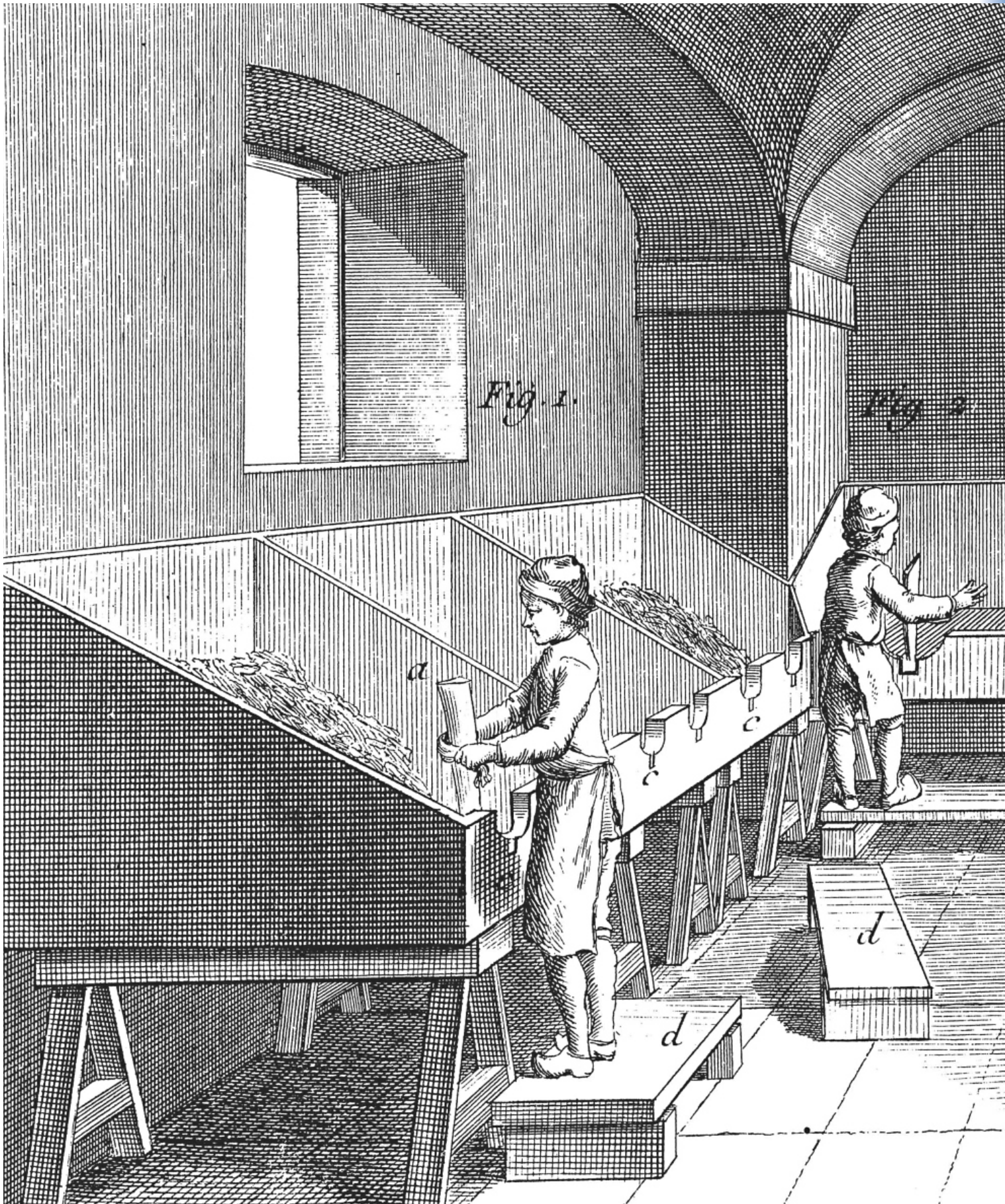


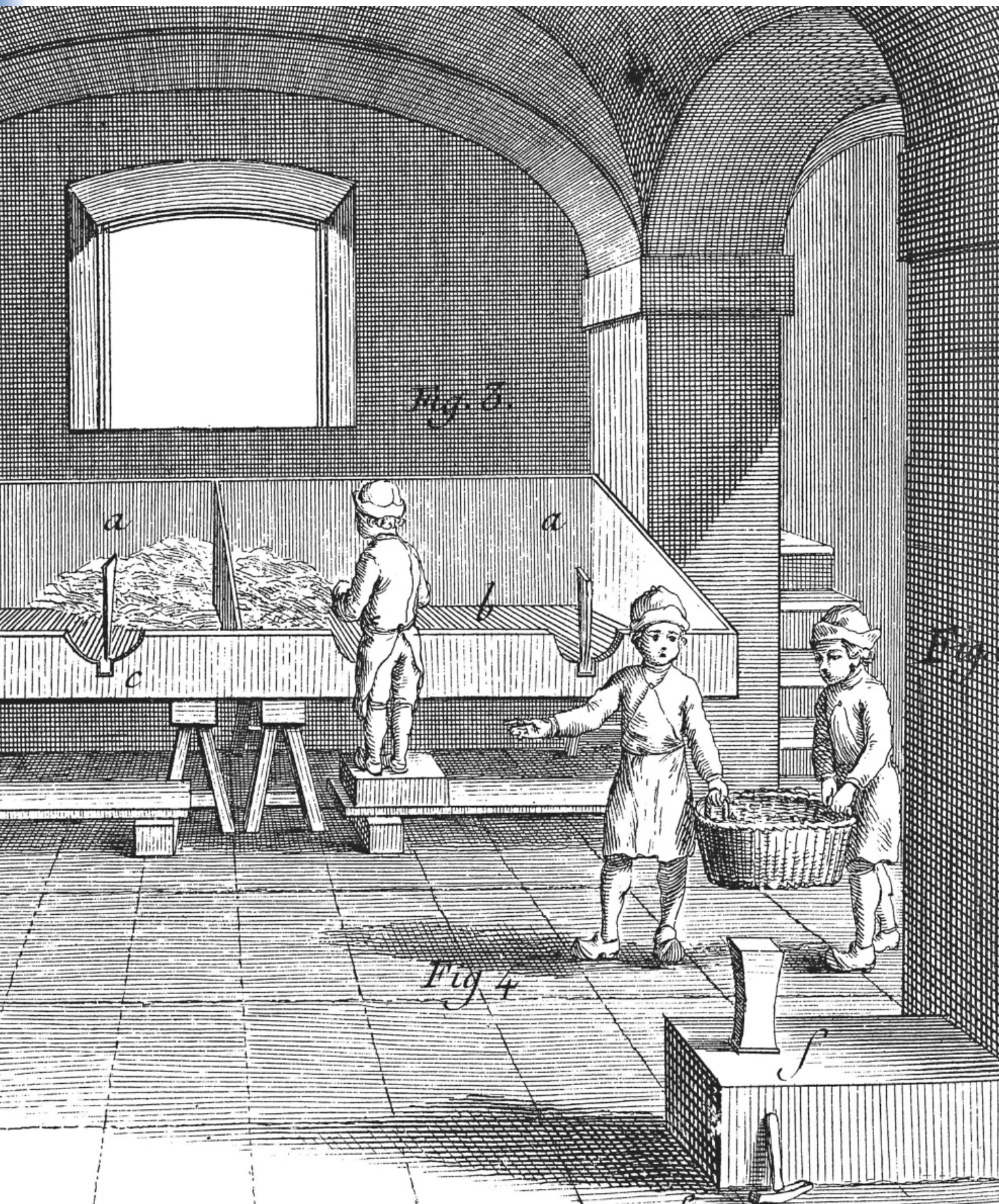
PAPER

Material, Medium and Magic

Fig. 1.

Fig. 2.





The Art of Paper Making

Papermaking is a manual process, in which hands, the body, and the flow of water are brought together. A form of choreography occurs at the papermaker's vat: dipping the scoop sieve in, lifting it out and gently wobbling it until the water runs free and then pressing the sheet on to the felt. These steps are important in that they guarantee evenly thick sheets with a smooth surface.

All crafts are based on human ratios. So if you were to create your own paper, your own dimensions need to be aligned to the format. At a height of about 1.70 m, I should therefore format sizes of up to 60 cm × 80 cm, but no larger.

