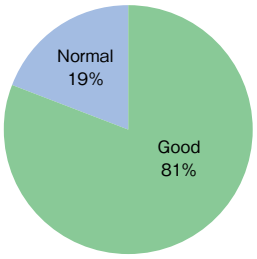
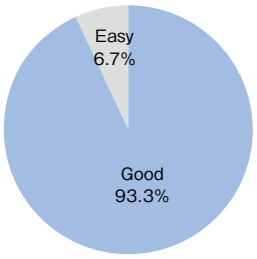
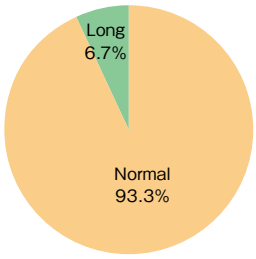
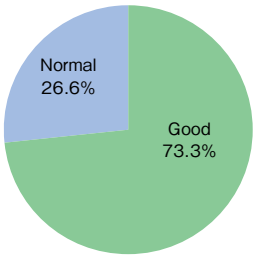
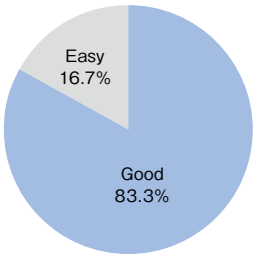
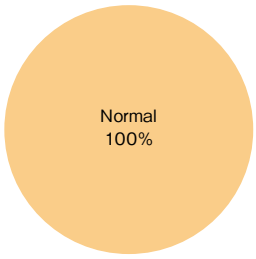
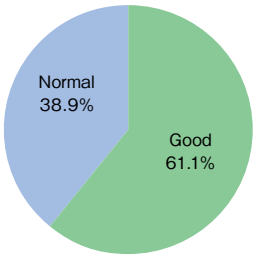
<table>
<tr><th>Course</th><th>Response rate</th><th>Difficulty</th><th>Length of time</th><th>Course content</th></tr>
<tr><td>Basic Operation of Single-lens Reflex Digital Camera

Photography of Archeological Objects</td><td>100%</td><td colspan="3"> 

〈Comment〉
・Good.
・Thank you for the interesting and informative lectures and videos.
・I would appreciate if you could talk about your experience of drawing and sketching/ measuring of artefacts in one of your lectures.
・What kind of modern devices/instruments would you recommend to get better quality illustrations?
・I gained new skills. I would like to learn more professional skills.
・Thank you.</td></tr>
<tr><td>Philosophy and History of Cultural Heritage Preservation</td><td>100%</td><td colspan="3"> 

〈Comment〉
・Good.
・New skills AM❤JP.
・I hope we can enrich our knowledge.
・I gained new skills.
・I learned and achieved new knowledge.</td></tr>
<tr><td>The Role and Nature of Conservation Science</td><td>100%</td><td colspan="3"> 

〈Comment〉
・I learned and achieved new knowledge.
・Thank you. It was a very important and informative lecture. I think we must study it in detail.
・It was really interesting, we learned essential information.
・I will use the new knowledge during my practice, mainly after fieldwork research. Thanks for presenting!</td></tr>
</table>

Course	Response rate	Difficulty	Length of time	Course content
Textile Conservation Cleaning	75%			
		〈Comment〉 ・Thank You. ・I got interesting information. ・I hope we can know more detailed information about textile, how we can restore it and enrich our knowledge in that area. ・Thank you for the informative video.		
Textile Conservation Stitch Support	100%			
		〈Comment〉 ・The course will help our specialists improve their qualifications in the above-mentioned topics. Thanks for the courses!! ・I hope that during this meeting we will enrich our knowledge.		
Japanese Embroidery	95%			
		〈Comment〉 ・I really enjoyed the meeting and we discovered so many things from different angles. ・I expanded my knowledge of Japanese culture, especially art. Thanks. ・I learned and achieved new knowledge. ・It was interesting.		

1

The History and Philosophy of Cultural Heritage

The Ordinance for the Abandonment of Castles (*Haijou Rei*) and The Abolishment of Buddhism and Destroy Shakyamuni (*Haibutsu Kishaku*): Meiji Restoration (*Meiji Ishin*) and Cultural Heritage

Kazuya Yamauchi

Teikyo University
Research Institute of Cultural Properties

The History and Philosophy of Cultural Heritage

The Ordinance for the Abandonment of Castles (*Haijou Rei*) and The Abolishment of Buddhism and Destroy Shakyamuni (*Haibutsu Kishaku*): Meiji Restoration (*Meiji Ishin*) and Cultural Heritage

Kazuya Yamauchi
Teikyo University
Research Institute of Cultural Properties

Although current circumstances dictate that we meet through the internet, it gives me great pleasure to meet you all today. Presently, I will talk on the broad theme of "The History and Philosophy of Cultural Heritage". As a case study for thinking about this theme, I will talk about an event which took place in the past in Japan, " The Ordinance for the Abandonment of Castles (*Haijou Rei*) and the Abolishment of Buddhism and Destroy Shakyamuni (*Haibutsu Kishaku*): Meiji Restoration (*Meiji Ishin*) and Cultural Heritage", which is the title of my seminar.

Before beginning my seminar today, as a way of introducing myself to you, I would like to mention my relationship with Armenia. I currently work at the Research Institute of Cultural Properties at Teikyo University, but until 2015, I worked at the Tokyo National Institute for Cultural Properties. At that time, Dr. Makoto Arimura, was a young colleague of mine. It was around 2008 when I began to think about starting a project for the preservation of cultural heritage in the Caucasus countries. As Dr. Arimura was researching Armenian archaeology, I thought about the possibility of an international cooperation in the preservation of cultural heritage in Armenia. I discussed this idea with a Japanese organization called the Japan Consortium for International Cooperation in Cultural Heritage. Armenia was chosen for the 2010 cooperation partner country survey with the aim of cooperating in the area of the preservation of cultural heritage. Subsequently, I visited Armenia in February 2011 which was my first encounter with the country. The left photograph in Fig. 1 shows discussions held in Armenia with participants from the Armenian side. The photograph on the right is the survey report compiled at the time. For those of you that are interested, the report is available on the internet.

Based on the results of this survey, a joint project between Japan and Armenia began from 2011. With the support of the Agency of Cultural Affairs in Japan, the joint project became part of the International Cooperation in Cultural Heritage Institutional Exchange Project. In collaboration with the History Museum of Armenia, a decision was made to conserve and carry out scientific research on the archeological metal materials in the Collection of the History Museum of Armenia. This project continued for three years until March 2014. The museum's director at the time was Ms Anelka Grigoryan and the vice minister of the Ministry of Culture of Armenia was Ms Alev Samuelyan. At the beginning, they must have felt very bewildered at the sudden appearance of specialists from Japan, a country in the far east of Eurasia, visiting them with a proposal for cooperation. However, as the interaction among the specialists progressed, gradually trust developed and

Fig. 1

Fig. 2

the project proceeded smoothly to achieve great success. At the international workshop held in Armenia, specialists not only from Armenia, but also Georgia, Kyrgyzstan, Kazakhstan, Romania, Russia, Iran, and Iraq participated to create new networks and friendships. (Fig. 2)

In conjunction with our project, Dr. Mie Ishii, who organized today's online seminar, was also carrying out her project. In fact, I had asked for her support in conserving Armenian textile and in 2010 she began an international cooperation on the preservation of textiles in the Republic of Armenia. This project is entering its eleventh year. (Fig. 3)

From 2020, as one of the International Cooperation in Cultural Heritage Institutional Exchange Project, commissioned by the Agency for Cultural Affairs, Saga University, which is where Dr. Ishii currently works, is cooperating with the Armenian Apostolic Church Museums of the Mother See of Holy Etchmiadzin to begin an Institutional Exchange Project in Human Resource Development for the Preservation of Cultural Heritage in the Republic of Armenia. This is the result of her cooperation over many years with Armenian specialists to build a relationship based on trust and friendship. With the spread of the coronavirus, this year we are only able to cooperate and hold exchanges online, but I believe in the future, our joint project will continue in Armenia. I also believe that this project will further strengthen the friendship between Armenia and Japan. I am mentioning these past events to you because I want you to know that it is the accumulation of such past events which form the foundation of our current relationship. Now, I would like to return to the main theme of today's seminar.

As I am sure all of you already know, the two Buddha statues of Bamiyan in Afghanistan were destroyed using explosives in March 2001. Since 2002, I have participated in the preservation of the cultural heritage in Bamiyan which was destroyed by the Taliban government. As you can see from the photographs, there are fragments of various sizes remaining at the foot of the destroyed Buddha statue. This type of vandalism against cultural heritage had an immense impact on the international community and it was denounced by all as a senseless act. However, the Japanese cannot deride this incident since a similar event occurred in Japan approximately 150 years ago. (Fig. 4)

Around that time, Japan was facing immense changes. In other words, Japan was transforming itself from an era ruled by the shogun and samurai into a modern country with the emperor at its center. In Japanese history, this event is known as *Meiji Ishin* which is translated as the Meiji Restoration[1]. After the fall of the Edo Shogunate which had previously ruled over Japan, the Meiji Government was inaugurated in 1868 and the Meiji period began. This was a massive change for Japan and the Japanese people of that period. The people felt great bewilderment as conventional values were discarded and replaced by the appearance of completely new values.

In order to advance Japan's modernization, the new Japanese government actively incorporated western civilization. Thus, it can be said that the foundation for the shape of current day Japan was established during this period[2]. The westernization of Japan was described by the word *Bunmei Kaika* which can be translated as Enlightenment or Westernization. *Bunmei Kaika* also meant the denial of the past, namely, old objects or traditions of the Edo period, as uncivilized or primitive and the affirmation of western culture which was newly entering Japan. During this period, *chonmage*, the traditional topknot hairstyle, was discarded and replaced by the more current style, *zangiri*, cropped hair, which became fashionable along with the dissemination of western clothes, western style buildings, gas lamps, schools, newspapers, magazines. Furthermore, beef, which the Japanese previously did not eat, was used as an ingredient in dishes such as sukiyaki. In this way, *Meiji Ishin* (Meiji Restoration) and *Bunmei Kaika* (Enlightenment/Westernization) resulted in rapid and dramatic changes in Japanese culture and the daily lives of the Japanese people. Overturning traditional values, it was an event which simply turned the Japanese world upside down. This wave of change also had an immense impact on Japanese traditional architecture and religion.

Fig. 3

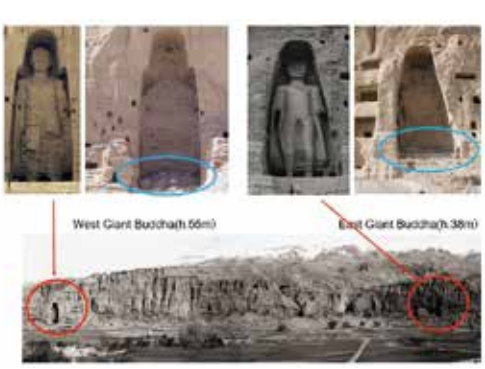


Fig. 4

In 1873, six years into the Meiji period, the Army Ministry of Japan issued an order which was to separate all the castles in Japan into those which should remain and be used and those which should be demolished. Having placed the emperor at its center, the Meiji government considered the Edo shogunate or the castles, which were a symbol of the samurai class, as redundant which resulted in the issuing of this order[3].

Fig. 5 Inuyama castle

Fig. 6 Matsumoto castle

Fig. 7 Himeji castle

Inuyama castle (Fig. 5), Matsumoto castle (Fig. 6) and Himeji castle (Fig. 7) are currently designated as National Treasures. The two castles on the left were due to be demolished at that time. The castle on the far right, the famous Himeji castle was selected to remain at that time. Today, Himeji castle is registered as a UNESCO World Heritage Site. Therefore, even castles, which today are designated as National Treasures, faced the possibility of demolition during a period of large social change. Conversely, it can be said that they are National Treasures because they managed to survive and remain[4].

Put simply, *Haibutsu Kishikaku* means to discard Buddhism and the teachings of Buddha. For any tourist who has visited Japan, these words must seem very strange since Buddhist temples are one of the most popular Japanese tourist spots[5-6]. The Buddhist temple in Nara, the Horyuji temple is known as the oldest intact wood architecture in the world. Horyuji temple is a Japanese Cultural Property with several of the buildings designated as National Treasures and furthermore, it is registered as a UNESCO World Heritage Site. Another temple in Nara is Kofukuji temple which is also a Japanese Cultural Property and is registered as a UNESCO World Heritage Site. The Five-storied Pagoda on the right is designated as a National Treasure. It is hard to believe, but during *Meiji Ishin*, these Buddhist temples faced the danger of demolition.

