

## EXCERPTS FROM “ARTISTS CANVASES: THEIR HISTORY AND FUTURE”

“...Given the well established catalogue of drawbacks it is perhaps surprising that more attention has not been paid to developing new supports. One of the reasons for this is that the conservators have not really played a very prominent role in the development of new materials for artists. This is short sighted. We have tended to see ourselves as a group who acts on old works after the event of creation in order to try and slow down their inevitable deterioration. But we should also be prepared to extend our role so that we can try to advise living artists as to the best materials before they commence work. Such an approach is probably essential if the sheer volume of art created today is to have much chance of survival. Of course it may be objected that many artists do not care whether their work survives. If that is so then they have the right to make that choice. The problem at the moment is that artists are not able to obtain readily information as to the durability of their materials. Such information is not widely enough available in art schools or in literature likely to be consulted by artists.

Linen and cotton have continued to be preferred by artists seeking to paint on stretched fabrics. Given the materials previously available, linen in particular has always been a sensible choice, yet today from the viewpoints of their chemical stability and mechanical properties they are very far from ideal materials. It is worth considering some of their drawbacks in more detail since this will help to serve as one reference point in assessing new materials.

Strength loss is the most evident problem. Whilst linen and cotton begin their life with much greater strength than is necessary for a painting support, they retain it only for a short period. The cellulose chains of which they are composed suffer degradation leading to chain scission under the influence of light, moisture and environmental pollutants. The strength loss is rapid and extensive. Tests conducted on samples naturally aged in the Tate Gallery London revealed that in only 24 years linen canvas samples had declined to practically 1/3 of their original strength. Hardly surprising then that so few canvas paintings survive more than a couple of hundred years without some form of treatment to provide additional structural support. Unlined paintings of more than 300 years of age are so rare as to be almost collectors' items. Some of this extensive treatment must of course be attributed to lining having become a standard restoration treatment, though it should be remembered that this is not without a certain basis in the condition of the paintings themselves. It is evident that a large number of 20th century paintings have already been lined after perhaps only 50 years of existence. Such treatments are themselves hazardous operations and tend to impose significant changes on the appearance and handling properties of the painting especially if considered as a whole object rather than simply the visual image.

Cotton is even less satisfactory than linen. The fibres are 2 to 3 times weaker than equivalent linen fibres and consequently though their rate of deterioration due to light is slower than that of linen, low strength values will quickly be reached. These factors are sure to cause immense problems for conservators fifty years from now entrusted with the care of the large paintings on cotton which are so common in our galleries today.

Just as problematical given the optical role that exposed canvas plays in many modern paintings are the colour changes that accompany the chemical degradation. Significant darkening and yellowing of the surface take place very rapidly. The 24 year old linen samples from the Tate Gallery showed a decrease in reflectance of 10% at the red end of the spectrum and 50% at the blue end of the spectrum.

Again cotton is known to change colour more rapidly than linen and since its natural cream white colour has often been utilised by artists such a change will completely alter the tonal relationships within the painting. The original intention of an artist such as Morris Louis or Helen Frankenthaler will be irretrievably lost.

But more subtle problems also exist. Linen and cotton are moisture sensitive supports. The moisture regain at 65% HF of linen and cotton is taken as 12% and 8.5% respectively. They swell and shrink differentially from other layers in the painting and their mechanical properties also change. This process in the painting as a whole can lead to powerful shear and tensile stresses being set up and to cracking and delamination. Cotton can imbibe as much as 40% moisture at 100% RH and appears to respond more rapidly to moisture changes. It has been observed that large paintings on cotton are particularly prone to fluctuations between very slack and very taut states. This affinity for moisture also leads to soiling of the cotton and linen supports...”

### “MECHANICAL PROPERTIES

Woven fabrics in general and cotton and linen in particular do not have ideal mechanical properties when considered for use as a painting support. What is required is a material which becomes taut under the minimum of applied strain, which does not subsequently relax and which has the same properties in all directions. This requires a material of high initial Young's Modulus (and low elongation) resistant to stress relaxation and creep and exhibiting isotropic behaviour. Cotton and linen fail on all these counts when considered in the woven form.

