

# REPORT ON A SPECIAL INVESTIGATION OF THE SHOSAIN TREASURES-PAPER (2<sup>ND</sup> PHASE): FOREWORD

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The Office of the Shosoin Treasure House conducted a special investigation of paper between 2005 and 2008, appointing Mr. Ken'ichi Yuyama, Mr. Katsuhiko Masuda, Mr. Akinori Ohkawa, and Mr. Eikei Akao as the researchers in charge. This issue presents a comprehensive report on their findings and three individual reports by each of the researchers.

The current investigation efforts marked the 2<sup>nd</sup> phase of investigations following the 1<sup>st</sup> phase conducted between 1960 and 1962 (reported in "Various Papers Preserved in the Shosoin," 1970). Since the last investigation, the research environment within and surrounding the Shosoin Treasure House has undergone significant changes, as characterized by the advancement of scientific equipment, sophistication of research methods for ancient documents and hand-copied sutras, revision of cultural histories of paper in East Asia, progress in the research of large-volume pre-modern documents within Japan, and sophistication of studies on ancient cultural assets. Thereupon, the current investigation focuses on the fact that the paper sheets in the Treasure House remain today as a result of having been used for documents and hand-copied sutras, and from that standpoint retraces the processing methods, manufacturing techniques and raw materials. During the four years of the study, the total number of cases and items investigated amounted to 113 and 268, respectively (excluding duplications).

To cite a part of the results of these investigations, there was a high probability that some of the plant fiber material of the paper in the literary documents, such as spindle tree (*maumi*; *Euonymus sieboldianus*) fiber, ramie (苧麻; *Boehmeria nivea*), sophora root (苦参; *Sophora flavescens*) and elm tree fiber was used in practice in the Nara period. In addition, recommendations for reviewing the terms "*tamezuki*" (溜漉) and "*nagashizuki*" (流漉) from the 1<sup>st</sup> phase of the investigations is made, as well as assumptions about the skills of papermaking as found in the Shosoin literature and the points of time in history when the technical skills of paper making advanced.

## REPORT ON A SPECIAL INVESTIGATION OF THE SHOSAIN TREASURES-PAPER (2<sup>ND</sup> PHASE)

This paper is part of a series of reports on the individual items of special investigations into ancient papers carried out by the Office of the Shosoin Treasure House for four years between 2005 and 2008. The investigation consisted of visual and microscopic observations of paper in ordinary conditions and under transmitted light, mainly for the purpose of obtaining basic numerical data about the paper and insights into the paper characteristics, fiber types and other paper features. This report cites the target items of the investigation with the most characteristic features, and also considers the issues of verifying the findings of and inferences from the 1<sup>st</sup> phase investigation conducted between 1960 and 1962.

This paper consists of summarized observation findings of each item by four researchers, and a comprehensive list of basic data, e.g. the sheet size, thickness, width between threads and number of spits in a bamboo mould, distinction between front and back in paper sheets, fiber orientation, presence of filler, fiber type, and presence of any treatment. In the observation findings, the investigation items were broadly categorized into “*Todaiji Kenmotsucho* (東大寺献物帳; List of Treasures), books and the like,” “document papers” and “sutra scroll papers.” The document papers were then chronologically listed according to the 1<sup>st</sup> phase investigation report (entitled, “Various Papers Preserved in the Shosoin” [『正倉院の紙』]). The latter part of the findings deals with the summarized results of fiber analysis conducted on fiber particles collected from selected items.

Though this report is unable to cover all of the numerous items for reasons of space, the information is expected to be useful for future study as a comprehensive summary of findings by the researchers involved in this special investigation.

PAPERMAKING PROCESSES DESCRIBED IN THE *ENGI SHIKI*  
—A THEORETICAL NOTE ON ANCIENT  
DOCUMENT PAPERS—

Ken'ichi Yuyama

To shed light on ancient papermaking techniques of Japan, this study examines the papermaking processes described in the *Engi Shiki* (延喜式) with a focus on *setsu* (截; cutting raw materials into short portions), *neri* (viscous additives) and *tamezuki*-like *nagashizuki*, instead of following the conventional concept of the transition from *tamezuki* (溜漉) to *nagashizuki* (流漉).