Haibutsu Kishaku (Abolishment of Buddhism and Destroy Shakyamuni) was issued by the Meiji government in 1868 and was part of the anti-Buddhist movement which began with the *Shinbutsu Bunri Rei* (Ordinance Distinguishing between Shinto and Buddhism)[7]. *Meiji Ishin*, which I mentioned previously, played an important role in this turn of events. Originally, Shinto was the religion which existed in Japan from ancient times and Buddhism entered Japan through the Silk Road in the beginning of the 6th century. Subsequently, the ancient Shinto and the newly emerged Buddhism joined together. From a historical standpoint, it is generally accepted in Japan that Buddha and Bodhisattva changed their form to appear in Japan as Gods. This may be difficult to understand for those of you who believe in Christianity but this was the form of faith among the Japanese people. However, the Meiji Restoration decreed that religion should be based on Shinto which involved the worship of Gods who were the ancestors of the emperor and the need arose to separate Shinto from Buddhism. As a result, where as previously, "Buddhism was above and Shinto was below" the order was reversed where "Shinto became above and Buddhism below". Thus, previously accepted concepts and values were overturned and at the time resulted in immense confusion. Originally, the aim was to remove Buddhist elements from Shinto shrines but ultimately it ended with the destruction of Buddhist temples, statues and objects. There are wood block prints showing a scene where sutra books are being burnt in order to convert a Buddhist temple into an elementary school. In the image (not printed here), a Buddhist priest is lamenting on the situation. Stone statues were also destructed around that time and the heads of the statues have been destroyed. Such destructions remind us of the destruction of the Bamiyan statues.

Kofukuji temple in Nara which I previously mentioned was built in its current location in the 8th century which means that the temple's history is over 1,300 years old. Kofukuji temple has in its possession a statue of Ashura, the God which protects Buddha. This Ashura statue is one of the most popular Buddhist statues among Japanese people[8]. In the beginning of the Meiji period amidst the *Haibutsu Kishaku*, 130 Buddhist priests from Kofukuji temple were converted into Shinto priests of the nearby Kasugataisha shrine. Thus, in 1872, Kofukuji temple was abandoned and became a desolate temple without any priests. The temple was restored and its priests were allowed to return nine years later in 1881, but in the period in-between, there was no one at Kofukuji temple. There was a plan to burn the Five-storied Pagoda

in order to obtain the metal fittings used in the building. However, it is said that nearby residents prevented this from happening by stating their concern that the fire could potentially spread into their neighborhood. Photographs which show the state of Kofukuji temple during this period still remain today. Please look at the next images.

Photographs of Kofukuji temple at that time show two arms of the Ashura statue being removed[9]. The state of the other statues is also in poor condition. They were all gathered into one room and left there in an unorderly manner. As a result of the immense changes taking place, Buddhist statues which were once an object of worship become worthless. Among the Buddhist statues, quite a few were sold as wood and burnt.

Registered as a UNESCO World Heritage Site in 1993, Horyuji temple faced a similar fate to Kofukuji temple during that same period. Built as a Buddhist temple in 607, Horyuji temple was burnt down once in 670 but was rebuilt and remains intact today as the oldest wood architecture in the world. Most of Horyuji temple's remaining buildings, along with many of the statues housed inside them, are designated as a National Treasure[10-11].

Although Horyuji temple was able to avoid the destruction of its buildings and Buddhist statues, the temple lost its revenue and the Buddhist priests faced a precarious situation in their everyday lives. At times, they were forced to burn the temple's valuable ancient documents as firewood for the cooking stoves. Furthermore, the temple's sutras were sold off and used as wrapping paper for sweets and food or else the sutras were exchanged for food. Faced with financial difficulties in their livelihood, Horyuji temple offered the treasures from the temple's collection to the imperial family and received money in return which enabled them to overcome the difficult situation and remain until the present time[12].
Haibutsu Kishaku meant that large quantities of Buddhist objects were discarded or sold off. One example is the *Tenpyo Shakyo* which refers to the hand-copying sutra (*shakyo*) executed as a national project in the Nara period[13].

During the period of *Haibutsu Kishaku*, these valuable sutras were sold off at what would be considered today an unbelievably low price. *Tenpyo Shakyo* can be found in the collections of museums abroad today and many of them were obtained during that period. In conjunction with *Haibutsu Kishaku*, many cultural properties faced extinction during the period of *Bunmei Kaika*. Objects collected in Japan by the American zoologist, Edward Morse, are currently in the collection of the Peabody Essex Museum in America. Among the Peabody collection is a large number of Japanese signboards (*kanban*). The museum exhibition rooms display wooden signboards for Japanese shops with words such as "tobacco", "*amazake* (sweet fermented rice drink)", "*mizuame* (starch syrup)" written on them. The signboard in the shape of a *geta* (traditional Japanese wooden clogs) belonged to a shop specialized in selling the wooden footwear which were widely worn at that time. These types of objects can hardly be found in the collection of Japanese museums. During *Meiji Ishin* and *Bunmei Kaika*, many Japanese objects left the country and today foreign museums possess numerous objects which can no longer be found within Japan. The fate of cultural heritage in Japan was greatly impacted by changes in the thoughts and values of a period where old objects were actively destroyed to make way for new things.

As I have been mentioning in my talk to you today, the wave of *Haibutsu Kishaku* resulted in the destruction of Buddhist temples, statues and objects. In conjunction with Enlightenment/Westernizataion which had the tendency to depreciate traditional Japanese art, many Japanese artworks left the country. However, on the other hand, it also resulted in the rise of a movement to reevaluate traditional Japanese art and preserve Japanese cultural property. The 1868 *Shinbutsu Bunri Rei* (Ordinance Distinguishing Shinto and Buddhism) caused the wave of *Haibutsu Kishaku* to spread rapidly throughout Japan. However, a move to reexamine these events occured three years later in 1871 and the *Kokikyubutsu Hozon Rei* (Ordinance to Preserve Antiquities and Old Items) was enacted. This ordinance was passed as a result of the destruction of Japanese cultural properties and the exportation of Japanese artwork abroad through the wave of *Haibutsu Kishaku* and *Bunmei Kaika*. It was also the first step towards the systematic preservation of cultural property in Japan. The preamble to this ordinance states that "It is important to cherish old objects in order to steadily determine matters." After the Second World War, in 1950, the *Bunkazai Hogo Hou* (Law for the Protection of Cultural Properties) was passed anew in Japan. This law has been continuously revised and amended throughout the years into the current Law for the Protection of Cultural Properties and the establishment of a system for preserving cultural properties.

The diagram in Fig. 8 shows the current system for preserving cultural property in Japan. Prior to the establishment of this system, it was necessary for Japan to overcome the bitter experience of witnessing the destruction of cultural property and cultural heritage through *Haibutsu Kishaku* which I have been talking to you about today. I will not refer to the details but the concept of cultural heritage changed in accordance to the times and changes in values, and thus systems were accordingly created anew[14].

Cultural heritage constantly faces the danger of extinction. The causes are varied such as natural deterioration, natural disasters such as earthquakes and heavy rainfall, man-made disasters such as fires and conflicts. Furthermore, the course

of history and changes in values which I mentioned today can also be a factor. We may not be able to preserve every single cultural heritage. However, it is necessary to always question why cultural heritage is important, why it should be preserved and to hold discussions about it with other people. Old objects should not be merely preserved because they are old, but we need to think about what it means to pass on old objects to the next generation. Moreover, the value of cultural heritage is different according to each person and country. In order to protect cultural heritage and preserve it for future generations, we need to respect diversity, understand and share different values. It is through constantly questioning to oneself the meaning for preserving cultural heritage that will ultimately lead us to the preservation of cultural heritage[15]. One can only live in the times when he/she is alive.

Therefore, it is necessary to think about what you can do in the time when you are alive.

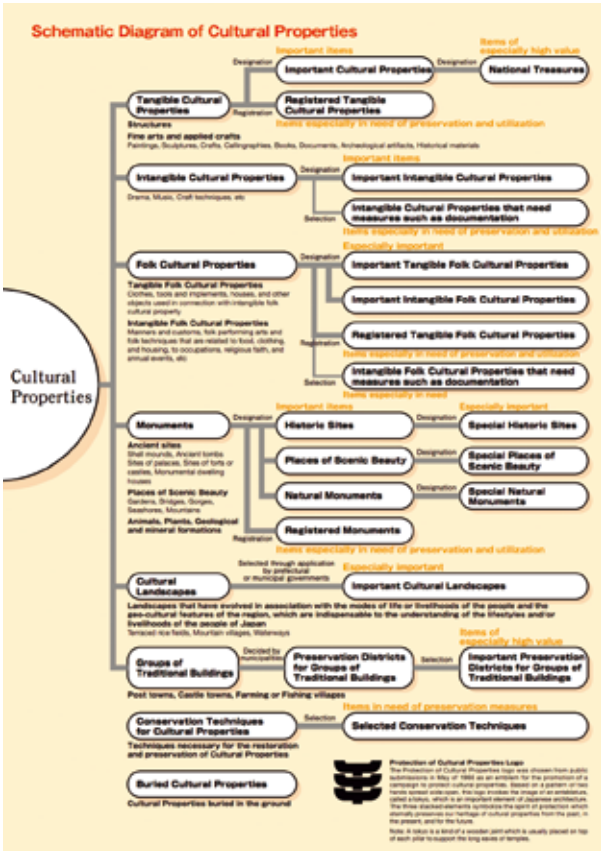


Fig. 8

Note

1. Meiji Restoration
   https://en.wikipedia.org/wiki/Meiji_Restoration
2. 文明開化　*Bunmei Kaika* Meiji era
   https://en.wikipedia.org/wiki/Meiji_(era)
3. 廃城令　Ordinance for Abandonment of Castles
   https://ja.wikipedia.org/wiki/%E5%85%A8%E5%9B%BD%E5%9F%8E%E9%83%AD%E5%AD%98%E5%BB%83%E3%83%8E%E5%87%A6%E5%88%86%E4%B8%A6%E5%85%B5%E5%96%B6%E5%9C%B0%E7%AD%89%E6%92%B0%E5%AE%9A%E6%96%B9
4. Matsumoto castle
   https://en.wikipedia.org/wiki/Matsumoto_Castle
5. Horyuji
   http://www.horyuji.or.jp/
6. Kofukuji
   https://www.kohfukuji.com/
7. *Haibutsu Kishaku* (Abolishment of Buddha and Destroy Shakyamuni)
   https://ja.wikipedia.org/wiki/%E5%BB%83%E4%BB%8F%E6%AF%80%E9%87%88
8. Kofukuji Ashura statue
   https://www.kohfukuji.com/property/b-0009/
9. Kofukuji Kongo Buddha
   https://www.kohfukuji.com/english/
10. Horyuji Tamamushi Shrine
    https://en.wikipedia.org/wiki/Tamamushi_Shrine
11. Horyuji Kondo Shyaka Sannzonzo
    http://www.horyuji.or.jp/en/
12. Horyuji temple Gojyu no tou
    http://www.horyuji.or.jp/en/
13. *Tenpyo Shakyo* (National treasure, Tokugawa Museum)
    https://www.tokugawa-art-museum.jp/about/treasures/calligraphy/post-01/
14. Schematic diagram of cultural properties
    https://www.bunka.go.jp/english/policy/cultural_properties/introduction/overview/
15. Cathedral and Churches of Etchmiadzin and the Archaeological Site of Zvartnots.
    https://whc.unesco.org/en/list/1011/　(Accessed 2/7/2021, English)

Image: Fig. 5 Inuyama castle (Inuyama city tourist association), Fig. 6 Matsumoto castle (Matsumoto castle managing office), Fig. 7 Himeji castle (Himeji city).

2

Cultural Properties and Science

— The Role and Nature of Conservation Science —

Tomohide Matsushima
Kochi University

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1. Introduction

The academic field which scientifically analyzes and researches cultural properties is called "conservation science." The term "science" generally refers to natural science, so it may be difficult to think of cultural properties and natural science as connected. It may be easier to gain a proper image if conservation science is regarded as a field which empirically, logically, and systematically researches art (cultural properties) based on knowledge derived from science and technology.

This paper provides a simple introduction to the origins of conservation science in Japan, and the nature of actual research.

In investigative research on cultural properties, the mainstream approach thus far has been observation and description by researchers in the humanities, primarily art history. Those results have established a framework. They have illuminated the aesthetics of cultural property pieces and their latent historical information, and drawn people's interest to their beauty and narrative dynamism so that they visit the sites of cultural properties to appreciate them. However, if sometimes the descriptions depend too much on subjectivity, a dogmatic tendency is strengthened, and it is no longer easy to achieve objectivity enabling sharing with other researchers at an academic level. In contrast, most of the information obtained using the techniques of natural science are numerically quantified or captured in images, and thus have the characteristic of being objective and easy to share with other researchers.