Using water as a tool for the production of paper sheets is of fundamental importance to

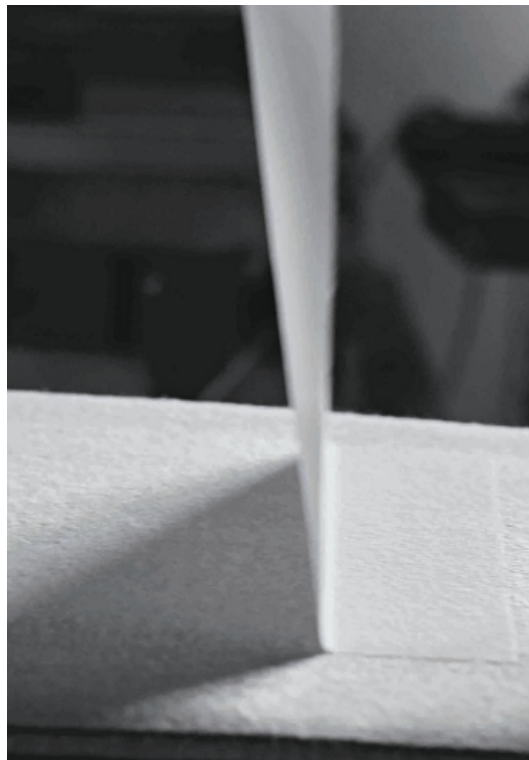
the papermaker. Understanding the flow and speed of water affords an even distribution of fibers and teaches the maker to sense and respect, patience and humility, as well as his or her own limitations.

There are wonderful moments when creating paper, such as the moment of raising the sieve scoop and strain-hardening the fibers by gently shaking the pulp, as well as the sounds coming from the water. These are moments of great meditative calm. The creator feels as if they are a part of a river. For me, the magic of handmade paper lies in perceiving its subtle details, which, with all my senses, I can co-determine through many changes. The aesthetic appeal and properties of various papers can be shaped at microscopic level. I have noticed that the sound of paper changes depending on the degree to





which the fiber has been milled. The drying method also influences the paper surface. And the inner balance of the paper is reflected in its bend. Recently, I designed a nearly transparent white paper with opaque white lines. The sheets were dried on wooden boards. This resulted in a wood grain on the paper surface – a beautiful detail that is only visible at a second glance. This surprising element, like every other detail, helps to us understand the entire universe of hand-made paper. Making paper has been my passion for nearly forty years. — *John Gerard*



The paper artist and creator John Gerard at work: Removal of the scoop sieve (left); working on the pulp; peeling the paper sheet from the felt.

Handmade Paper

The Zerkall paper mill is located on the northern edge of the Eifel in the valley of the Kall River, which flows into the Ruhr in the village of Zerkall. The water-powered mill, first mentioned in 1512, served successively as a grinding mill, a fulling or walk mill, and oil mill until 1887, when a small cardboard mill was set up in the building. In 1903, the Düren paper manufacturer, Gustav Renker, acquired the mill to set up a modern production facility for the manufacture

of traditional laid paper on a rotary cylinder mold. The high quality of the water in the Kall River meant the location offered the best conditions. Since which time, the Zerkall paper factory has been producing genuine laid papers in a cylinder mold and processing them into writing, advertising, printing and artist's papers in various formats, surfaces and colors. The resulting papers are acid-free, neutral glued, alkaline buffered, and manufactured without optical



Cylinder molds for making mold-made papers. Cotton fibers and cellulose are the paper raw materials.





View of the paper mill in Zerkall.
Artificial pond holding the water
for the production of paper.



brighteners and so meet the strict international requirements for maximum aging resistance. The paper is scooped with a sieve-like cylinder, which slowly rotates in the vat around its axis, working almost like a human hand movement. With regard to structure and volume, cylinder-mold paper is therefore largely like true handmade paper. Watermarks and ripples are especially clear and rich in contour compared to machine-made paper, as they are on the rotating scoop and reach the screen side of the paper. In order to preserve the all-round deckle edge while scooping, the round screen must be subdivided

into the format with a fixed division before production. Due to the large variety of formats and the different screen structures, Zerkall uses a different cylinder mold for each batch. Further processing and converting is then mainly done by hand in order to preserve the genuine deckle edges. Today, traditional manufacturers of handmade paper can be counted on one hand: in addition to Zerkall, there are Hahnemühle in Germany, Fabriano in Italy, St. Cuthberts in England and Arches in France. — Felix Renker

Washi: Japanese Paper

Paper is a natural product that can be experienced visually, haptically or acoustically. Lightweight paper produces different sounds from those produced by heavy paper. Rough paper arouses different feelings than those from smooth paper. Translucent paper opens up new perspectives for its application.