The *Nenryoshi* article (年料紙条; Provisions for the Annual Amount of Paper Production and Materials) of the *Zushoryo Shiki* (図書寮式; Regulations Relating to the *Zushoryo*) of the *Engi Shiki* stipulates the production regulations for 20,000 sheets of paper sized 65.1 cm wide × 35.5 cm long. This study first examines the descriptions of allowances of papermaking tools therein, discussing that they are concerned with the annual quantity of supplies needed for 4 *zoshishu* (造紙手; papermaking operators). With regards to the quantity of raw materials stipulated therein, it is revealed that 8 *zoshishu* would have been needed in order to achieve the production quota calculated for *chuko* (中功; spring and autumn days, i.e. February, March, September and October, according to the lunar calendar) described in the *Zoshi* article (造紙条; Provisions for Papermaking Processes). New explanations are proposed that the contradictions in the *Nenryoshi* article were incurred by the partial influence of the 8-person *zoshishu* arrangements in the late Nara Period and 9<sup>th</sup>-century Heian Period situations, which had originally been based on the 4-person *zoshishu* arrangements under the *Yoro Ritsuryo* (養老律令).

Examination of ancient document papers in the Shosoin Treasures House were performed based on the interpretations of historical archives as described above. The conclusion was reached that what makes ancient papermaking distinctive is that after *setsu*, most paper materials, regardless of their type, were mixed with Scarlet *Kadsura* (*Kadsura japonica*) as *neri* in the sheet forming process, and processed in the *tamezuki*-like *nagashizuki* technique with a lesser oscillation of the sheet forming tools.

# THE FINDINGS FROM THE SURVEY OF ANCIENT DOCUMENT PAPERS IN THE SHOSAIN TREASURE HOUSE AND THE PRESENT PAPERS MADE BY VARIOUS HAND SHEET FORMING TECHNIQUE

Katsuhiko Masuda

This paper reports on the findings that the technique to make ancient document papers preserved in the Shosoin Treasure House is a unique characteristic to Japanese papermaking.

Firstly, the terms *tamezuki* (溜漉) or scoop and drain through a bamboo mould filter and *nagashizuki* (流漉) or scoop and flow on a mould sieve both of which describe to sort the techniques of sheet forming by hand, were reviewed through observation of video recordings of current hand sheet forming movements, and new categories were presented. Hand sheet forming techniques from China and Korea were also compared. It is proposed that Japanese papermaking techniques are better categorized as the *yurisuki* (揺漉) technique, or the sloshing method.

Secondly, handmade papers of Japan, Korea and the U.S.A. made by different sheet forming techniques was examined on the orientation of surface fibers. The results of this examination confirmed that one paper made by the *tamezuki* technique, in accordance to the proposed categories, actually showed good fiber orientation on both sides as like papers of *nagashizuki*. It proved that determining the sheet forming technique, *tamezuki* and *nagashizuki* from the fiber orientation of the surface was difficult.

Considering the above mentioned, the examination records of the ancient document papers are discussed to search a certain unique character on the papers. The features found on the papers, sheet formation, the extent of spots and the fiber orientation on both sides, suggested that the *tamezuki* and *nagashizuki* techniques were used concurrently, and that the sheet was formed with deckle because several of them had thicker edges which were created only when charged stock hit deckle by sloshing motion. The Chinese and Korean papers presently made without deckle, the papers accordingly haven't thick edges.

# VISUAL OBSERVATION OF THE SCROLLS IN THE *SHOGOZO* REPOSITORY-A SURVEY REPORT

Eikei Akao

The author had the opportunity to make an actual observation of part of the collection of scroll in the *Shogozo* (聖語藏) which included eleven volumes of hand-copied sutras categorized as having originated in the Sui/Tang dynasties, four volumes of those from the Nara period, and what was regarded as a hand-copied sutra of Silla. This report focuses on bibliographical findings from the visual observation in terms of such factors as the sheet size, number of lines on a single sheet, paper thickness, number of spits in a bamboo mould and paper quality. Paper fiber analyses were also performed on several of the volumes.

Among the materials categorized as Sui dynasty copies, the 38<sup>th</sup> volume of *Daichidoron* (大智度論; Commentary on the Great Wisdom Sutra) and the 4<sup>th</sup> volume of *Daishogonron* (大莊嚴論; the Great Glorification Discourse) were assumed to have been created prior to the Sui dynasty. Among the eight volumes categorized as Tang dynasty copies, six were found to have been translated by the Buddhist monk Xuanzang (玄奘), some of which, however, could not be described as high-quality. Some copies seemed highly probable as being from the Nara period, while the volume assumed to be from Silla remains an objective of future studies.