In this way, the character of obtained information differs between the humanities and natural sciences, even when the subject matter is the same. Conservation science might be regarded as a discipline which arose to provide support and greater validity to previous humanities-based research. It is currently a discipline essential for cultural property and museum research. However, a discipline is an area where it is assumed that objectivity is ensured in all cases, and that, ultimately, original research (innovative research) is regarded highly from the subjective standpoint of researchers. People engaged in the new discipline of conservation science carry out research every day, while continuing to ask themselves what they can do as scientists to protect cultural properties.

2. The standpoint of conservation science

Even when the field is different, the stance of pursuing the truth is the same provided the subject matter of research is the same. Therefore, in recent years, a cooperative research approach, even between different fields, has become common. Domains like this which are the subject of research by different fields are called interdisciplinary.

As shown in Fig. 1, conservation science is an interdisciplinary area. However, the author would like to point out again that there are clear differences between the two fields, humanities and natural science, in that the former focuses on finding problems, while the latter focuses on finding answers.

2.1 The origins and importance of conservation science in Japan

In Japan, it is said that the first application of natural science techniques to a cultural property was the conservation survey of the Hōryū-ji murals. Hōryū-ji was built in the seventh century and is known as the oldest extant wooden building in the world[1]. A survey of the murals of the Kondō (main hall) was advocated by OKAKURA Kakuzo (1862–1913), an art critic of the Meiji period. Methods of conserving the Kondō murals at Hōryū-ji were discussed, and the project went as far as developing a synthetic resin to prevent flaking, but in 1949 there was a fire during the restoration work. This fire at the Kondō led to strengthening of the system for protecting cultural properties, and the Act on Protection of Cultural Properties was enacted in 1950. After the Kondō fire, there were dramatic improvements in conservation techniques for

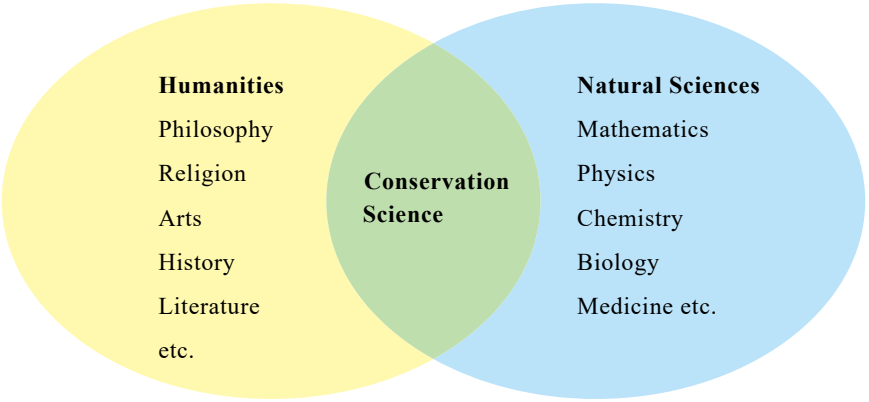

Fig. 1 Standpoint of conservation science.

cultural properties due to a unified effort to achieve conservation and restoration. The origins of conservation science in Japan cannot be told without mentioning this mural conservation project.

As another example of scientific analysis and investigation of a cultural property, there is the case of the *Einin no Tsubo* incident which caused a tremendous uproar in the antique art world around 1960 due to a question of authenticity. This incident began in 1959 when a *heishi* (an old type of *tsubo*, i.e., sake bottle) marked with the writing "2nd year of Einin" (1294) was taken to be a masterpiece of Koseto ware from the Kamakura period, and nationally designated as an important cultural property. Shortly after this designation, some art historians began to question whether the *heishi* was perhaps a fake. Some say there were doubts before designation, but, in the end, designation of this *heishi* as an important cultural property was rescinded two years later. The incident became a scandal involving the art history world, the antique art world, and the cultural properties protection administration, marked by events like the technical official of the Ministry of Education, Science, Sports and Culture who recommended the designation taking responsibility and resigning[2-3].

At that time, it was decided to use scientific methods as a way to resolve the incident. X-ray fluorescence spectroscopy was used to analyze the materials without damaging the *heishi*. X-ray fluorescence spectroscopy is a form of scientific analysis that enables determination of a material's type by measuring the elements in the material, and by using this technique, vital evidence was presented to resolve the question of authenticity. This incident showed the public, for the first time, the importance of scientific techniques in investigating cultural properties.

Closer to our daily lives, the X-rays we have all experienced in medical care are a method of scientific analysis essential for scientific investigation of cultural properties. More formally, this is known as "transmission X-ray radiography," and it is a typical technique for non-destructive analysis. Sometimes the news presents a story of a hidden motif found inside a painting, and cases like this are a result of transmission X-ray radiography. Examination using transmission X-ray radiography is a scientific survey technique that is essential in all cultural property fields, and has a major impact on the interpretation of artistic works. For example, it allows one—without even touching a work—to do things like find a layout drawn underneath an oil painting that is invisible to the naked eye, or to find items embedded inside Japanese Buddhist statues.

Attempts have been made in various fields to obtain new results using approaches different from those used heretofore. However, today cultural diversity is being advocated, and in that context, it has reached the point where people have recognized the importance of cultural identity derived from cultural properties, and it is thought that the social role of applying science to cultural properties will become even more important.

3. Science of the conservation environment − Light, temperature/humidity, air management, biological damage control −

The three primary research fields in conservation science are: science of the conservation environment, scientific analysis of cultural properties, and materials/techniques for conservation and restoration. To understand these fields, it must be recognized that cultural properties are composites of various materials. To safely store cultural properties, it is crucial to make an overall judgment based on observation of each individual material. A stance is needed where history and art are set aside, and the property is viewed as material. For example, *nihonga* (modern Japanese-style paintings) are composed of materials such as inorganic pigments and organic dyes for providing color, *nikawa* (glue) whose main ingredient is

collagen, and *washi* (Japanese paper), silk, wood, or other material used as the painting surface (base material). That is, these are delicate things when viewed as materials, and special consideration must be given to their handling and conservation environment.

3.1 Science of the conservation environment

To begin, this section describes changes in conservation environment science for cultural properties in Japan. In Japan, the term "conservation environment" was first used in the cultural property field in 1967[4]. Research on the conservation environment for cultural properties changed because various types of damage to cultural properties occurred, starting around the 1970s, due to harmful volatile substances. This was a result of factors such as building materials used in the art museums and other museums that are facilities for exhibiting cultural properties to the public. Also, even if repair or restoration is done, if the property is returned to the original poor environment, it will be harmed again, and repeated repairs will lead to the loss of the original form and materials. Reflecting on this, Garry Thomson advocated an approach in the 1980s called preventive conservation, which emphasizes environmental improvement rather than the previous approach prioritizing repair, and this type of conservation has become mainstream throughout the world. As a reference source, these ideas are presented in *The Museum Environment* (1986)[5].

Here, prevention means taking preemptive steps before damage or deterioration occurs. At present, conservation science has adopted this approach of environmental improvement through preventive conservation as a principle, and it is regarded as important to solve problems by not handling each cultural property deterioration factor in the same way, and instead establishing an order of priority suited to the piece or facility. Table 1 shows the main deterioration factors for cultural properties.

Table 1 Causes of cultural property damage

① Theft/ destruction	Deliberate, accident, terrorism
② Earthquake/ fire/ flood	Natural disaster, accident
③ Impact/ vibration	Transportation, accident
④ Biological/ pest attack	Mold, fungi, lichens, insects, animals, plants
⑤ Environmental air (gas)	Outdoor air pollution …… factory, traffic, volcanic activity Indoor air pollution …… building materials, paints
⑥ Temperature and humidity (air conditioning)	Temperature change, dampness, dryness, malfunction of air conditioning
⑦ Light (lamp)	Artificial light (fluorescence, tungsten, LED light) Natural light (sunlight)

As shown in Table 1, the deterioration factors of cultural properties are diverse. Generally speaking, temperature, humidity, and light attract attention as deterioration factors, but considering the degree to which cultural properties are damaged, it is evident that factors such as fading due to light are quite hard to notice in the short term, compared to more severe cases such as destruction, earthquakes, and fire. Probabilities of occurrence, i.e., the frequency with which damage occurs, are also diverse. Thus, in determining the risk that these deterioration factors will damage a cultural property, the basic approach is to consider the product of the magnitude of damage caused by each deterioration factor, with the probability of occurrence of the event. However, judgment is difficult given that it is hard to estimate which factors threaten a high degree of damage, and which events occur at what probability.

Risk = Cumulative degree of damage due to deterioration factor x Probability of occurrence

People engaged on the front lines of conservation management must have the ability, in the environment where they are placed, to grasp the degree of risk of each deteriorating factor, create an order of priority for preventative measures, and properly implement that plan.

3.2 Deterioration factors

This section provides a more specific explanation of the cumulative deterioration factors indicated in Table 1: Light,

Humidity, Air environment, and Living organisms.

3.2.1 Light

⑦ Light (lighting, illumination) is a part of ordinary life, and is not generally recognized as causing major cumulative damage in deterioration of cultural properties. It is well known that sunlight contains ultraviolet (UV) rays, but UV rays are also emitted by fluorescent lights. Therefore, if fluorescent lights are used as is for exhibitions, special caution is necessary because there is a risk of damaging the pieces. As a countermeasure, museums use equipment like fluorescent lights for which steps have been taken to prevent diffusion of UV rays. Also, in lighting with incandescent bulbs such as the halogen lamps used for spotlights, heat rays due to the large amount of infrared rays are emitted in addition to a minute amount of UV rays. Therefore, this issue must be addressed by using bulbs incorporating a mechanism for reflecting infrared rays. At present, white LED lighting, which has high color rendering and does not emit UV rays, is coming into wider use in museums.

Even with visible light rays, which are not UV or infrared rays, if illuminance is high, things like dyes will fade[6]. Therefore, general restrictions are established for each piece category, using an approach called "integrated illuminance" which is cognizant of the exhibition environment. For pieces that are extremely sensitive to light—especially photos, dyed and woven textiles, and the like—the irradiance is kept below an annual integrated illuminance of 15,000 lux-hours assuming an illuminance of 50 lux (example: 50 lux (illuminance) x 8 hours (illumination time) x 300 days (days museum is open)). Also, pieces such as oil paintings are comparatively sensitive to light, and museums strive to minimize fading by limiting to an irradiation amount of less than 600,000 lux-hours per year assuming an illuminance of 150 lux (example: 150 lux x 8 hours x 300 days). *CIE Technical Report: Control of Damage to Museum Objects by Optical Radiation* (2004)[7] is one reference on this topic. This concept of integrated illuminance takes account of the advantage that the conditions of exhibition lighting can be set within the proper range to suit the exhibition environment and the people exhibited to (museum visitors). For example, if a work that is extremely sensitive to light is exhibited, and it is determined that 50 lux (generally felt to be dark by everyone) is too dark to be suitable, then provided the value is within 15,000 lux-hours (the annual integrated illuminance), the illuminance can be increased within the appropriate range for the work by shortening the lighting time or the number of days that the exhibiting facility is open.

3.2.2 Temperature/humidity

This section explains ⑥ Temperature and humidity. Temperature and humidity are closely related and cannot be considered in isolation[8]. A sudden change in humidity poses a risk of causing physical damage in the form of deformation of the piece itself, and if high humidity continues it may cause growth of fungus. Therefore it is important to minimize fluctuations in temperature/humidity, and maintain appropriate values. There are specific methods for doing this such as reducing gaps between storage boxes or exhibition cases, increasing airtightness, and reducing relative humidity fluctuations in the space. However, it is still important to not neglect proper daily air-conditioning management. If routine management is carried out relying only on air-conditioning equipment, especially in places with large climatic variation, there are many cases where recovery work is difficult after a problem occurs, and special care is needed due to the risk of causing severe impacts.