The oldest surviving paper fragments in Japan date back to the year 701. Said to be the first paper made in Japan, they are company registers that are archived at the *Shōsō-in* in the Imperial Treasure House in Nara. Until then, paper had been imported from Korea. The copying of Buddhist sutras led to the growth of paper production in the seventh and eighth centuries. To this day, there is a high degree of continuity in the development, quality-improvement and use of paper in Japan. The name Washi derives from *Wa* for old Japan; handmade/traditional and *shi* for paper, this is why *Washi* became the term for all Japanese handmade papers.

Nagashizuki

The traditional Japanese process of hand-papermaking is fascinating, because it involves laying several layers of fiber on top of one another. As a result, the usually fine paper becomes very strong and difficult to tear. The smallest constituent parts of the paper are plant-fibers, which determine its particular character, materiality, volume, weight, stability, gloss, and overall design. The length and width of the vascular cells, the raw fibers, are decisive for the fiber-composite structure in surfaces and solids. In Japanese papermaking this differs from that in Western culture due to the raw material and the process used, as well as to the additive *neri*.

Raw Materials

The three raw materials most commonly used in Japan are characterized by relatively long fibers with specific features:



Workers debarking kozo at the Awagami paper manufacture in Japan.

Kozo (*Broussonetia papyrifera*), length: 3–25 mm, diameter: 0.025 mm; very long, strong, and soft.

Mitsumata (*Edgeworthia papyrifera*)
length: 1–5 mm, diameter: 0.02 mm; glossy, elastic, dense.

Gampi (*Wikstroemia sikokiana*), length: 2–4.5 mm, diameter: 0.018 mm; transparent, silk-like, durable.

The papers produced are used for different purposes according to their fiber-specific properties: *Kozo* for calligraphy and for the traditional paper sliding doors found in Japanese architecture; *Mitsumata* for restoration purposes; *Gampi* for the application of gold leaf.

In the past, silk cocoons, animal-produced silkworm fibers, were also used to make precious papers.

Unlike in Japan, high-quality papers in Europe are made of cotton; in the past, they were made of linen or flax. Linter from the ripe cotton bole is made into fiber sheets, which are then used in papermaking. Depending on cultivation, the band-like fibers are usually shorter than the Japanese fibers. Such papers have a higher grammage as well, which is also partly attributable to the filler materials.

Various cultures to this day still use local raw materials: in Nepal, for instance, the inner bark of *Lokta* (*Daphne cannabina*), a plant of the *Daphne* genus; in China, whole stalks and stems of bamboo; and in Tibet the inner root fibers of *Stellera chamaejasme*, a plant of the *Stellera* genus.

Preparing the Fibers

The branches are debarked and the white inner bark is then separated from the outer bark. This inner bark is boiled, cleaned, rinsed, beaten with a wooden hammer or masher, or mechanically made into paper pulp in the *naginata* (the Asian version of the Hollander beater used to defiber the raw material, which is crushed rather than



Kigami, handmade paper from Japan.

ground). The technical processes used in fiber production affect the quality of the paper.

The root extract *neri* serves to perfect Japanese papermaking. This starchy substance slows down the draining of the water, thereby improving sheet formation. *Neri* is derived from the roots of the Japanese *tororo-aoi* plant (*Abelmoschus manihot*) a plant of the genus *Abelmoschus*, until recently classified as genus *Hibiscus*.

The Papermaking Mold

Dip molds are the papermakers' 'gems', because making them requires a lot of time and elaborate work.

In the Western technique, the sieve, the ribbed mold (with copper or bronze wires), or the fine wire mesh (for woven paper) is invariably attached to the wooden frame or deckle. In the Japanese tradition, by contrast, the *su* (sieve) of the *suketa* is laid on top of the *keta* (wooden frame) and held in place only by the cover (the

The paper scooped with the su is couched on the stack of paper without an intermediate layer. After each sheet a narrow ribbon is inserted to make it easier to separate the sheets after pressing.



The *nagashizuki* papermaking technique. The dip mold is repeatedly dipped into the pulp vat. Excess pulp is poured out over the back edge of the *suketa*.

The paper is dried by applying pressed, damp sheets of paper onto a firm surface with a roller. The paper stays smooth and retains its shape.



covering frame). A holding device used in the dipping process allows for the production of very large formats. Very thin bamboo splints or interconnected blades of grass are used for the ribs or wires of the sieve. They are tied together in parallel sequence with yarn to form a surface. Depending on the paper thickness, the ribs form a kind of 'watermark' in the paper due to the greater or smaller amount of superimposed pulp in the dipping process.