They require considerable amounts of strain (from the point of view of the paint ground and size layers) to achieve a taut state. What is more they do not follow a classical Hookean stress/strain extension curve, but

stretch first by the removal of the crimp in the weave. This initial low modulus extension is hardly reversible and hence rapid stress relaxation follows. So if canvas is to remain taut for any length of time it must be pre-stretched before it is painted on. This drawback exists depending on weave type to a greater or lesser degree with all woven fabrics including glass fabrics. However even once the decrimping region is passed the cotton or linen canvas will not retain its taut state over a prolonged period of time. This is because under constant applied strain they suffer from stress relaxation. So a canvas which was initially tightly stretched can become slack over a number of years. To counter this effect since the eighteenth century stretchers have been made with wedges enabling them to be regularly enlarged to re-tighten slackened supports. Unfortunately doing this causes the renewed application of very high stresses at the turned over edges of the painting and the corners. Since the linen or cotton will by this time have also declined in strength the frequent result is fracture of the canvas starting usually at the top edge and corners.

On large paintings such problems are further magnified by the weight of canvas involved. This can be so great that it causes the canvas near the top of the painting to gradually extend (creep) under the constant applied load of the canvas lower down. Creep which has been studied by Tassinari in relation to hemp canvas is the other side of the coin of stress relaxation and can lead to bulging along the lower edge of paintings. Again the treatment is often wedging out which brings the eventual failure at the edges one step nearer.

Whilst stress relaxation, creep and Young's Modulus can all be improved upon by the judicious choice of materials the anisotropic nature of canvas stems mostly from its woven character. Woven materials tend to be highly anisotropic. Their two stiffest directions are the weft and warp but it is common for the weft in the initial phases of stretching to be two or three times stiffer than the warp. Appropriate choice of weave can minimise this difference, but the problem will still exist. It is no doubt more serious in cotton and linen which respond to moisture and thus must also transmit anisotropic strains to the paint and ground layers.

This leads us to the fact that canvas paintings are secured on stretchers. The stretcher serves to restrain the painting from contracting back to its unstressed size while it remains elastically deformed. Complex strain patterns are generated throughout the layers of the painting which tend towards maxima at the edges and corners and reduce and become more uniform in the central zone. Further shrinkage of the painting whether caused by desiccation of a size layer or by moisture content in the canvas will superimpose higher stresses onto the pattern imposed by the restraint of the stretcher, cracks and delamination can then result.

Cotton and linen interact with this fundamental problem of restraint on a stretcher in three ways.

First because they are not high Modulus materials in the woven state stretching them to a 'taut' state requires relatively large applied strains. There is thus in the painting composite always a danger that large strains may need to be imposed on the paint and ground layers in order to tighten the whole structure. This will obviously be influenced by factors such as the thickness and degree of cracking of the paint and ground layers.

Second cotton and linen respond to moisture changes, they thus contribute to either very dramatic additional stresses such as when they become extremely moist or else much more gradual but repetitive stress changes as the humidity fluctuates. These cyclical changes may well lead to failure in the paint layer due to fatigue mechanisms, but this requires further investigation.

Thirdly their creep and stress relaxation behaviour outlined above mean that the stretching process is not a once for all procedure, but one which of necessity if the painting is to be kept taut must be repeated frequently in the life of the painting.

These points emphasise that it would be short sighted to consider the fabric support as the only problem. Evidently the whole stretching process must be called into question and the design of stretchers more carefully considered. In recent years for instance there have merged spring tensioned stretchers which rely on mechanical systems to expand and contract the overall dimensions. These do at least allow the possibility of some retraction, i.e. reduction in restraint which may be a definite advantage. On the other hand they tend to maintain high tension states and do not change the nature of the basic imposed stress system. It is perhaps indicative of a growing concern amongst artists for their materials that Richard Hamilton has designed, patented and had manufactured a number of mechanical stretchers for his own use.

Amongst other causes of problems Marion Mecklenberg has pointed out that it would appear that one of the most active layers in the painting composite appears to be the glue size layer. He suggests that desiccation can lead to very large stresses in the size film which can lead to fracture in the paint and ground layers. This would strongly imply that a new artist's canvas should avoid the need for moisture responsive size layers. Cotton and linen are traditionally associated with the use of size. Not only are they frequently sized by the artist, but they are often sized at least on the warp threads during weaving.

Two reasons are commonly cited for the sizing of canvas by artists. One is that it is necessary to prevent cellulosic materials from coming into contact with oil paint. This need is of course specific to cotton and linen fabric although it is worth noting that there is very little

evidence available to quantify the effects of such contact. The other is that the ground layer needs to be prevented from penetrating through to the back of the canvas. This problem would continue to exist with modern alternative fabrics and emphasises that not only do we need to find a material which does not require sizing with animal glue, but that this must be related to suggestions as to the most suitable types of ground. In this area synthetic materials particularly acrylics are already being widely used.

Finally it is worth noting that cotton and linen are both susceptible to mould growth and deteriorate even more rapidly if they have the misfortune to be in very damp conditions. Several artists have already expressed specific concern about this problem particularly with paintings in acrylic media on cotton duck. ...”

“The need exists then for an investigation into fabric supports. It is necessary at the start to list some of the desired parameters of a suitable fabric:-

- 1 excellent durability, resistance to acidic pollutants and light.
- 2 high stiffness (Young’s Modulus), low extensibility.
- 3 good elastic recovery.
- 4 negligible hygroscopicity (moisture pick up).
- 5 resistances to creep and stress relaxation.
- 6 good adhesion to chosen grounds.
- 7 lack of need for sizing.
- 8 acceptability to artists (texture, handling, appearance, etc).
- 9 low cost, ready availability, large sizes. ...”

“Acrylic fibres tend to have lower tenacities than do flax and cotton as well as quite high elongations and this latter is undoubtedly the major drawback. It makes them highly flexible and also pleasant to handle, hence their use in clothing. Their chemical stability is excellent. For instance Orlon acrylic type 42 will withstand 1000 hours in 60% concentrated sulphuric acid; by comparison cotton degrades in less than 10 hours under the same conditions. Light resistance is also extremely good; acrylics tend to have the best resistance to ultraviolet radiation in daylight. These properties of flexibility and stability have resulted in acrylics finding use as media, varnish and adhesives in the painting and conservation field. Certainly their compatibility with an acrylic support would be outstanding. On the other hand the ideal combination in a painting would be a stiff dimensionally stable support with a permanently flexible ground and paint layer and acrylics may well not provide this support stiffness. They do also absorb some moisture having regain values of 1-2.5% but this is fairly small.

Polyester fabrics would appear to be the most satisfactory synthetics which are readily available. The fibres have high tenacity and relatively low elongation at break, they are thus fairly stiff. Elastic recovery though worse than nylon is better than polypropylene. They will also withstand 3% strain without any permanent set occurring. Moisture absorption is extremely low, typically around 0.4% at 65% RH and the fibres will imbibe only 2% moisture when maintained at 100% RH. At low extensions the fibres resist creep and they are characterised by a fairly high initial modulus of 100-130 gm/denier. Polyesters have good abrasion resistance, and are absolutely resistant to mildew and have good resistance to degradation by sunlight though this degradation is very significantly reduced if the ultraviolet component is excluded by glass. Indeed under this type of exposure certain polyesters can be superior to acrylics. The material is available in a wide range of forms, including “spun” forms which have fluffy canvas like appearance, it is also relatively cheap.

In developing new materials for the artist to use it would therefore seem at present best to focus attention primarily upon the polyesters and acrylics.”

(ARTISTS CANVASES: THEIR HISTORY AND FUTURE)

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