3.2.3 Air environment

Management of ⑤ Air environment, focuses on substances which pollute the air—not only atmospheric pollutants such as gases and ash from factories, cars, and volcanoes, but also indoor pollutants whose sources are located indoors. Attention must be paid not only to storage rooms, but also to exhibition rooms. If a new exhibition case is installed, or new materials in large amounts are brought into a room, for reasons such as new construction or remodeling of a building, care must be taken regarding the effects. For the same reasons given in the section on temperature/humidity, if exhibition is done in an exhibition case with high airtightness, or storage is done in storage boxes, it is hard to notice any problems from the outside, and thus the case or box must be opened and inspected periodically. In research on the air environment, the Tokyo National Research Institute for Cultural Properties reported in 1967, for the first time in the world, a case of indoor pollution[9]. In Japan, since the 1960s, buildings have been increasingly made from concrete and airtightness has increased, due to the need to protect cultural properties from fire and to conserve energy. It was found that, as a result, alkaline substances volatilized from concrete have an effect on cultural properties. These are cases unique to Japan where new buildings were built and used as museums. After that, in the 1970s, research began in Europe and the U.S. on

the air environment inside exhibition cases. In Europe and the U.S., there are many cases of using historical buildings as museums, and adequate time has passed so that pollutants which volatilize from the buildings themselves are low-level and there is little impact. However, this is because exhibition cases made of new materials came into use to protect cultural properties from air pollution gases released in large amounts due to global economic growth.

3.2.4 Living organisms

To prevent damage due to ④ Living organisms, it is important to construct an environment which does not allow contact with insects that feed on cultural properties, or fungi which cause discoloration. Daily management is necessary at locations that are hard to see, and includes being careful to not leave any moisture (including humidity) needed for the growth of insects or fungi. These tasks are not difficult, and can be achieved through routine cleaning and maintenance of a clean environment. Cleaning away dust and debris suppresses the occurrence of fungus and enables proactive prevention of infiltration of organisms which feed on fungi. More specific methods of dealing with these issues are reported in *Controlling Museum Fungal Problems* (1991)[10].

An increasing number of curators have knowledge of conservation management, and they are working hard to create management systems suited to the circumstances at each facility. However, even if biological damage occurs, and a facility is forced to carry out fumigation or disinfestation/sterilization, highly-specialized knowledge is needed for handling the pesticides used. Even for people who have majored in conservation science, a prudent approach of checking with higher level experts before starting work is necessary to select pesticides that do not cause degeneration or discoloration, in accordance with the various materials that make up the cultural property.

Biological damage is our one-sided human perspective, and nothing more than instinctive natural activity from the organism's perspective. That is, biological damage will inevitably keep recurring if storage conditions and facility management systems are not reviewed. This is not an issue only for the people who manage facilities; it is a key point that all people handling cultural properties must be aware of on a day-to-day basis.

In typical facilities, fumigation measures were previously carried out simultaneously in store rooms and exhibition rooms. This approach was highly efficient, and work could be done easily, so it was done periodically. The pesticides used for fumigation were those widely used in the agricultural field for tasks such as disinfestation. However, this sort of pesticide destroys the ozone layer and developed countries decided to ban its use from 2005. Therefore, alternative measures that don't use pesticides began to be examined, and a pest control technique called integrated pest management emerged from the agricultural field. *Integrated Pest Management in Museum, Library and Archival Facilities* (1993)[11] is a good reference for applications to cultural properties and museum pieces.

The above effects on the ozone layer are a major factor, but in agriculture predicated on the use of pesticides, pests also develop resistance to pesticides, and thus pesticide toxicity gets stronger, and effects on environmental pollution and the human body become more severe. This was the impetus that lead to the creation of IPM. The concept of IPM is not to exterminate pests, but to carry out management by reducing their number below the level which causes damage, and creating an environment for maintaining that level. Therefore, for measures to counter biological damage of cultural properties, the previous approach centered on extermination or treatment using pesticides, keeping in mind the previous occurrence of pests, has shifted to an approach focused on preventive measures to preempt damage.

To conserve cultural properties, we must also look to global trends, and change our response in this way.

4. Scientific analysis of cultural properties —Typical analysis techniques—

This section explains scientific analysis of cultural properties. In Japan, no-destruction/no-contact is a fundamental principle for scientific analysis of cultural properties, and thus obtained results are not necessarily absolute. The reason for this is that it is impossible to collect samples directly from cultural properties and subject them to rigorous analysis[12]. However, researchers are working every day by analyzing previous experience and obtained results, so that the reliability of obtained results can be improved. This section primarily explains optical examination and dating methods for investigating cultural properties in line with the principle of no-destruction/no-contact.

4.1 X-ray examination methods

4.1.1 Transmission X-ray radiography

As described at the beginning, transmission X-ray radiography is a particularly useful non-destructive/non-contact

examination technique.

Transmission X-ray radiography uses X-rays' ability to pass through objects. X-rays are a form of light (electromagnetic waves) with a wavelength shorter then UV rays, and graded from shorter to longer wavelengths, rays are classified as: X-rays → UV rays → visible light rays → infrared rays. X-rays cannot be seen with the eye or felt with the skin. When a person is subjected to X-rays, it is called "exposure," and thus people tend to have a frightening image of X-rays, but they are very effective if the rules regarding their use are observed.

Imaging is done by irradiating a cultural property with X-rays emitted by a generator, and allowing the X-rays that pass through to impinge on film or digital photosensitive media placed to block X-rays. By using the fact that the intensity of X-rays that pass through varies depending on the elements making up the cultural property, and the density and thickness of its materials, differences in those changes are imaged. This technique has played an extremely important role because it reveals the internal structure of cultural properties that cannot be seen from the outside, and the distribution of materials used. In Japan, it is possible to determine whether sculptures (Buddhist images) are made from a single piece of wood, or multiple pieces joined together, and whether there are any objects embedded inside the statue. In the case of pictures, it is possible to identify the structure of the support, white and red pigments containing heavy elements such as lead or mercury, and white pigments such as *gofun* (Paris white) containing calcium. Also X-rays pass through almost all organic dyes, and thus they can be discriminated from inorganic pigments based on imaging.

Examination of cultural properties using X-rays came to Japan from overseas. Alan Burroughs of the Fogg Museum at Harvard University was a pioneer who systematized X-ray radiography examination of cultural property pieces. From 1925 to 1944, he conducted large-scale X-ray radiography to elucidate the production techniques of pictures and thereby built the foundations of a database. These research results sparked increased interest in X-ray radiography of pictures in Europe. The details are described in *Technical Studies in the Field of the Fine Arts, April* (1942)[13]. Also, there was the Italian, Arturo Gilardoni, who was the first person to specifically advocate technical applications and methods of X-ray radiography for cultural property pieces. His book *X-Rays in Art* (1977)[14] is an extremely valuable reference.

4.1.2 X-ray CT

Transmission X-ray radiography also includes a technique called "X-ray CT" (Computed Tomography) that is widely used in medicine.

This technique was pioneered in the medical field, and research and development have progressed since around 1975. For details, *Image Reconstruction from Projections: The Fundamentals of Computerized Tomography* (1980)[15] is a suitable reference.

With this technique, a three-dimensional image or tomographic image is obtained by carrying out transmission X-ray radiography from various angles, and then synthesizing those images on a computer. In examining cultural properties, this is used primarily to observe the inner structure of three-dimensional objects such as sculptures and craft objects. It is an extremely useful technique, but a large facility is needed to carry out X-ray CT, and problems arise due to the risk of transporting cultural properties to the facility, and limitations on the form of cultural properties that can be scanned.

As indicated below, transmission X-ray radiography and X-ray CT share the basic principle of directly irradiating the object of interest with X-rays, and then imaging only the X-rays that pass through.

Imaging principle of transmission X-ray radiography and X-ray CT

Irradiated X-rays ⇒ Object ⇒ X-ray film or other photosensitive media

Concept of imaging method for transmission X-ray radiography and X-ray CT

Step 1. X-ray irradiation Step 2. Incidence of X-rays onto object Step 3. X-rays pass through object Step 4. Imaging of X-rays that pass through

4.1.3 Emissiography

In the field of cultural properties, there is an imaging technique that employs a method different from the principle above. This technique is called "emissiography." The technique was developed around 1966, and the details are described in *The Radiography of Paintings by Electron Emission* (1958)[16]. An image is produced by using X-ray irradiation, and capturing the minute amount of light produced from the surface of the object with film placed on the side of the X-ray irradiation equipment. This radiography enables detection of things like mineral pigments containing heavy elements. Rather than

obtaining an image by passing X-rays through the object, this method images only information from the surface of the object. Therefore, it is possible to image a picture rendered on a canvas or panel without the effects of the transmission, seen in images obtained by transmitting through the canvas or panel, and even in cases of pictures rendered on a thick support, or cases where it is difficult to set up film behind the object, an image can be obtained which cannot be obtained with the naked eye, and it is possible to observe the pigment distribution.

Principle of emissiography

Irradiated X-rays ⇒ Film or other photosensitive media ⇒ Object

Concept of method for emissiography

Step 1. X-ray irradiation Step 2. Incidence of X-rays onto object Step 3. Minute amount of light produced from surface of object Step 4. Imaging of produced light

Based on the concept indicated above, film placed in front of the object is directly exposed by the irradiated X-rays, and one may wonder whether an image of the object can really be obtained. However, the reason why the film is not directly exposed by the irradiated X-rays is as follows.

The film used for emissiography is camera film for prints. This film has almost no sensitivity if the irradiated X-rays have high energy, and conversely has the characteristic of being sensitive to minute amounts of light produced from the surface of the object. Therefore, only information on the surface of the object is obtained. However, in emissiography, it is not possible to shield the film itself in order to expose the film with the minute amount of light, and when imaging, the film is exposed if the surroundings are bright, so total darkness at the imaging location is an absolute requirement. Therefore, the imaging conditions are extremely demanding, and the imaging technology itself is difficult due to the need for a high-output X-ray tube. Therefore, the method is not in general use.

4.2 X-ray fluorescence spectroscopy

Next is an explanation of X-ray fluorescence spectroscopy. Up to the step of irradiating the cultural property with X-rays, this is the same as transmission X-ray radiography, but rather than analyzing by passing X-rays through the object, this technique measures the reaction, produced by the irradiated X-rays, of elements making up the substances on the surface of the object.

Measurement principle of fluorescence X-rays

X-ray irradiation ⇒ Production of minute amount of light from surface of object (fluorescence X-rays) ⇒ Detection of produced light (fluorescence X-rays)

4.2.1 Concept of measurement method for fluorescence X-rays

Step 1. X-ray irradiation Step 2. Reflection of X-rays by object Step 3. Production of minute amount of light from surface of object (fluorescence X-rays) Step 4. Measurement of produced light (fluorescent light) with detector Step 5. Analysis of measured data using software and a PC

When a cultural property is irradiated with X-rays, each element in the substances making up the surface of the cultural property produces a reaction (fluorescence X-rays) characteristic of that element. If analysis is carried out by selecting these characteristic reactions, it is possible to determine the types of substances making up the surface of the cultural property, and to a certain extent their quantities. Thus, it must be kept in mind that the method only yields information near the surface. Furthermore, X-ray fluorescence analyzers are generally limited in their measurement point range (diameter 3 mm or more, and 8 mm or less), and there is a possibility that measurement points will be limited. In an actual examination, accurate analysis is sometimes performed by first mapping the heavy and light elements, through use of the technique simultaneously with transmission X-ray radiography, and then selection of points is considered for X-ray fluorescence spectroscopy.

Also, the materials which make up cultural properties are complex configurations of elements, and thus to judge the obtained results one needs previous research experience and adequate knowledge of the elements making up the materials.

However, this is an essential analysis technique in modern scientific investigation, and the results achieved are major results.

4.2.2 Advantages of portable equipment

One advantage shared by optical investigations other than X-ray CT and emissiography is that all of the equipment used is portable. This advantage is important for avoiding the risk of moving cultural properties. The potential damage due to factors like vibration or dropping is extremely large, and thus as a rule, it is necessary to consider carrying out examination *in situ* (at the location where the cultural property is kept). Therefore, portable optical survey techniques which are non-destructive/non-contact should be recognized as important for investigating cultural properties.

4.3 An example of transmission X-ray analysis and X-ray fluorescence analysis

In recent years, various interesting results have been reported using transmission X-ray analysis and X-ray fluorescence analysis. In a scientific survey, conducted by the Tokyo National Research Institute for Cultural Properties in 2004, of the *Kohakubai-zu Byobu* ("Folding Screen of Red and White Plum Blossoms") (a National Treasure, residing at the MOA Museum of Art) by the Edo period artist OGATA Korin (1658-1716), the thickness of the *hakuashi* (parts where gold foil overlaps) of the gold background was investigated using transmission X-ray radiography, and the metal composition of the gold foil was measured using X-ray fluorescence analysis. The results showed that the gold background part of the folding screen painting was not gold foil, which had been the prevailing theory, and the possibility was raised that the screen was painted to look like gold foil using gold paint. This new theory has garnered some attention. It was also pointed out, based on X-ray fluorescence analysis, that there is a high probability that the stream part at the center, previously thought to be silver foil, was produced using organic dye not silver[17]. This result stimulated a lot of discussion in the Japanese art history world.