The Dipping Process

The dipping process is unique and requires great skill: dipping the mold, catching the paper pulp, lifting out the dip mold and gently moving the mold horizontally to give direction to the fibers, which will also cause them to interlace. The remaining pulp mass is quickly poured off again over the back edge of the mold. Depending on the quality and thickness of the paper, this process is repeated several times. As a result, multiple, thin pulp layers are superimposed on one another, thus creating a very strong, tear-resistant yet thin sheet of paper.

Thanks to the fiber consistency and the addition of the root extract *neri*, no layer pads are needed in the process of couching the papers. Each sheet has to be couching precisely onto the stack to ensure that the papers can be properly separated after pressing. The sheets are dried on heated metal plates; in the past they were dried

on wooden planks, which would cause wood textures to show in the paper. Fine brushes or rollers are used to apply the damp papers onto the metal plate. As a result, the paper has a slightly shiny, smooth surface on one side and a rougher one on the other.

A Digression on the History and Use in Art, of Washi

In her 2013 performance *Washi Tales*, the artist Kyoko Ibe (b. 1941) makes extensive use of paper. Openings resulting from cuts in the paper allow viewers to look through them and make the installation lighter. The paper's grain direction is already influenced by the movement of the dip mold during the production process and must run parallel to the openings. Otherwise the space-filling, hanging surfaces would tear.

The making of paper yarn from *shifu* (paper cloth) also requires a particular grain direction. In Japan this tradition traces back to the early seventeenth century. — *Therese Weber*

Kyoko Ibe, *Washi Tales*, performance, 2013.



Color by Design

James Cropper has been producing paper and cardboard in England's Lake District since 1845. The paper mill has made an international name for itself with dyed papers that are custom-made for use as packaging of fine textiles or other luxury items, as well as catalog and book covers.

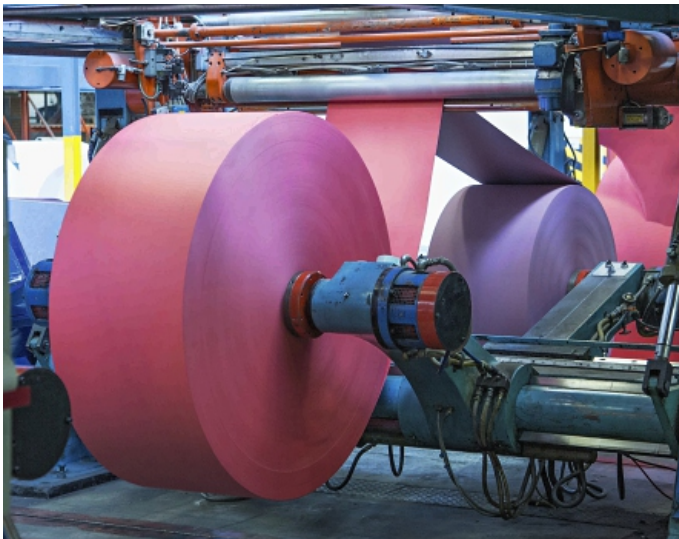
In most cases, color development begins as soon as the customer has registered his interest or order. The commissioned color designers will usually come to Cropper to work with the papermakers and paint lab to realize a color concept. There are around 4000 colors in the laboratory and around 200,000 digitally stored color mixes in the database.

In order to develop a new color shade, the specialist expertise of the papermakers is needed. Colors are often an abstract idea in the designer's imagination. To actually achieve the designer's objective, the paper professionals need to know exactly what it is going to be used for, what influences the paper will be exposed to and how it is to be further processed or used. In short, every factor will have an effect on the color. The actual use and the exact application

of a product must always be perfectly understood so that further dynamics such as light and refraction can be analyzed. In practical testing, for example, color fastness is important, as is the effect of wear and tear on the colors. It would be annoying if the dye used to make carrier bags happened to rub off on to textiles.

After measuring the sample colors, these values are then used as a basis. Software plus a good deal of knowledge and experience will then be used to find different ingredients for the color recipe. Up to five colors or pigments can be mixed to create a specific color. After this 'recipe development,' handmade samples of the paper are produced (color patterns made from paper). Many attempts may be needed to hit the precise tone in the paper mix. The entire process is initially run through manually. The result is then tested in different light backgrounds and shades, after which final machine production will only go ahead once all has been approved.

— James Cropper Paper



A view of the production floor of the James Cropper Colored Paper Mill in the Lake District, Great Britain.

