Special Lectures

The Historical Significance of Researching European Paper with and without Watermarks and Its Technological Development

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The introduction of paper as a new writing material in Europe

Parchment and papyrus have hitherto served as writing materials in Europe, when the Arab papermakers in Xàtiva on the Iberian Peninsula introduce the production of rag paper to the Western world. The new writing material and the art of papermaking spread in the 13th century from Spain to the southern and northern parts of Italy. Here papermakers in Fabriano develop a new European technology that results in a stronger and better quality of rag paper than the Arabic one. The Italian papermakers not only change the whole preparation process to break down and dissolve the worn out textiles into individual fibers, but also the equipment and sheet formation technique that increase the production. This new technological development of the art of papermaking spreads during the next centuries to France and Germany and from here to the rest of the European countries.

Development of European papermaking technology

The collected rags of worn-out textiles are sorted into 5-7 qualities according to whiteness and strength, cut into small pieces and the woven structure weakened for weeks during a retting process by sprinkling with water and addition of lime, until the right degree of mouldering is obtained.

Mechanical treatment and rinsing

Water-driven fulling mills are normally used as after-treatment of woolen textiles, but the Italian papermakers introduce the local fulling mill system as efficient equipment for pounding the rags instead of the Arabic pounding by hands. The rags are dissolved during the mechanical treatment of the stamping mill and rinsed for water-soluble dirt with addition of water except for the last stamping. Here only lime particles are added for obtaining a total disintegration of the woven structure into individual recycled textile fibers.

Papermaking mould with fixed screen of metal wire and watermarks

The local knowledge of metal work in Fabriano inspires to a new construction of the papermaker's mould in the 13th century. The Arabic loose-lying flexible screen of reeds is now replaced by a fixed and rigid screen of metal wire with laid lines and chain lines and filigree – a watermark - of metal thread sewn to the metal wire. The watermark serves as a logo for the paper mill and quality of the paper similar to the logos stamped on silver ware, led seals on textiles and wax seals on documents as guarantee of genuineness. An impression of the woven structure of the metal wire is left in the paper with the vertical chain lines and horizontal laid lines and watermarks, visible when the sheet of paper is held against light.

Sheet formation

Two papermakers work together in the sheet formation process to increase the production of the new writing paper. One papermaker works at the vat, where the warm pulp is scooped by the dipping mould with the loose deckle, and one works at the post, where the mould without deckle is turned upside down and the sheet of paper

couched on a felt. The new sheet is covered by another felt, and the post is then ready for the couching of the next sheet of paper.

Pressing and drying of the paper.

The post of paper and felts are pressed together for removal of superfluous water before paper and felts are separated in two piles. The second pressing takes place of the pile of sheets of paper without felts before the slow drying of the sheets of paper by air takes place on the drying loft.

After treatment – sizing and glazing

The Arabic starch sizing, added by brush to both sides of the paper, is replaced by the papermakers in Italy in the 14th century by gelatin sizing, applied to the paper by dipping the sheets in warm gelatin. Superfluous gelatin is removed by pressing the pile of sized sheets before the final drying by air takes place on the drying loft. A smooth surface of the writing paper is finally obtained by polishing or pounding of the material.

Invention of printing and printing paper

The German gold smith and later book printer Johan Gutenberg from Mainz is considered as the inventor of the art of printing. Copying by hand as hitherto practiced of texts on parchment, papyrus and paper is more or less replaced, when mass production of books with movable single bronze types is a reality in the 15th century. Good quality rags with fibers of sufficient length are chosen for printing paper to obtain a strong and flexible quality. A more hygroscopic paper is needed for printing because of the thicker condition of the printing ink compared to writing ink.

Writing paper and printing paper

The Danish astronomer Tycho Brahe needs writing paper for his astronomic observations and printing paper for publications of his scientific results and theories. The numerous European watermarks represented in his observations and publications illustrate his dependence of the import and trade of paper to Denmark at the end of the 16th century, where no other paper mills are in function. He therefore builds his private paper mill, and studies of his watermarked writing paper and printing paper illustrate how he obtains the difference needed between the two paper qualities with the construction of the metal wire of his moulds.

Permanence and durability of European paper

Increased demands for paper results in the 18th century with the invention of the pure mechanical Hollander beater as replacement of the time consuming retting process and stamping process. Now rinsing and dissolving of the rags into individual fibers can be done in one day. Addition of lime particles is not needed as earlier for disintegration of the textiles and the buffer of importance for the durability of the European paper is no longer present. Bluing of paper with addition of blue pigments and fibers is needed because of the lack of good quality white rags in order to obtain a less yellowish shade. Addition of rosin sizing to the pulp is less time consuming than the after treatment gelatin sizing of the sheets of paper, but the permanence and durability and strength of the European paper are reduced by these changes of the technology during the 19th century.

Scientific analysis of paper and studies of European paper history

Julius Wiesner's microscopic analysis of Arabic and European paper and Central Asian paper at the end of the 19th century results in real data about the fiber materials and technology used of importance for the history of paper. Filigranology - a new scientific paper historical field - is in the same period started by Aurelio and Augusto Zonghi and Charles Moïse Briquet with studies of watermarked paper and registration of the watermarks as a tool for dating and provenance of European paper. Watermarks are, however, not to be found in numerous sheets of papers in manuscripts, books, prints and drawings because of cuttings in various formats of the paper. These papers have to be studied as well, because valuable paper historical information about the technology and fiber materials used is to be found here, and registration of chain lines and laid lines of the metal wire is of importance for the possible connection to paper with watermarks of known provenance and date.

Workshop

Quality of Paper and the Rank of Books : Case Study of Chinese and Japanese Manuscripts and Books

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Paper of Book is an important element of Codicology. The speaker shows that it is possible to prove the rank of books by analyzing papers by a digital microscope, in the case study of Chinese and Japanese manuscripts and books.

1. The Court Manuscripts of the Early Tang period (Official manuscripts)

   Directly made of hemp fiber, one of the finest paper in history, bamboo screen was 11 lines /1 cm, 40 items

   [Slide 1] Myoho Rengekyo 妙法蓮華経, vol. 3, (675 transcription), × 500, hemp fiber.

   measuring the bamboo screen

   It shows the complete forms of Kai-shu 楷書 and the glyphic standards of Kai-shu, variant ratio=variant occurrences / total–singleton × 100 is 0.81% (all of variant ratios of these court manuscripts are under 1% ➡ HNG (http://www.chise.org/hng-ids-find/)

   Cf. [Slide 2] Moshi 毛詩, early Tang, ×100, tamesuki 溜漉, made of Kaji 構 (梶) (Broussonetia papyrifera) fiber.

   Private manuscripts of early Tang were transcribed on Broussonetia papyrifera paper. Variant ratios of private manuscripts were rather high, for example the variant ratio of S. 2577 妙法蓮華経巻八 transcribed in early Tang is 2.03%

   Cf. [Slide 3] Monzen Shuchu 文選集註, vol. 88, Japanese Manuscript, early 11c, × 500, nagashisuki 流漉, Japanese Kouzo 楮 paper.

   It is possible to distinguish Chinese or Japanese paper from the fiber and the method of making paper.