4.4 Surveys using UV rays and infrared rays

This section explains survey techniques using more familiar forms of light: UV rays and infrared rays.

4.4.1 UV fluorescence imaging

The survey technique using UV rays is called UV fluorescence imaging. The materials making up cultural properties such as oils, *nikawa* (glue), and silk, are organic materials. When they are irradiated with UV rays, they absorb energy, and there is a reaction where they are excited and emit a minute amount of light called fluorescence. With this technique, that fluorescence is imaged with a digital camera.

In examining oil paintings, this is used to check for the existence of repairs (because new varnish does not emit fluorescence) or to identify parts with touch-ups. Also, as applied research, there are differences in the color of fluorescence depending on the substance, and thus substances can be inferred to a certain degree, and in some cases this is also used in auxiliary examinations for inferring the type of dye. As an example of a particularly significant result achieved using UV fluorescence imaging, the paintings of the *shumiza* (rectangular base) of the *Tamamushi no Zushi* (Tamamushi Shrine) at Hōryūji are famous. It helped to elucidate the production technique, i.e., whether the paintings were *mitsuda-e*, a type of oil painting,[18] or *urushi-e* using lacquer.

4.4.2 Infrared imaging

The examination technique using infrared rays is called infrared imaging. Details of this technique are described in *Reflectography of Paintings Using an Infrared Vidicon Television System* (1969)[19]. This is used for tasks such as investigating underlying rough sketches drawn with charcoal lines under the surface of cultural properties covered with dust or lacquer, etc. Old varnish and lacquer coatings have the characteristic that they absorb or reflect visible light, but allow infrared rays to pass through. If there are lines drawn with *sumi* (charcoal, i.e., carbon), which absorbs infrared rays, underneath a coating of this sort of material, then the rough sketch lines can be seen due to the difference in reflectance with the substrate. To capture this reflection, there is a method of imaging with a digital camera sensitive to infrared light. In recent years major results have been achieved by using extremely high-precision digital cameras and investigating line drawings which could not be seen with the naked eye. Initially, when this technique was used for examining cultural properties, it was used to decipher old documents called *urushigami monjo* (lacquer paper writings) which were preserved without rotting because discarded documents were used as lid paper for containers of lacquer, and the lacquer seeped into them. This made a major contribution to elucidating the social background and logistical situation of the times when the documents were written.

For both of the above two examination techniques, silver film has previously been used because it is sensitive to

the minute amounts of light in each case, but today demand for such film is low and it has become difficult to obtain. Researchers have largely switched to digital cameras partly because it is simpler.

4.5 Dating method

Next, this section discusses destructive analysis although the samples taken are minute. The focus is dating methods where research is currently progressing, and major results have been achieved. Typical techniques are radiocarbon dating (a dating method using carbon-14) and dendrochronology.

4.5.1 Radiocarbon dating

If the materials which make up a cultural property are wood, shell, or other remains of living organisms, the date when the object was made can be estimated through radiocarbon dating.

Elemental carbon exists in various types. Among these is a carbon atom called carbon-14, and on the earth, carbon dioxide combining carbon-14 atoms with oxygen, and ordinary carbon dioxide are diffused in the atmosphere while maintaining a fixed ratio. These two types of carbon dioxide dissolve in water, and thus in the water of the sea, rivers, lakes and marshes, there is carbon dioxide containing carbon-14 atoms in the same ratio. Plants carrying out photosynthesis take in this carbon dioxide, and thus the tissues of plants also contain carbon-14 atoms in the same ratio, and the animals which eat these plants, and indeed all the animals making up the food chain, incorporate carbon-14 atoms in the same ratio. However, when these organisms die, they no longer take in carbon-14, and that ratio constantly decreases. The principle of dating by analyzing this ratio is called radiocarbon dating. It should be noted that this analysis requires an extremely high level of expertise and databases, and precise dating is difficult. Also, an extremely fundamental point is that one must consider the fact that the year of production of the materials used in a cultural property does not necessarily match the year of production of the cultural property [20].

4.5.2 Dendrochronology

Dendrochronology is a method of scientific dating by analyzing the growth rings of trees [21]. The superior point of dendrochronology is that it can accurately determine the date of a tree to a specific year. Dates found with radiocarbon dating inevitably have a statistical error ranging from a few tens to a few hundreds of years, but if radiocarbon dating is used together with dendrochronology, dates can be determined more accurately. However, the problem of using dendrochronology in research on cultural properties is the same as that of radiocarbon dating. The determined date is merely the date of the tree itself and does not necessarily determine the date when the cultural property was produced. Even if the form of a tree is almost intact, e.g., in the columns of shrines and temples, it's easy to imagine that the materials were used when some time had passed since the tree died, or that the materials were reused from another purpose, and thus that the date is older than it should be. Furthermore, identification of the date is inevitably difficult if the material has been substantially worked.

The two dating methods indicated above have an extremely long time axis and are frequently used in the field of archaeology to conduct research on the traces left by human beings. However, the cultural properties which are the focus of conservation science are from the medieval or early modern period of Japan, and these methods cannot be easily used to investigate production dates for art history where the aim is to elucidate things like styles and artists.

These are issues shared by all types of natural science-based dating in the field of cultural property research.

5. Challenges for conservation science

In the field of cultural property conservation studies, conservation science is the field which primarily handles numerical figures and formulas. At first glance, it seems that scientific data is very reliable, but it is important to discern the true meaning of the data and to verify its authenticity. At present, the equipment used in scientific analysis, and measurement methods themselves, have been simplified and become easier to handle. However, when the subject of analysis is a cultural property, there is a possibility of reaching a completely different conclusion in the end if experience is accumulated enabling judgment, from both the fields of the humanities and the natural sciences, of results obtained based on limited conditions, including techniques of handling and measurement of the work itself.

Also, if the nature of the cultural properties which are the subject of examination and analysis is considered from a global perspective, then adopting Japanese cultural properties as the subject of research will present further difficulties.

If *nihonga* (Japanese-style paintings) painted using delicate materials (unlike the West) and their methods of handling are considered, and one looks at the condition of intricate and delicate works such as lacquerware which suddenly lose their beauty, one sometimes feels there is an intentional rejection of timeless existence. This unique character of Japanese culture definitely presents us with diverse issues that cannot be globalized in terms of conservation and restoration of cultural properties. An intention expressing that timeless existence is undesirable is one point that must be recognized for people engaged in conservation science, and struggling in that gap between the principles of intention and conservation is a difficult point of conservation science in Japan.

6. The future of conservation science

As has already been pointed out, conservation science is the interdisciplinary field whose aim is conservation of cultural properties. Therefore, investigation using scientific techniques is performed with the main purpose of passing on cultural properties to the next generation, and the same principles are shared with cultural property conservation studies.

In conservation science, research using the latest scientific equipment tends to garner attention, but if viewed from the simple perspective of conserving cultural properties, conservation work has been routine for a long time in Japan, with practices such as checking for insects or fungus at the turn of the seasons, or performing airing called *bakuryō* (airing of clothes or scrolls to prevent insect/fungus damage). As one example, there is the *bakuryō* of the Shosoin Repository located northwest of the Todaiji Daibutsuden (Great Buddha Hall), which is carried out once a year in the fall. Shosoin is a building which has stored arts and crafts connected with the Emperor from around the 8th century until recently[22]. It is widely known in Japan that the properties stored here were protected until modern times through management using the aforementioned *bakuryō* and storage methods using wood boxes called *karabitsu* which are resistant to the effects of humidity.

7. Conclusion

The most important thing is taking proper steps to ensure conservation of cultural properties, but the significance of their existence only becomes evident when we strive for use. However, it cannot be said that use poses no danger at all due to factors such as environmental changes. From the standpoint of conservation it is desirable to put away cultural properties inside repositories, but it is also desirable, from the standpoint of use, to exhibit them to the public. It is difficult to strike a balance.

The problem of this balance perhaps requires us—not only the experts who actually conserve and use cultural properties, but also the receiving side of use (museum visitors, etc.)—to consider what they receive by going to art museums or other museums. Use does not come into being as the responsibility only of the side which exhibits cultural properties to the public. So what does the receiving side receive?

It is difficult to give a clear answer, but there is one thing we can say. It is related to the fact that if human beings do not have an impetus, they cannot create something from nothing. All culture has come into being under the influence of things done in the past. People come into contact with nature and objects and culture, and act under their influence, and that action gives rise to new action (culture). When we consider that phenomena and results ripple out through people and become culture and cultural properties in this way, it becomes important for the people on the receiving side to work hard to gain some sense of the time when the culture was created. Perhaps this way of interacting with culture will be an opportunity to find paths to the future. We don't want it to be something transitory that is driven by the mass media. The importance of connections with culture are definitely not something that can be reduced to supply and demand. Today, amidst signs of change all over the world, recognizing once again the existence of universal culture and civilization through cultural properties should be treated as a top priority, and for that reason we need to take action to protect cultural properties and pass them on to the next generation.

Finally, if we are asked what is needed from people in the position of conserving, it is perhaps the humility of the people involved. Methods and measures are merely incidental.

Notes

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3

Basic Operation of Single-lens Reflex Digital Camera

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01

Basic Operation of Single-lens Reflex Digital Camera

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02

The aim of taking photographs of cultural property is to confirm the existence of the object and to document the object's condition at the moment it is being photographed.
A photograph reveals abundant information such as the shape, materials, production technique, color, trace of usage, and condition of the object. As a result, photographs are regarded as an important secondary source material.

03

How to Hold and Position the Camera

Hold firmly using both hands.

04

Use the right hand to grip the camera and place the forefinger on the shutter release button.

Support the camera lens with the left hand.

05

Close the sides of your arms to stabilize the camera.

06

When the camera is held in a vertical position, either hand can be on the top side.

07

How to Recharge the Battery

A digital camera will not function if the battery is empty.

08

Place the battery inside the charger and plug it into the wall socket to recharge.
Once the battery is charged, the lamp light on the charger will stop blinking.

09

Insert Battery

Open the cover and insert the battery by pressing down on the lock latch with the side of the battery.

10

Turn on the power switch which is located next to the shutter release button.

11

Menu Button and Multi Selector Button

Use the selector button to navigate the menu display in the monitor.
Press the button in the center to finalize the selection.

12

Memory Card

Photographic data is stored in a SD card or a CF card (Either one can be used).

13

Check that the direction of the SD and CF card is inserted correctly and slide it in until it is firmly placed.

14

Formatting the Memory Card

The memory card must be formatted before being used.
All data is deleted.
Store the necessary data on a computer.

15

Types and Settings of Image Quality Mode
With the D810, three types are available: RAW, TIFF, JPEG.
RAW (non-compressed data) allows for adjustments in brightness and color on the computer after the photograph has been taken.
JPEG (compressed data) is the most generally used type. A high image quality setting provides large data capacity.

16

画像サイズ	
L	7360px×4912px
M	5520px×3680px
S	3680px×2456px

Image Size Settings
When a photograph is taken using JPEG or TIFF for the image quality, the image size can be selected from L, M, S.
The larger the image size, the larger the size it can be printed, but the data capacity also becomes larger too.
According to the purpose of the photograph, select whether to store the image on a computer or to make a large size print.

17

Attach and Remove Lens from the Camera

While pressing the lens-release button, rotate the lens in the direction of the arrow.

18

This will release the lens from the camera.

19

Once the lens is released from the camera, immediately place the protective cap onto the lens.

20

When attaching the lens to the camera, align the mounting indexes of the lens and the camera together. Rotate the lens in the direction of the arrow until it clicks into place. Once the lens is firmly attached to the camera, the procedure is completed.

21

Exchange lenses on a flat surface. Always keep the removed lens in an upright position to prevent damage to the lens from any overturning.

22

When removing or attaching a lens, point the lens mount of the camera downwards to reduce the risk of dust entering inside the camera.

23

Manual Focus (MF)

Autofocus (AF) is not necessarily the best option for every situation.
In situations where it is difficult to see the subject, such as in a dark environment or when the light is coming from behind (back light), the camera may be unable to detect and focus on the subject.

24

Set the focus mode selector of the camera body and the focus mode of the lens to "M". Rotate the focus ring manually to adjust the focus.

25

Using manual focus (MF)

significantly expands the range of expression.

26

Types and Settings of Photographing Modes

A camera has four main photographing modes.

27

Programmed Auto

This mode automatically adjusts the aperture and the shutter speed according to the photograph's purpose.

It is suitable for snapshots.

Shutter Priority Mode

The photographer selects the shutter speed.

