February Meeting:
“Hanging Out with Tapestries, Carpets and Quilts: the Effect of Textile Properties on Appearance.”
By Mary Ballard

The February meeting was held at the Fashion Institute of Technology. Vice Chair June Bové introduced Mary Ballard, Senior Textile Conservator, Conservation Analytical Laboratories, Smithsonian Institution, before Ms. Ballard commenced her talk, excerpted below:

“There is a good deal of information available to textile conservators about textile history and about textile structures (weaves and yarns). Less familiar is the field of textile technology and the physical properties associated with fibers, yarns, and textiles. We have relied, I think, on traditional methods of reducing strain on large tapestries, carpets, quilts—and on the techniques developed by mentors like Kathryn Scott and Nobuko Kajitani.

“In order to devise our own solutions in the future—and to appreciate the sound ideas we have received in the past—it is worthwhile to consider some fundamental concepts about the physical properties of fibers: linear density, specific stress, strain, yield, elastic recovery, plastic deformation, primary and secondary creep. Using these terms, we can describe the success of certain suspension systems for large hangings.

“Linear density is used by textile technologists to equalize fiber, yarn, or fabric comparisons despite differences in fiber shape, size, or weight. Tex is the weight in grams of 1,000 meters of fiber (or yarn, etc.); denier is the gram weight of 9,000 meters. Engineers for other media—paint, paper, metals, wood—use pounds per square inch (mass per area). Linear density is different: it measures mass per unit length.

“Specific stress (a.k.a. tenacity) measures the strength of a fiber, yarn, or fabric in grams per tex or grams per denier. Because the fibers are equalized by linear density, it is possible to compare what effect the same amount of weight on different fibers (Figure 1.)

“Strain or elongation is the principal reaction to stress: the fibers will stretch longer, the greater the weight that is applied. How easily the different fibers stretch can be seen in Figure 1 by reading across the horizontal axis. Wool stretches a lot with a small stress (weight); flax takes a lot of weight but extends only a minor amount.

“Yield. Most fibers actually have a similar basic stress-strain curve (Figure 2). With minor amounts of stress or strain, the fiber will have a small extension and return to its original shape and size when the load or pull is removed: this is the elastic region. For example, spandex is very elastic. Beyond a certain point the fiber will be less likely to recover its original shape and size. The region past the yield point but before breaking is the plastic region. It is very helpful to compare the elastic recovery of different fibers from various extensions (Figure 3). Wool and nylon snap back very well from 2% or 5% extension, while acetate and rayon do not. Textile technologists study the effect of repeated extension-relaxation cycles on fibers, yarns, and fabrics, but for textile conservators there is another more pertinent phenomenon.
"Creep is the slow elongation that occurs through time after a single stress is applied (and maintained). Creep is the technologists' term for the "growth" we see occasionally in the length of a textile after it has been hung. It can either be elastic and reversible (primary creep) or plastic and less reversible (secondary creep). We know from some clever uses several centuries ago of discontinuous weft in tapestries that weavers were quite familiar with the propensity for wool to creep. When a tapestry is hung, the upper selvage takes all the weight below it—i.e. the upper sections of the tapestry are weighed down—stressed—by the areas below them. Depending upon the type and condition of the fibers in those upper sections, the tapestry will elongate up there. Ironically, it will appear that the bottom hem-line is drooping when the problem is actually higher up. To prevent tapestries from being pulled apart by their own weight, linen straps were traditionally used to support and transfer the weight. Flax (Figure 1) stretches much less than silk or wool, so it was used to prevent creep.

"In considering the most appropriate backing fabric for an antique textile, the fiber properties and fabric construction of the museum specimen are paramount. For example, an 18th-century crewel embroidery with a linen ground and wool embroidery is about 6 feet high. If we were to use cellulose acetate or rayon as a backing fabric, it would stretch more readily than the flax—at say 10 grams/tex of weight (see Figure 1). Those "support" fabrics would elongate so readily, the poor antique would simply be carrying the additional weight of the ersatz support. However, a more tightly twisted, heavier linen could carry the weight transfer from the embroidered panel quite easily. Paradoxically, from the front, either solution would appear successful: the stretcher backing fabrics will not provide support but they will not create bulges or puckers.

"Bulging and sagging occur if the specimen itself stretches more than the backing fabric. The cause can be an insufficient weight transfer that allows the antique textile to creep—as with a sagging tapestry—or a relative humidity change that alters the relationship between the museum textile and the backing fabric.

"An increase in relative humidity usually causes relaxation and elongation in natural fibers if the weight-load (stress) conditions stay the same (Figure 4). For example, silk with 30 gram/tex of stress will extend about 10% at 65% RH but the same stress will cause a 20% extension at 100% RH. In part, there is a weight gain from moisture absorption—the fibers themselves weigh more.

"For an oversize (perhaps 12' x 24') pile carpet from Cranbrook Academy traveling in an international exhibit, a prudent way to transfer weight was with 2" wide Velcro bands running horizontally every 60" in height from the top. Thus, the tremendous weight of the carpet was divided into 5 sections, as though four 5' carpets were hung one below the next. Because of the nature of the Velcro bands and their complimentary slats, elongation less than the 2" width of the Velcro (about 2/60" or 3% elongation) could be adjusted. Any elongation greater than that and the carpet would not hang properly against the slats spaced 60" apart on the walls. A two inch wide band of Velcro holds about seven pounds (3.2 kg) per inch (2.54 cm). For practical purposes including pest monitoring, no backing fabric or dust lining were used.