Among the materials from the Tempyo period, the *Gogatsu-Tsuitachi-Kyo* (五月一日經; 1<sup>st</sup> May Sutras) was assumed to represent the then latest scriptures of the Tang dynasty, as it had basically been based on the scriptures of *Kai-yuan Shi-jiao-lu* (開元釈教録) brought from China by the Buddhist monk Genbo (玄昉). These scrolls will certainly make significant contributions to the ongoing development of a manuscript of the complete Buddhist scriptures. To this end, the *Shogozo* Scrolls represent a cultural treasure that encompasses the whole Chinese-character cultural sphere, i.e., China, the Korean Peninsula and Japan, and ongoing digitalization efforts will undoubtedly provide a valuable and essential source of information in disciplines such as Buddhist studies, bibliography, and Japanese linguistics.

# A STUDY ON THE *NUINOSENGAI* SHOES

Yoko Tanaka

There are 4 pairs of Embroidered shoes called “*nuinosengai* (North Section, No. 152, No. 1 to 4)” in the Shosoin Treasures. The name “*nuinosengai*” appears on the “*Byobu Kasen To Cho*” (List of Folding Screens and Patterned Rugs), where it is noted that 8 pairs of *nuinosengai* were bequeathed to the Todaiji Temple on 26 July in Tenpyo Shoho 8 (756A.D.). According to the “*Zatsumotsu Shutsunyucho*” (Record of Various Objects Taken Out and Put in the Repository), 4 out of the 8 pairs were withdrawn from the warehouse of the Todaiji Temple on 3 October in Konin 11 (820A.D.). The remaining 4 pairs have been kept in the Shosoin Treasure House to date.

The structure and materials of the 4 pairs of shoes and the brocade patterns found on them were studied, which derived the following:

- 1 of the shoes of the No. 2 pair actually forms a complete pair with 1 of shoes of the No. 3 pair. The pairs must have been mixed up at some time during the course of history.
- The 4 pairs have the same brocade pieces here and there, which shows these shoes were manufactured in the same period at the same studio.
- Some pieces of the brocade used in the 4 pairs of shoes are found to have been woven in the technique used for Tang style weft-faced compound satin. This technique was confirmed to have been used during the Tang dynasty in China, but is rarely found in the brocades kept in the Shosoin Treasures. Therefore, there is a high probability that the brocade pieces were made in China.

# AIR POLLUTION INVESTIGATION IN THE SHOSOIN

## — HISTORY AND RECENT RESULTS —

Masakazu Naruse

Rikia Nakamura

The air pollution investigation activities at the Shosoin Treasure House are twofold: investigation of metal corrosion, and that of sulfur oxide concentrations, which have been conducted since 1950 and 1954, respectively. The metal corrosion investigation provides indirect information on air pollution, where changes in the reflectance of three plate specimens made of silver, copper and iron left at a designated location for a certain period of time are measured. The investigation of sulfur oxide concentrations is concerned with the direct quantitative analysis of the concentrations, which was conducted by several different approaches, such as the lead dioxide method. Today, sulfur dioxide concentrations is quantified by the triethanolamine filter paper method (the TEA method). In the current investigation, nitrogen dioxide concentration is also quantified by means of ion chromatographs, together with sulfur dioxide concentration. The data obtained in the early stages of the investigation were effectively utilized for the construction of the present West Repository in 1962 and the addition of air conditioning systems to the present East Repository in 1964. According to the previous reports compiled between 1975 and 1979, the air pollution levels inside the present repositories were kept low, providing a satisfactory environment for the conservation of the treasures within.

This article reports on the air pollution status inside and outside the present repositories in recent years, as clarified by the ongoing air pollution investigation. The results of investigation by the TEA method showed that sulfur dioxide concentrations have been kept low inside the present East and West Repositories, proving that the air filters are properly functioning as had been shown in the past reports.

It was found in the metal corrosion investigation that the reflectance of copper plate exposed on the second floor of the north section in the present East Repository has rapidly decreased in the past few years. This decrease was not caused by air-polluting substrates through the anteroom. Further investigation into the cause of the decrease of the reflectance and improvement of the interior environment is required.

The repository of the new Treasure House office building has a cleaner environment than that in the present East Repository. This conclusion about the new repository was based on a comprehensive evaluation of the results of metal plate reflectance measurements and sulfur dioxide and nitrogen dioxide concentration analyses. It was also found that the environment of locations for handling the treasures in the new office building was equivalent to the environment in the present East Repository and anteroom. It is thus concluded that in terms of air pollution, the new office building provides a safe environment for carrying out repairs and investigations of the treasures.