This mode is used when the photographer wants to prioritize capturing "movement" such as freezing the subject's motion or deliberately showing the blur of motion.
It is suitable for photographing movement such as in sports.

Aperture Priority Mode

The photographer selects the aperture.

This mode allows the photographer to adjust the range of focus (depth of field) to create blurred backgrounds or focus on the entire area.

Manual Mode

This mode allows the photographer to adjust the shutter speed and aperture.

Although the level of difficulty increases, the photographer is able to freely control the amount of exposure.

ISO

By changing the ISO Sensitivity, it is possible to change the brightness.

Equipment

By using these equipment, the range of expression in the photograph significantly expands.

37

Interchangeable lenses allow the photographer to change the angle of view.

38

A Camera leveler is used to make sure that the camera is in a horizontal position.

39

A tripod is used to secure the camera and prevent any blurring which can result from hand movement.

40

A color chart is used for color correction adjustments.

41

Lighting is used to adjust the brightness and to create visual effects.

42

A background paper is used to effectively display the object which is to be photographed.

43

Transfer of Data to the Computer

By transfering data to the computer, photographs can be edited and the data can be stored in the computer.

44

Turn off the power switch, remove the memory card from the camera, insert it into the card reader and transfer the data.

45

It is also possible to transfer the data by connecting the camera and computer with a USB cable. Connect the camera and computer with a USB cable and turn on the camera's power switch. Click on transfer images. Remove the transferred data from the memory card.

Video Recording

The video recording of cultural property and their conservation techniques conveys the ambience of the place. Switch the live view selector and press the movie-record button to start and end the video recording.

The video recording can be edited with an editing software.

Summary

Learn how to handle a digital single-lens reflex camera and enjoy taking photographs.

4

Photography of Archaeological Objects

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01

Photography of Archaeological Objects
Hiroo Kansha
Tokyo National Research Institute for Cultural Properties

02

This video explains the method for the photographic documentation of cultural property.

In this video you will learn about the method of photographing cultural property and the method of editing the photograph taken on a computer.

03

Photographic Documentation is important for documenting, transmitting, and utilizing cultural property information for people all over the world and the next generation.

04

A high resolution digital camera is used to enable documenting details with precision.

05

Equipment used for taking photographs:
① white simili paper (used as background for taking upright photographs)
② black colored paper (used as background for taking overhead photographs)
③ scale (ruler) ④ blower ⑤ eraser
⑥ shutter release cable ⑦ camera
⑧ color chart ⑨ camera leveler

If a specific background sheet or stand is unavailable, replace with items such as a hanger rack or simili paper.

06

Preparation of Equipment: camera, tripod, lighting, camera leveler, shutter release cable, blower, scale (ruler), eraser, white simili paper (used as background for taking upright photographs), black colored paper (used as background for taking overhead photographs)

07

It is useful to have a camera leveler to check the camera' s tilt and also a color chart.

08

Close the curtains to prevent outdoor light from entering.

09

Wear tight fitting clothes to prevent contact with equipment.

Since there is a lot of crouching movement, avoid wearing a skirt.

Remove all accessories such as watch and rings to avoid damaging the cultural property which is being photographed.

When photographing the cultural property indoors, use “aperture priority mode”.
Continue to press “mode” button while rotating the main command dial to display “A”.

To enable editing on a computer, proceed from “shooting menu” → “image quality” and select “NEF (RAW)”.

Taking Upright Photographs

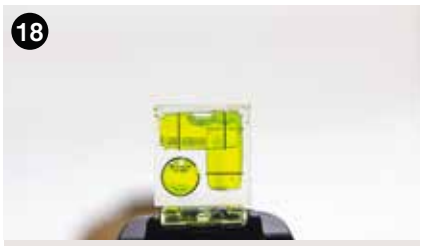
For photographing three-dimensional cultural property, take upright photographs from a horizontal direction.

Attach simili paper to a hanger rack of approximately 1m height. Make sure to stretch the paper to avoid creases.

Position the object to be photographed in the center.

Position the tripod in front of the object.

To express depth, position the camera at a slightly higher level than the object.



Use the camera leveler to check that the camera is balanced horizontally on both sides.

19

Make sure that the object is in the center of the lens.

20

The use of a shutter release cable when taking a photograph prevents blurring.

21

The distance between the object and the background determines the way shadows appear.
Place the object at a certain distance from the background.

22

Comparison of Shadows

23

The photograph' s image changes according to the position, angle, and strength of the lighting source.

24

Comparison of Shades and Shadows

Photographs which show clear differentiation between light and dark areas are not appropriate for cultural property photographs.
Position lighting sources so that information regarding the object can be sufficiently determined from the photograph.

25

Comparison of Blank Space

Leave enough blank space to enable subsequent editing using a computer.

26

Difference According to Aperture Value

When photographing details, the range of focus will vary according to the "depth of field".
Set the aperture value to ensure that both near and far areas are in focus.

27

Overhead Photographs

Overhead photographs are taken for objects which are not three-dimensional such as earthenware fragments and coins.

The camera is installed at a lower height compared to an upright photograph since the photographer peers into the camera from above the object.

To prevent the camera from falling onto the object and damaging it, always position the object after the camera is installed.

Use a leveler to ensure that the camera is installed vertically.

If the background paper is dirty, use a blower to remove the dirt.

When positioning pieces such as an earthenware fragment, determine which part it originates from in the overall object.

If the object' s rim is not horizontal, adjust the angle using items such as an eraser.

Determine the lighting position to achieve a clear photograph including information such as the object' s engraved lines and patterns.

The position of reflected light and shadows change according to the lighting position. Arrange the lighting to ensure that sufficient information of the object can be determined from the photograph.

Editing Photographs using a Computer

Photographs taken using NEF (RAW) can be edited afterwards with a computer.
To edit photographs, use Capture NX-D, provided free of charge by Nikon.

Activate Capture NX-D and select the photograph to be edited.

Exposure can be changed by clicking “Exposure”. To brighten, raise the number. To darken, lower the number.

Color adjustments can be made using “White Balance” (WB).

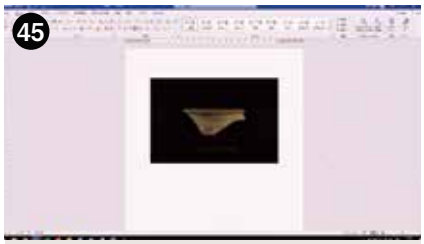
Raising the “Color Temperature” number strengthens the orange of warm colors and lowering the number strengthens the blue of cool colors.

Changing the “Tint” enables adjustments from purple to green.

Adjustments in “Brightness”, “Contrast” and “Saturation” can be made by setting the “Tone”.

Once the final image of the photograph is decided, click “Convert Files”.

Select “JPEG” format, choose the file location to store the file, the file name, and click save.



JPEG format enables digital images to be easily pasted onto a word processer software such as Microsoft Word.

White spaces in the digital images can be cut using Microsoft Word.

Conclusion

Use of a digital camera enables the checking, retaking, and editing of photographs to be executed easily.
Begin by experimenting with various ways of photographing to understand how to use the camera and its characteristics.
When taking a photograph, determine what and how you want to document it.

5

Textile Conservation Cleaning

Mie Ishii
Saga University Faculty of Art and Regional Design

01

Textile Conservation Cleaning
Mie Ishii
Saga University Faculty of Art and Regional Design

This video will display three demonstrations on cleaning methods which are carried out in textile conservation.
1. Surface cleaning
2. Spot cleaning
3. Wet cleaning

02

Content
1. Surface cleaning
2. Solubility test for wet cleaning
3. Water quality test
4. Spot cleaning
・Suction table
5. Wet cleaning
・Vat wet cleaning
・Drying lace
6. Wet cleaning table

03

Textile Conservation
Surface cleaning

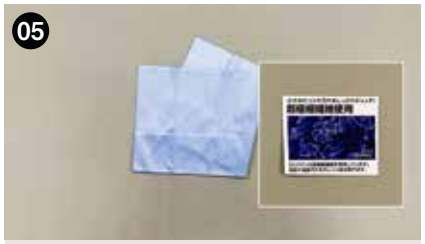
Surface cleaning is a cleaning method which mechanically removes dust from the textile.

04

Surface cleaning is also known as mechanical cleaning.

Equipment to prepare for surface cleaning: Brushes with a soft and white bristle, tweezers, an acrylic plate, a microfiber cloth or an eyeglass cleaning cloth, a weight, a rubber sponge, eraser, a vacuum cleaner with a HEPA filter, and a vacuum cleaner nozzle for cleaning crevices.

05



A microfiber cloth is made from ultra-fine synthetic fibers such as polyester and nylon which remove dust from the textile by adsorbing the fine particles and oil from the textile on to the fibers of the cloth.

06

When using a cloth to wipe off the dust, lightly stroke the textile following the direction of the warp and weft.

07

When using a brush to remove the dust, move the brush following the direction of the textile' s warp and weft, and position the vacuum nozzle to suction the dust.

08

Place a fine net on the tip of the vacuum cleaner nozzle to prevent the suction of the textile.

09

The suction power of the vacuum cleaner is controlled by adjusting the voltage.

10

To suction the dust from textiles with thick surfaces such as carpets and tapestries, place a net screen over the surface of the textile and move the vacuum cleaner nozzle over it.

11

When encountering difficulties with removing the dust, partially set aside the net screen and place the vacuum cleaner nozzle directly over that specific area.

12

Textile Conservation
Solubility Test for Wet Cleaning

A wet cleaning test is executed before deciding whether to use this method to clean a textile.

The test examines the textile and the solubility of the dirt towards acid, base, and detergent.

This test is useful for planning the wet cleaning method of a textile as well as for making the decision not to apply the wet cleaning process on a textile.

13

Equipment to prepare: Small plates, blotting paper, scissors, tweezers, eye dropper bottles or syringes. (Armenian salt bag)

14

The reagents are a 25% aqueous ammonia solution, a detergent* solution which has been diluted to the proposed wash concentration, distilled water, and acetic acid. (*Dehypon®LS45 (CASNo. 68439-51-0) 2g/l (0.2%) or Dehypon® LS54 (CASNo. 68439-51-0) 3g/l (0.3%) manufactured by BASF Ltd.)

15

Please obtain permission from the textile owner prior to executing the test since you will need to collect yarn samples for the test.

Attach an ID number to the colored yarns of the textile and take a photograph before cutting off the yarns for documentation purposes.

16

Position the collected yarn samples on to a blotting paper. (Ammonia solution (alkali), Non-ionic detergent, Distilled water, Acetic acid (acid))

Place one or two drops of the reagent on to the yarn samples and observe the colorfastness of the dye and the amount of dirt released.

17

Textile Conservation
Water Quality Test

18

Tap water is used to wet clean a textile. It is advisable to filter the tap water to remove elements such as chlorine, iron and lead. (Soft water, Filter)

Chlorine can cause discoloration of the dye and when iron and lead attach on to the textile, they cause spots to appear on the textile.

For the water quality test, use a test paper which can detect the presence of elements such as chlorine, iron, and lead in the water. (Water, Clorine, Iron, Lead)

Pour the water into a beaker, soak the test paper inside the beaker, observe and check any changes in color. (Chlorine test)

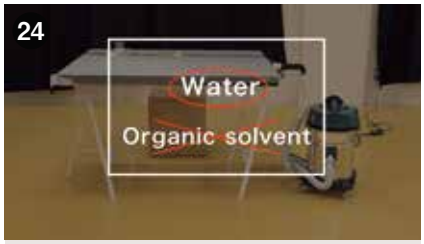
Textile Conservation
Spot Cleaning
Suction Table

Spot cleaning refers to the cleaning method of removing stains from a partial area of the textile. (Kimono)

A suction table is used to remove water-based stains.

A suction table is constructed from finely perforated layers of punched stainless steel sheets.

Aqueous solutions can be used but organic solvents cannot be used since they are flammable with the use of electricity.



The water is suctioned with a water suction vacuum cleaner.

The suction power is controlled by adjusting the voltage.

As the entire table is perforated, cover the table with a polyethylene sheet but leave uncovered the area which requires spot cleaning.

Cotton fabric and blotting paper is used to absorb the liquids and they are laid out on the table. The textile is then positioned over it.

Turn on the electricity of the vacuum cleaner and begin to suction. (Spot suction)

Use a syringe to pour drops of detergent and water on to the stained area of the textile.

Turn off the electricity and confirm whether the stain has been removed from the textile.

Textile Conservation
Wet Cleaning
Washing in a Vat

Wet cleaning refers to the cleaning method of removing dirt by using water.

Equipment to prepare: White, plastic vat, polyester sheet, sponge, neutral detergent, pH litmus paper, thermometer, small test tube, measuring cup, small glass bottle, paper for recording data.

Acrylic or glass plate, sheet or towel, stainless steel needle, cardboard with graph paper placed over it and covered with a polyethylene sheet, electric fan, hairdryer.

Weak areas are protected from both sides with a nylon or cotton net. (Indian printed cotton)

Place the textile on a polyester sheet and put it inside the vat.

Pour water gently into the vat.

Gently press down on the textile using a sponge that is specifically used with water and then release the sponge from the textile. The dirt is pushed out by applying a pumping movement.

Place another polyester sheet over the textile and turn it over on to the reverse side.

Wash the reverse side of the textile using a sponge.

Keep the textile on top of the polyester sheet while removing it from the vat.

Pour out the water in the vat.

Place the textile back into the vat.

Collect a sample of the remaining water in a glass bottle to measure the pH balance and record the data. (Pre-wash water)

Check the temperature of the neutral detergent which has been diluted to the proposed concentration. Place the textile gently into the vat. (Dehypon®LS45 0.2% (2g/l))

Wash the textile with a sponge which is used specifically with detergents.

Place a polyester sheet over the textile and turn it over on to the reverse side and wash.

Remove the textile from the vat. Pour out the water in the vat.

Collect a sample of the water, measure the pH balance,

record the data.

Place the textile in a vat and pour in the water.

Rinse the front side and back side of the textile using a sponge which is used specifically with water.

Remove the textile from the vat and pour out the water in the vat.

Collect a sample of the water and measure the pH balance. Continue to rinse the textile until all the foam is removed.

Confirm whether there is any detergent remaining in the water used for rinsing the textile.

How to Check Remaining Detergent

Prepare two glass test tubes.

Pour the water used for rinsing the textile into the first test tube. (Final rinse water)

Pour tap water into the second test tube. (Tap water)

Shake the two test tubes simultaneously to examine the way the foam disappears.

If the foam in the water used for rinsing the textile disappears in the same way as the tap water, this means that the rinsing procedure is completed.

Keep the textile on the polyester sheet while removing it from the vat.

Dry the textile with a towel.

Cover the textile with a cotton cloth or a towel and gently stroke it with the hand to facilitate the absorption of moisture.

Turn the textile on to the reverse side and repeat the same procedure to remove all the moisture.

In order to obtain a flat surface finish, allow the textile to dry on a glass or acrylic plate.

The capillary phenomenon in the fibers of a textile cause the moisture to gather in areas where evaporation can occur easily. As a result, stains can occur more easily during the drying process.

Firstly, place the front side of the textile facing downwards. Align the warp and weft yarns and swiftly dry the textile using an electric fan.

Once the drying process is well underway, turn the textile over so that the front side is facing upwards.

Textile Conservation Drying Lace (Armenian needle point lace)

In order to maintain the shape and size of a textile after completing the washing process, a drying technique is used where pins are inserted through the textile while it is being dried.

Use a drying board which is made by placing a grid paper over a cardboard and covering it with a polyethylene sheet. Place the lace on the drying board and adjust the shape of the lace using stainless steel pins.

55

Begin by placing a pin at the lace' s center and then continue placing the pins to the left and right of the center. Move the pins while drying.

A hair dryer is used for drying the lace.

56

Textile Conservation
Wet Cleaning
Wet Cleaning Table

For wet cleaning large scale textiles, install a large wash bath to the sink.

57

This wash bath is constructed from wood which has been coated over with waterproof paint.

Cover the interior of the wash bath with a polyethylene sheet and attach the sheet' s edges to the wash bath using clothes pegs.

58

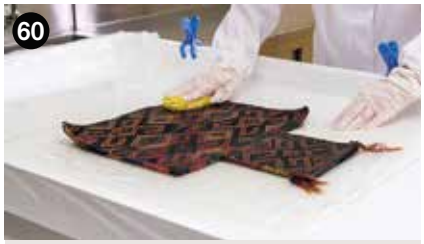
Place a jack on the table to install the wash bath.

Rotate the jack' s handle to move the wash bath up and down.

59

The wash bath contains a drainage outlet.

60



A demonstration of the rinsing process.

Pour water into the wash bath. Dirt from the textile is removed by gently sponging the textile.

61

Raise the wash bath using the jack to drain out the water.

62

Open the drainage outlet of the wash tub, spread out the polyethylene sheet and allow the water to drain out of the wash bath.

6

Textile Conservation Support Stitching

Mie Ishii

Saga University Faculty of Art and Regional Design

Midori Yokoyama

NHK Culture Center

01

Textile Conservation Support Stitching
Mie Ishii
Saga University Faculty of Art and Regional Design
Midori Yokoyama
NHK Culture Center Saitama

02

This video will show a demonstration of stitch support which is one of the support treatments used in textile conservation.

Mie Ishii will present the stitch support method used in British textile conservation and Midori Yokoyama will present the method used in Japanese Embroidery.

03

The demonstration will show how different regions and cultures reflect contrasting ways of thinking and methods regarding textile conservation.

04

Please compare the equipment and stitches.

There are various methods of stitch supports.

Armenia should develop its own individual stitch support method.

05

Preparation of the Support Fabric

06

Washing the Support Fabric

The silk fabric used for textile conservation should be hand washed by gently folding the fabric consecutively in 40℃ water.

07

The washing process removes elements such as machine oil and stabilizes the support fabric by shrinking the fabric' s weave.

08

Drying the Fabric

The fabric is dried using a towel to prevent creases from forming.

09

Hang the fabric to dry.

Iron the fabric to align the weave.

Place another fabric over the support fabric before ironing.

Apply steam over the fabric, iron and align the weave.

The fabric is rolled onto a tube during the ironing process to prevent creases from forming.

Stitch Support

Method using Japanese Embroidery Technique

Technique: Kayoko Fukuda of Joshibi University of Art and Design.

Preparation of a Stitching Panel

Prepare a wood frame, felt, silk fabric and pushpins.

Choose a wood type where the pushpins can be pierced firmly into the wood.

First, cover the entire wood frame with felt.

This prevents the edges of the wood frame from ripping the silk fabric when it is being stretched.

It also prevents the fabric from coming into direct contact with the acid arising from the wood.

Cut the felt to cover the width and entire length of the wood frame.

Loop the felt and sew.

Next, use a thin silk fabric to mount the frame.

Use pushpins to prevent the warp and weft direction of the silk from distorting.

Mount the silk firmly to prevent it from loosening.

Marking the Support Fabric and the Textile

Method using Japanese Embroidery Technique

Mark the midway position of the wood frame wrapped in felt.

Mark the midway position along the width direction of the silk support fabric and textile.

Ensure that the three markings are aligned.

Fasten with needles and tack down using a basting thread.

If the length of the textile exceeds the wood frame, roll the textile and secure it to the wood frame using a string.

Making Thread used for Support Stitching

Method using Japanese Embroidery Technique

A thread used for support stitching is purposely made by twisting the silk thread to match the thread used in the textile.

Secure the awl slightly below eye level.

Measure approximately 70 cm of the Kamaito (an untwisted degummed silk thread). Hook the thread onto the awl.

Hold the two strands of the silk thread, rotate once, hook, and secure it onto the awl.

Divide the single strand of the silk thread into one quarter strands.

Bring the one quarter strand of the silk thread to the right side of the body and hold it between the right and the left hand.

Rub the left hand upwards to twist the thread twice.

Move the left hand from A to B on the right hand.

Once the strand of thread is twisted, secure it with a weight or hold it in the mouth.

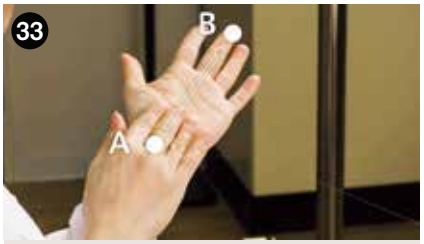
Twist the remaining one quarter strand of thread using the same procedure.

This is called an under twist.

Bring the strands of thread to the left side of the body.

Hold the two strands of thread together between the left and right hand.

Rub the right hand upwards to twist the thread twice.



Move the right hand from A to B on the left hand.

Lastly, pluck the thread lightly to adjust the twist.

Cut the thread at the base of the awl.

Completion of a twisted thread.

Position

Stitch Support Method using Japanese Embroidery Technique

Sit down and maintain a single fist space between the body and stitching stand.

Position the left hand below the wood frame.

Make sure that the elbow of the right hand is not leaning on the wood frame.

Do not place the tools on the top of the textile.

How to Hold a Needle
Stitch Support Method Using Japanese Embroidery Technique

When the needle is pierced from underneath the fabric, pick it up with the thumb and forefinger of the right hand.

Pull the needle upwards to the right side at 30˚- 45˚angle and pull the thread by hooking it on the little finger.

Do not touch the thread more than is necessary.

Re-hold the needle with the thumb and middle finger. Point the needle tip downwards and pass it through the fabric.

As the needle appears on the back side of the fabric, hold it with the thumb and the forefinger of the left hand.

Hook the thread on the little finger and pull it towards the left bottom side of the fabric.

Point the tip of the needle upwards and hold it with the thumb and the forefinger.

Keep the first joint of the thumb of the left hand lightly touching the back side of the fabric and pierce the needle up through the fabric.

Bring the needle in and out vertically against the fabric.

This technique prevents the start and end of the stitch from unraveling.

Start and End of the Stitch

Stitch Support Method Using Japanese Embroidery Technique

This technique prevents the start and end of the stitch from unraveling.

To begin stitching, pierce the needle from the front of the fabric. Make two back stitches (point stitches) inside the design area.

Bring the thread up to the front side and pull it up using the left hand. Place the scissors along the fabric surface and clip at the base of the thread.

To end the stitching, make two back stitches (point stitches).

Bring the thread up to the front side and clip at the base of the thread.

This makes the thread tail fall to the back side of the fabric.

Support Stitching

Stitch Support Method Using Japanese Embroidery Technique

Secure the unraveled gold thread using a couching stitch.

Use a tweezer to pull together the two strands of gold thread and tack the strands down with a thread that has been twisted.

This is the back side of the textile after the overall execution of support stitching is completed.

Work the support stitchings in a zig zag pattern along areas which do not have reinforcement stitches.

55

Method to Dismantle the Stitching Panel

Stitch Support Method Using Japanese Embroidery Technique

56

Begin by cutting the thin silk fabric with scissors.

57

Make cuts into the silk fabric of the stitching panel with scissors.

58

Do not cut areas which have repair stitchings.

59

Remove the thin silk fabric using tweezers.

60

This is the textile after the thin silk fabric of the stitching panel has been completely removed.

61

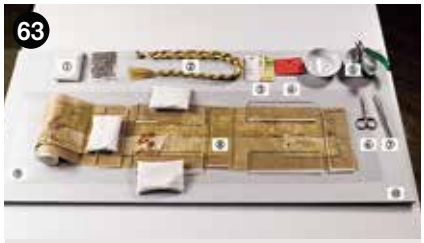
Completion of the stitch support of the textile.

62

Textile Conservation Support Stitching Using British Methods

Technique: The Textile Conservation Centre, Courtauld Institute of Art U.K.

63



Preparation for sewing the support fabric to the textile. Tools ① weight ② silk thread ③ beading needle ④ insect needle ⑤ nippers ⑥ scissors ⑦ tweezers ⑧ acrylic sheet ⑨ polyester sheet ⑩ archival board

When sewing the support fabric to the reverse side of the textile, arrange the textile and the support fabric so that the warp direction of both the textile and support fabric are aligned.

The support fabric is not affixed.

Place the support fabric and the textile on top of a polyester sheet so that the textile can be moved around easily and to ensure the smooth movement of the needle.

Use transparent acrylic or glass plates as weights to fix the textile's position.

Begin by placing a pin at the textile's center and continue placing to the left and right of the center.

Pierce the pins vertically.

If the pins are pierced diagonally, the fabric will move.

Textile conservation in Britain often does not use basting stitches which means that the fabrics can be realigned easily if they shift due to any movement.

This is a stitching technique known as the laid thread and couching stitch.

Maintain the textile in a flat position and do not lift it while support stitching.

Stitch the support fabric and textile together by smoothly sliding in the needle without lifting the textile.

Use tweezers when pulling the needle out.

Work a long single stitch and then hold it down with another small holding stitch to prevent the laid thread from moving. Laid thread and couching stitch. A Western conservation stitching method which was introduced to Japan in the late 1990's.

Use back stitches at the beginning and the end of stitching.

Do not use a knot stitch since it can be difficult to pull out without causing tear.

Support Stitching by Rolling the Textile

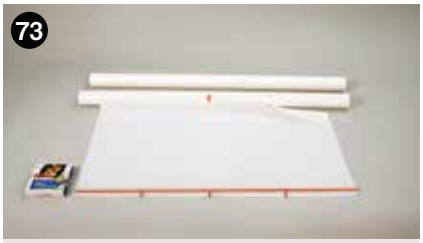
Textile Conservation Support Stitching Using British Methods

Technique: The Textile Conservation Centre, Courtauld Institute of Art (U.K.)

Use a roller for large scale textiles.

An explanation of the installation procedure for support stitching a rolled textile.

This is an overview of the rolled stitch support set up.



Two tubes, a fabric for rolling the textile, archival tape.

Make line markings on the 5cm diameter tube and align it with the fabric. Use archival tape to attach the fabric to the tube.

A stitching panel with an open window and cutout window panels.

Cut out a window in the archival cardboard.

Attach a frame with a 5 mm border along the reverse side of the window' s opening.

Insert the cutout window panel.

A hole is created when the cutout window panel is removed.

Support stitching is executed from this area.

The heads of the insect pins are cut off and used for pinning.

Align together the markings on the fabric used for rolling the textile and the support fabric. Attach them together using a pin.

Begin by piercing the pin vertically to determine the position.

Subsequently, re-insert the same pin horizontally to facilitate the rolling procedure of the fabric with the pins.

Install the rolled textile onto the holder stand.

Fix the tube onto the tube holder and adjust the height of the stand to the table.

(Roll holder, stand, stitching panel.)

Install the stitching panel by drawing it away from the table.

The reverse side of the stitching stand will prevent any movement.

The stitching area can be adjusted by removing the cutout window panel to create a hole.

When stitching, one hand is positioned above and the other hand beneath the window.

7

Japanese Embroidery

Midori Yokoyama
NHK Culture Center

01

Japanese Embroidery
Midori Yokoyama
NHK Culture Center

02

Contents
1. Tools I
2. Tools II
3. Embroidery thread
4. Embroidery frame

03

5. Twisting thread
6. Position
7. How to hold a needle
8. Start and end stitch

04

9. Basic embroidering techniques
① *Hiranui* : Satin stitch
② *Hasunui* : Diagonal satin stitch
③ *Warinui* : V-shaped satin stitch
④ *Sagaranui* : Japanese knot stitch
⑤ *Matsurinui* : Outline stitch
⑥ *Komagake* : Couching stitch

05

Tools I (For Embroidery)

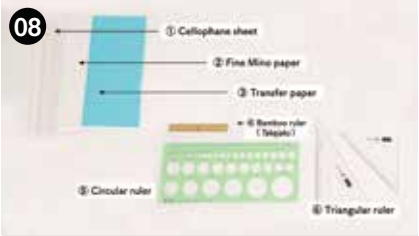
06

① Velvet cushion pillow
② Needles
(i) handmade needles
(ii) machine-made needles
③ Pin cushion
④ Spool (*Koma*) (two spools form a set)
⑤ Stiletto for embroidering
⑥ Awl for twisting thread
⑦ Thread snips
⑧ Tweezers

07

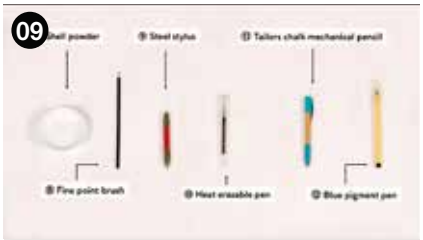
Tools II (To Draw a Design)

08



① Cellophane sheet
② Fine *Mino* paper
③ Transfer paper
④ Bamboo ruler (*Takejaku*)
⑤ Circular ruler
⑥ Triangular ruler

09



⑦ Shell powder
⑧ Fine point brush
⑨ Steel stylus
⑩ Heat erasable pen
⑪ Tailors chalk mechanical pencil
⑫ Blue pigment pen

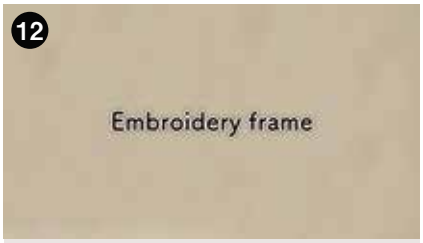
10

Embroidery Thread

11

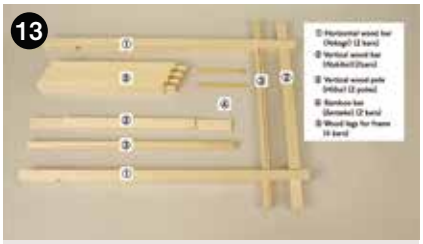
① Lacquer thread
② Gold thread #3
③ Twisted gold thread
④ Gold thread #0
⑤ Gold couching thread
⑥ Japanese embroidery thread (*Kamaito*)

12



Embroidery Frame

13



① Horizontal wood bar (*Yokogi*) (2 bars)
② Vertical wood bar (*Nukibo*) (2 bars)
③ Vertical wood pole (*Hiibo*) (2 poles)
④ Bamboo bar (*Sentake*) (2 bars)
⑤ Wood legs for frame (4 bars)

14

Twisting Thread

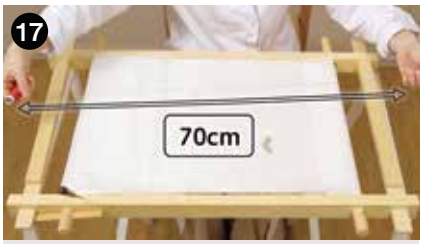
15

Kamaito thread is used in Japanese embroidery.
Kamaito thread: degummed untwisted silk thread
Kamaito thread is twisted by the embroiderer to match the design or is used untwisted.

16

To create a single plied, right twist thread from two strands of thread.
Secure the awl slightly below eye level.

17



Measure approximately 70cm of *Kamaito* thread.
Hook the thread onto an awl.

18

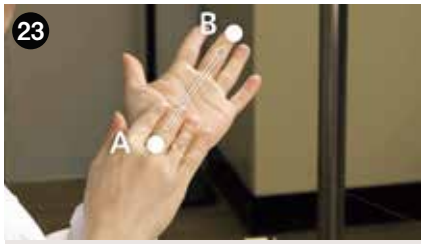
Hold the two strands of thread, rotate once, hook and secure it onto the awl.

Bring the single strand of thread to the right side of the body and hold it between the right and left hand.

Rub the left hand upwards to twist the thread three times.
Move the left hand from A to B on the right hand.

Once a strand of thread is twisted, secure it with a weight or hold it in the mouth.
Twist the other strand of the thread using the same procedure.
This is called an under twist.

Bring the threads to the left side of the body.
Hold the two strands of thread together between the left and the right hand.



Rub the right hand upwards to twist the thread three times.
Move the right hand from A to B on the left hand.

Lastly, pluck the thread lightly to adjust the twist.

Cut the thread at the base of the awl.
Completion of a plied (twisted) thread.

Position

Sit down and maintain a single fist space between the body and the embroidery frame.

Position the right hand above and the left hand below the embroidery frame.

Make sure that the elbow of the right arm is not leaning on the embroidery frame.

Do not place the tools on top of the embroidery.

Place tools here.

How to Hold a Needle

When the needle is pierced from underneath the fabric, pick it up with the thumb and the forefinger of the right hand.

Pull the needle upwards to the right side at 30˚-45˚ angle and pull the thread by hooking it on the little finger.

Do not touch the thread more than is necessary.

Re-hold the needle with the thumb and the middle finger. Point the needle tip downwards and pass it through the fabric.

As the needle appears on the back side of the fabric, hold it with the thumb and the forefinger of the left hand.

Hook the thread on the little finger and pull it towards the left bottom side against the fabric.

Point the tip of the needle upwards and hold it with the thumb and the forefinger. Support the needle with the middle finger.

Keep the first joint of the thumb of the left hand lightly touching the back side of the fabric and pierce the needle up through the fabric.

Bring the needle in and out vertically against the fabric.

Start and End of the Stitch

This technique prevents the start and end of the stitch from unravelling.
To begin stitching, pierce the needle from the front of the fabric. Make two small back stitches (point stitches) inside the design area.

Use the left hand to pull up the thread at the front side. Place the scissors along the fabric surface and clip at the base of the thread.

To end stitching, make two back stitches (point stitches).

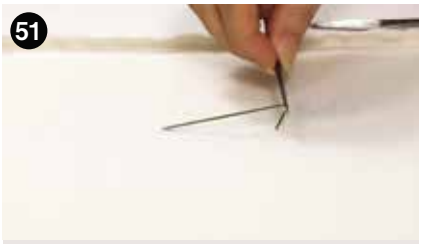
Use the left hand to pull up the thread at the front side. Place the scissors along the fabric surface and clip at the base of the thread. This makes the thread tail fall to the back side of the fabric.

***Hiranui*: Satin stitch**

Embroidering technique which involves stitching from the end to end of the design's outline to cover the entire surface.
Begin stitching from the center of the design.

Stitching a flower petal.
Bring the needle up from the outer side of the flower petal and bring it down at the center.
Continue stitching with the next stitch parallel to the first stitch.

Once half of the design is covered with stitches, return to the center, and continue stitching the remaining half of the design.



Embroidering with untwisted *Kamaito* thread.
Pass the awl along the thread of the working stitch, remove any twists in the thread, and spread out flat.

Pull down the thread with the left hand and stroke the thread with the awl in the right hand to create a shiny effect and beautiful finish.

***Hasunui*: Diagonal satin stitch**

Embroidering technique to make a satin stitch which is diagonal against the surface.

55

Work the stitch at 45˚-50˚ diagonal angle against the design.

56

Left diagonal satin stich.

There is a right diagonal satin stitch and a left diagonal satin stitch.

57

Right diagonal satin stich.

58

***Warinui*: V-shaped satin stitch**

59

Embroidering technique of symmetrically adjoining a left diagonal satin stitch and a right diagonal satin stitch to cover the entire design.
Stitching a leaf.

60

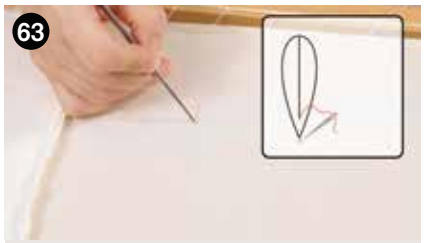
To stitch an entire design, work the right diagonal satin stitch on the left side and the left diagonal satin stitch on the right side of the design.

61

62

Bring the needle up through the leaf's axis which is approximately 7mm inward from the leaf tip.

63



Bring the needle down slightly outside the leaf tip.

Bring the needle up along the axis and continue stitching along the design's outline in the left part of the leaf.

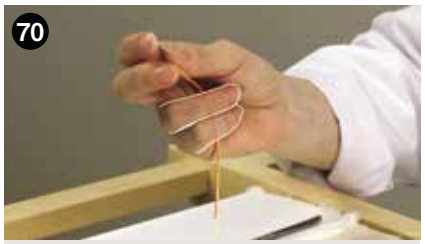
After the left part of the leaf is completed, begin stitching the right part.
Bring the needle up along the design's outline and bring it down along the center axis.

To create a beautiful leaf vein, work stitches so that they adjoin at the axis.

***Sagaranui*: Japanese knot stitch**

Embroidering technique for making a knot stitch on the fabric's surface.

Rotate the thread anti-clockwise to create a loop.



Hold the thread from the needle with the third and the small finger.

Pass the needle tip from underneath the loop and pull it upwards.

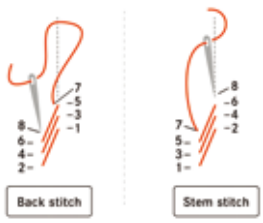
Pierce the needle at the left side from where the needle first came from.

Gently pull the thread with the left hand from the back side of the fabric.
Expand the loop with the middle and the little finger of the right hand that is holding the thread.

Insert the stiletto into the loop to complete the knot stitch.

***Matsurinui*: Outline stitch**

Also known as *Matsuinui* and *Matoinui*.
It is the main embroidering technique for creating a line.



Stitch diagonally along the line using a back stitch or a stem stitch.
Thickness is adjusted through the amount of layering to create lines and patterns.

***Komagake*: Couching stitch**

Also known as *Komanui* and *Komatori*.

Embroidering technique to frame a design's outline.

Thick threads and gold threads cannot be threaded through a needle.
They are wound onto a wooden spool known as *koma*.
Two spools each with a wound thread are used together.

Place the spools with two strands of thread along the design's outline to determine the spool's direction.

A separate fine thread is used to tack down the two strands of gold thread.

Leave 3mm space between tacking down threads.

The start and end of the gold threads are pulled through the fabric using another thread.

Japanese Embroidery ~END~