"A 50 pound button quilt—a medium weight cotton plain weave fabric entirely decorated with buttons into a possibly Masonic design of Cincinnati, Ohio—was acquired by the National Museum of American Art. In order to exhibit this vertically, the textile fabric was backed—a cotton support was sewn to it, then it was vertically strapped like a tapestry. The backing stabilized the fabric ground; the straps were used to prevent creep or growth that the fabrics could not tolerate. Finally, 2" wide Velcro bands were sewn horizontally 24" from the top to transfer the weight from the straps. Essentially, the backing and straps were now supporting only 24" of weight. This quilt is on semi-permanent view in the museum. I go by to visit it and to monitor it for creep or sagging: 1" every 24" would correspond to about a 4% extension, taking the design out of alignment—the buttons out of the vertical plane. So far, nothing so extreme has occurred.

"Some modern hangings have other forms of "inherent vice." Lillian Holm wove a hanging, First sight of New York, in the 1930's in plain weave with discontinuous wefts, using [allegedly] linen, wool, and cotton. If Ms. Holm had used linen warps or cotton warps, a rectilinear shape could have been maintained over the years. However, the wool (viscose rayon?) warps elongated over the years. Photographed flat the lined (but unbacked) hanging can be squared. Hung with its vertical warps in alignment, this was not possible—without

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Camille Myers Breeze  Newsletter Editor
intervening by sewing (gathering?) the deformed warps against less elastic linen or cotton backing straps.

"This, of course, brings us back to the issue of sewing threads, a topic of research which the Textile Conservation Group has explored in great detail. Certainly, the issue of hanging oversize textiles is in some manner just a mirror image: a focus on what we are holding up with the sewing threads rather than the sewing threads themselves. I hope that this presentation helps in the on-going review."

Following her presentation, Mary Ballard answered questions from the audience, many of which are transcribed below:

Q: "What thread do you recommend for sewing Velcro (machine stitched to a cotton tape) to a tapestry or carpet?

M.B.: "A cotton button and carpet thread is generally used on carpets and tapestries in good condition.

Q: "Did you generally put a backing on the reverse of an entire piece?

M.B.: "A backing transfers the weight of the antique original textile; the transfer of weight can be done by sewing or by adhesives. A lining, in contrast, is a dust cover, that is simply hemmed to the antique textile along the sides and bottom; it provides no support to the antique textile.

Q: "Has anyone actually quantified what the stitching between a backing and a piece accomplishes?

M.B.: "Where the stitching transfers the weight properly to a backing, the antique textile survives well. Other things being equal, the textile remains in good condition without treatment for decades until the backing wears out. If the backing wears out before the antique tapestry, well and good. If the antique tapestry wears out before the backing, there is a big problem with the selection of the backing, the type of stitching (or type of adhesion). The goal of textile conservation is to make sure the antique textile survives to subsequent generations; we use strong backing systems to make sure they do.

Q: "What would prevent the sides of hangings getting "rabbit ears" - longer at the edges? Would more Velcro help?

M.B.: "Linen or cotton tapes as vertical strapping could help prevent the sides of hangings from creeping. However, once it has occurred and if it is that secondary creep, the deformation may be permanent, irreversible. In that case (as I was taught by Kathryn Scott), the best thing visually, is to make certain that the vertical alignment (trees, borders, etc.) remain straight and truly perpendicular to the floor. The "rabbit-ears" at the top look a bit sad, but the alternative is a wavy hemline at the bottom or sea-sick making verticals. Technically, it would be recommended to use straps to stop any further growth.

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Figure 4 Stress-strain curves of various fibers at 0% RH, 65% RH and 100% RH and 20°C. (After Morton and Hearle.)
Q: "Which is a better support, strapping or backing?
M.B.: "Strapping and backing are both forms of weight transfer. Strapping uses tapes or bands; lining uses wider fabric. If one conservator sews zigzag stitches across/down a wide tape and spaces the tapes only six inches apart, that conservator is going to get better weight transfer than another conservator who uses a lining but simply does vertical running stitches once every twelve inches. Of course, the other question is what amount of support is sufficient support? For the Cranbrook carpet, Velcro in horizontal bands was fine.
Q: "Would you attempt blocking to correct badly distorted or elongated textiles?
M.B.: "Blocking or washing will only improve the textile if it has not yet been distorted beyond the point of plastic deformation. Some of the stretching is going to be permanent on pieces that have been on exhibit for a long time. The older the fiber and higher the humidity, the easier it will be to reach permanent deformation. (Weavers were probably aware that tapestries, for example, would stretch over time, and they used this to their advantage when creating effects like double chins or fluffy sheep.)
Q: "Would you ever recommend using a strainer to display a textile for exhibition?
M.B.: "I will refer you to a Harpers Ferry paper I did entitled, "Fabric Selection and its Relationship to Dimensional Changes in Support Systems for Constrained Fabric Mounting Devices" (with Stephen Collins, and Marion Mecklenberg., Textiles and Costumes on Parade: Exhibition Successes and Disasters, Harpers Ferry Regional Group 10th Preservation Symposium, November 8-9, 1990, pp. 10-20). Our tests showed that eventually most textiles will sag when stretched over open strain. This is caused by stress, strain, and creep--enhanced at high humidity by the lowering of the stress-strain curves for many fibers. One synthetic fiber that responds less to relative humidity is polyester."

References:


