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Rya Wall Hangings: Creation and Flame Retardation

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RYA WALL HANGINGS:

Creation and Flame Retardation

Submitted by

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April 1978

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Thesis Proposal for Master of Fine Arts Degree

College of Fine and Applied Arts

Rochester Institute of Technology

Title: "Rya Wall Hangings"

Submitted by: Shelley Matthews Date: December 14, 1977

Thesis Committee

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I propose for my thesis to execute a series of wall hangings. This series will be woven primarily in the rya technique. Possibly other textile procedures such as stitchery, tapestry and wrapping may be used to show the contrast of textures, and highlight the rya. My designs for these will come from nature using various fibers.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	i
INTRODUCTION	1
FLAME RETARDATION	3
CHART OF HOMEMADE FIRE RETARDANTS	17
GLOSSARY	22
MY WORK	23
Piece 1	26
Plate 1	
Piece 2	28
Plate 2	
Piece 3	30
Plate 3	
CONCLUSION	33
FOOTNOTES	34
BIBLIOGRAPHY	35

INTRODUCTION

Although Americans generally equate the word rya with rugs, it is actually a Scandinavian term for a knotting technique. Ghiordes knots found in early Egyptian tombs as fabric decoration are the foundation of rya. Rya traditionally has less than thirty knots per square inch and pile one and a fourth inches or longer. These proportions dictate large scale fabrics. The Scandinavians originally used rya textiles as bed coverings, wall hangings and as door coverings to add warmth to their homes. They were considered too beautiful to be placed on the floor .

The knotted fabrics not only add warmth, depth and texture to the wall, but because the long pile absorbs noise, they are also good acoustically. The lushness of rya, the freedom to mix colors for great richness and depth, the variety of relief effects, the ability to contrast glossy and matted fibers are all advantages of rya wall hangings.

Rya can be and is woven more quickly, cheaper, and perhaps more tightly on power looms. But because of the cost, machine produced wall hangings lack the variety of fibers, reliefs, textures, and colors of handwoven tapestries. Tactile awareness is made more obvious through contrast, which is more easily produced in luxurious, one of a kind wall hangings. The sculptured cut rya and rya loops of various dimensions are emphasized more when surrounded by flat tapestry woven areas.

There is a market for large, one of a kind pieces of art for decoration. Because of the size of these fabrics, the warmth they add to bare walls, their colors and their acoustical qualities, rya wall hangings are hung in public buildings.

However, the fire regulations in most states require that any textile hanging in a public area of more than five hundred square feet be flame resistant. Fiber artists must be aware of the chemicals, processes and effects of flame retardation on their work.

The original purpose of my thesis was to weave rya wall hangings, exploring fibers, materials, size of knots, textures, depth and relief. In discussing the possibilities of hanging my pieces, I learned that the fire regulations of New York State and most other states, require flame retardation for textiles. The process is complicated by the variety of fibers and varying lengths of pile which must be treated differently for fire retardation. As a result, my thesis will explore not only the weaving but also the research, as found in literature, into the flame retardation of rya wall hangings when woven from various fibers.

FLAME RETARDATION

For at least three hundred and forty years man has realized the need to flame retard fibers. The earliest recorded attempt was in 1638 when Gay Lussac used ammonium salts of sulfuric, hydrochloric or phosphoric acid to treat the backdrops and stage curtains in Parisian theatres. The need to discover effective chemicals to flame retard fabrics has continued and is growing as man-made fibers are developed. In the United States where a person dies of textile related burns once in every forty-four minutes,¹ there is a need for research into flame retardation.

Although the need to find economically feasible, effective fire retardants was recognized hundred of years ago, it was not until the disastrous fire at Boston's Cocoanut Grove Night Club in 1942, that the United States invested money in developing fire retardants or passed regulations requiring textiles be flame retarded. The incendiary bombs of World War II intensified that research.

Ignition and combustion of cellulose fibers is a multistage pyrolysis degradation of a substance by a combination of heat and a flaring process. Rapid degeneration begins at 570°F and is accompanied by the formation of combustible gases and vapors which ignite at 660°F. From then on, combustion becomes automatic, producing considerable heat and continuing until only ashes remain. In evaluating flame retardants it is important to evaluate the following: ignition time,

combustion time, flamespread, afterglow, char length, char residue, afterflaming, and the temperatures of ignition, combustion, fusion and calcination. There are two methods of testing these items, in both the ignition source is held under the fabric. In one test the cloth is held vertically above the flame, in the other it is held at a forty-five degree angle. In the vertical testing the acceptable results are: no afterflaming, less than four seconds afterglow, and less than three and a half inches of char length. In the forty-five degree angle test the acceptable results are: no afterflaming, less than four seconds afterglow, and two and a half inches of char length.²

Cellulose fibers such as cotton, linen and jute are combustible and have ignition temperatures between 350°C and 400°C. When they burn they give off heat, smoke, carbon dioxide, carbon monoxide and water. Plant fibers do not melt. The best treatment for cotton is THPC (tetakis hydroxymethyl phosphonium chloride) compounds; for rayon (reconstituted cellulose) it is Diammonium phosphate or Diammonium sulfanate.

Wool, silk, and other animal fibers consist of complex protein molecules containing high percentages of nitrogen as well as carbon, hydrogen, oxygen and small amounts of sulfur. Wool supports combustion with difficulty. Its ignition temperature is 600°C, it burns more slowly and is easier to extinguish than cotton. Hydrocyanide is given off when wool is burned. The most efficient flame retardant chemical for wool is THPC.

Three main classes of economically and physically feasible flame retardant treatments for natural fibers have been discovered. The temporary water soluble types for draperies, mattress stuffing and the like are used where contact with water is deemed unlikely; permanent treatments for garments, mattress ticking and interior fabrics where laundering may be required but severe weathering is unlikely; and treatments which are primarily used by the military for outdoor fabrics. Soluble ammonium phosphates and the borates are used in the first class. The second division is fire retarded with THPC treatments and phosphonoalkanoic amides. Outdoor fabrics are treated with the Sb_4O_6 chloroparaffin technique.

All three treatments have weaknesses. When determining which is most effective for the fabric the following things must be taken into consideration. A successful flame retardation treatment must not injure the fiber in any way: it should not damage the hand, permeability texture, color of the fabric, cause it to absorb too much water, or attract dust. The chemicals should be neutral or alkaline to avoid tendering the fibers and must also be compatible with other finishing techniques such as durable press, water and soil repellents and dyeing processes. No poisonous chemical should be used which could be deleterious to the skin such as arsenic, antimony or lead. Also, the chemicals should not add-on too much weight as this decreases the strength of the fibers. The treatment should be permanent to the life of the fabric and should be able to withstand numerous launderings. In order that it be widely

used, a flame retardation process must be inexpensive. The ease of application and permanence should be considered. A flame retardant should be chosen because it prohibits propagation of any flame and any appreciable afterglow, and results in a charred fabric which still retains considerable strength.

Class I

Although flame retardation treatments have been found that do meet the above standards, a permanent, economically feasible process that does not damage the fibers in some way has not been discovered. The ammonium phosphates and borates, which comprise the first class, cause a loss of strength, are temporary, and their effect is voided by exposure to water.

One such technique is called the Ban-Flame process. It is an urea-phosphate treatment, which because of the large excess of urea, degrades cellulose to such an extent that 35 to 40% of the textile strength is lost.³ The flame retardant ability also decreases with laundering but it is not necessarily voided by the first washing. High humidities also decrease the fire retardant qualities of the urea-phosphate treatment.

Nitrogen bases such as Guanidine, ammonium sulfamate, and dicyandiamide have replaced urea. These chemicals react slower than urea and, therefore, require somewhat higher curing temperatures. This also takes its toll in fabric strength.⁴

Cyanamide is more reactive than urea and has a medium curing temperature of 105°F for four minutes. This gives a better hand to the fabric but is only partially fire resistant when laundered. With this treatment, however, soft water will not decrease the fabric's flame retardant qualities while hard water can totally remove it.

The main advantage of the Borax treatment is that its weight add-on is so small as not to weaken the fibers. It is effective at add-ons of less than 7%. At 6% weight add-on and dried at 100°F or less there is little loss of strength. Even less effect is shown on strength when the borax phosphate treatment is combined with a salt acid. Copper salt is excellent to use and it has an added bonus in that it is a mildewicide. Wetting agents should also be used with the borax phosphate treatment as they help evenly distribute the chemicals.

Borax - H_3BO_3 gives a char length of less than five inches at add-ons of only 5%, but as with most fire retardant treatments, it has a drawback; it does not prevent afterglow, once the igniting agent is removed.

The borax based system is even more sensitive to moisture than the soluble phosphates. The loss of all flame resistant qualities after two weeks, at 49°F and 85% relative humidity has been reported.

Water reduces the flame retardation of all the chemicals in Class I because they are all water soluble. These chemicals were formerly able to withstand dry cleaning but the recently developed

water based soap in dry cleaning chemicals remove fire retardant chemicals which are water soluble, such as those in Class I.

Class II

In the second class, THPC (tetakis hydroxymethyl phosphonium chloride) is primarily used. The fabric used in this class that needs flame retardants is usually cotton, because it can be frequently laundered. The THPC formula typically contains 10% phosphorous and 26% bromide. It apparently does not react with the cotton but provides a polymeric surface coating. The emulsion polymerization is carried out at 80° - 85°F for two hours. The emulsion pH should be slightly basic pH 7.2 - 7.5. It is dried four to ten minutes at 80° - 110°F, and then cured four to six minutes at 140°F. Some allyl alcohol may evaporate during curing; therefore, good ventilation is needed to prevent eye irritation.⁵

This treatment does not affect breaking strength but does reduce tear strength. To offset the latter, a plasticizer may be added. Char length is not outstanding, approximately four and a half inches. Wash resistance is excellent, and most other fabric properties are good.

Another treatment uses APO (the reaction product of ethyleneimine and phosphoryl trichloride). This shows excellent durability even to industrial laundering, and burial for fifteen days underground. This treatment is also an excellent mildew preventative. However, APO has a few serious drawbacks. With time, APO can cause considerable loss

of strength in fibers although the problem can be partially counteracted by using water softeners when the chemicals are first applied to the fabric. APO has recently been taken off the market because its toxicity presented difficulties in fabric finishing plants.

Presently almost all the permanent fire retardant systems for cotton, except those used in military applications, are based on the THPC or phosphonalkanoic amides. But in the last two years two new formulas have been developed.

Recently a combination of THPC and APO has been developed as a fire retardant for cotton. After being applied to the fabric in a bath treatment, squeezed, dried, and cured (by heat), the cloth exhibits good flame resistance which is retained through repeated washings or dry cleanings. Mixtures of two or more chemicals are often more effective than the same weight of either of them alone. Examples are Borax combined with Boric Acid or this new addition of APO and THPC.

Another treatment which has recently been developed for all cellulose fabrics, such as cotton, viscose rayon, linen and jute, is Lynrus FRI, invented by Lynrus Finishing Company, Poughkeepsie, New York. This formula is so new and highly patented that little has been written about it.

Class III

The third class is comprised of Sb_4O_6 chloroparaffin treatments which are used by the military because they have very good fire retardant

qualities even when subjected to severe weathering. However, they have serious drawbacks for use in clothing and home furnishings.

They contribute add-ons of up to 40% of the weight of the fabric. In the application of more permanent types of flame proofing agents, it has been found necessary to employ excessive amounts of the retardant in order to obtain an effective treatment. In doing so, not only is the weight of the fabric increased appreciably but usually the hand and permeability are damaged.

TREATMENT OF VARIOUS FIBERS

Synthetics: Rayon and acetate resemble plant fibers chemically, whereas most other synthetic fibers shrink when exposed to temperatures approaching their melting or decomposition temperatures. The advent and proliferation of synthetic fibers has created new and difficult problems in flame retardant treatments and evaluation of fire hazard properties. At the same time, solutions are being found that offer considerable hope of virtually eliminating all fire problems associated with fabrics.

The flame retardant treatment of fabrics containing synthetic fibers requires special considerations. The problem is greatly aggravated when combinations of fibers are used in creating fabric. Even when the fabric is predominantly natural the presence of certain synthetic fibers even in relatively small amounts can make adequate treatment difficult. Ordinary water soluble chemical salt formulations, such as borax and boric acid, are totally ineffective on fabrics consisting wholly or mainly of synthetic

fibers. The recently developed formulas for flame retardation of synthetics do an adequate job; however, almost all require a high add-on of approximately 40%. In addition to this objectionable weight increase, these treatments sometimes leave an oily feeling on the fabric, cause stiffening, radically change the original color of the fabric and can tarnish metallic fibers. For these reasons it is best to leave the flame retardation of synthetics to the professionals.

Presently new fibers are being developed that have flame retardant qualities or that have flame retardant chemicals mixed into the solution before it becomes a fiber. Development of a general purpose textile fiber with good flame resistant properties is an important task confronting the fiber industry. Such a fiber must not only be resistant to burning and melting in a flame, but must also be available at a reasonable cost, be dyeable to a range of colors and display good comfort and wearing characteristics. A major step was taken with the discovery of kynol fiber in the early 1970's, but this fiber still needs to be improved in dyeability, abrasion resistance and processibility. During the past decade several new organic fibers have been prepared that possess outstanding fire resistant qualities. Widespread use of these fibers has been hindered by the lack of adequate textile properties, poor dyeability and high cost.

Nylon is a unique fiber, it is difficult to burn because it melts easily and the burning area tends to drop off. Almost all flame retardant treatments do more harm than good when applied to nylon since they delay

the melting process to the extent that the fabric continues burning.

Flexible plastic fibers which are flame retardant are from the vinyl class. While vinyl resins are inherently flame retardant, the addition of plasticizers for flexibility can render them flammable to varying degrees. In this case, antimony trioxide is frequently added to help promote flame resistance. Basic fabrics coated, impregnated or laminated with vinyl plastic are flame resistant to varying degrees. Generally the heavier the vinyl coating is, the more fire resistant it is.

Until recently there were only two non-combustible fibers, glass and asbestos. Inorganic materials are the only elements in non-combustible materials. Today, glass, quartz, carbonaceous residue, carbon graphite, stainless steel, super alloy, refractory whiskers, alumina, zirconia and boron are used to produce non-combustible fibers.⁶

Cellulose Fibers: Effective treatment of cellulosic fabrics may be obtained without professional assistance through the use of homemade solutions of flame retardant chemicals mixed with water.

HOW TO APPLY FIRE RETARDANTS

The amount of fire retardant needed varies from one fabric to another. The chemicals, fibers and thickness of the material must all be taken into consideration in determining the amount of chemicals needed. The add-on is the weight of the chemical deposited on the fibers of the fabric. The required weight of the chemicals is a percentage of

the weight of the fabric. The particular method of application and the proportion of water used does not affect the quality of flame retardation as long as the necessary add-on is obtained. Good results may be obtained by any method which allows the fabric to be adequately wetted, as dictated by convenience and by the character of the fabric treated. In the case of commercially prepared flame retardant chemicals, manufacturer's instructions should be followed.

Mixing Chemicals: The chemicals are dissolved in clean water. Warm water and stirring facilitate dissolving. The addition of a small percentage of wetting agent will help to secure prompt penetration of the fabric. It is necessary to wash new fabrics containing sizing prior to treatment so as to obtain proper absorption of chemicals.

Application: Water soluble flame retardants may be applied in three ways, by immersion of the fabric in the solution, by spraying or by brushing.

Immersion: The fabric is immersed at 70 - 90°F. The container must be large enough for the total yardage to be thoroughly immersed. There should be no folds in the fabric. Care must be used in wringing the material. A mechanical wringer is likely to extract too much of the flame retardant. Best results will be obtained if the material is allowed to dry in a horizontal position. Drying in a vertical position allows for drainage of solution depending on the wetness of the fabric. Increase the percentage of add-on if drying in a horizontal position is not feasible.

Also light weight fabrics are more difficult to treat and require a higher percentage of add-on.

Spraying or Brushing: Put mixed chemicals in a spray bottle or use paint brush to totally soak fabric with the chemicals. An even coating is desirable, therefore, three or four light coatings is preferable to one heavy coating.

CONCLUSION OF FLAME RETARDATION

My flame retardation research began at the Metropolitan Museum of Art in New York. They recommended that I contact Mr. Michael Bogle of the Merrimack Valley Textile Museum, Andover, Massachusetts because they felt he was the foremost expert in the United States on flame retardation of tapestries. I not only contacted Mr. Bogle but also contacted two major museums in New York City and two in Washington, D.C. All the museums admitted that they did not use flame retardants on their tapestries and wall hangings. Most of the textile conservationists said that not enough research had been done on flame retardants. They did not want to risk damaging the antique tapestries.

All of the museums that I talked to realized they were in violation of the fire code, but they also felt that if there was a confrontation regarding the lack of flame retardants, that the museums could arouse public opinion against the chemicals and the possibility of damaging irreplaceable tapestries. Also, many of the earlier wall hangings were woven in wool which is naturally flame retardant.

The hand weaver has many alternatives to consider when weaving wall hangings for a public building. Weaving the wall hanging entirely of animal fibers which do not ignite until they reach a temperature of near 600°C is one possibility.

Another alternative is to have professionals flame retard the fabric. This is especially important if synthetics are used. None of the

home methods of flame retardation are safe with synthetics. It is essential that the fiber artist not chemically treat the fabric unless he or she is sure of the fiber composition. As in the case with nylon, the wrong chemicals can increase the ability of the fabric to support fire.

Many synthetics are now flame retarded in the factory where they are created. If they are used in combination with animal fibers or inorganic materials, the finished piece will be flame retarded. It is important that if an artist decides that selecting flame retarded fibers to weave with is the best way to cope with the present laws, that all the components are fire retarded before they are woven. This would require that all cellulosic fibers be treated before they are woven. This has disadvantages in that some fibers will become stiff, making them difficult to weave.

Another option is to not chemically treat the wall hangings. Famous fabric artists may be able to arouse public support for their cause if a confrontation were to occur. It would be risky for any weaver to ignore the law. It is also extremely dangerous to human life not to fire retard wall hangings.

The last option is to temporarily treat the wall hanging in hope that new research will discover new processes. There is so much research regarding flame retardation currently going on that in a few years this paper may be outdated. Both new inherently flame retarded fibers and new treatments are now being invented.

HOMEMADE FIRE RETARDANTS

The following flame retardant formulas from Class I are intended for indoor decorative fabrics and can be made and applied by the hand weaver. Most of the ingredients can be purchased at the pharmacy or grocery store. These treatments provide protection against small sources of ignition such as matches, lighters, sparks, smoldering cigarettes and cigars, and coals. These will not necessarily protect the fabric against flaming combustion under severe fire exposure. Renewal of the treatment is required after every laundering, dry cleaning, or should be reapplied at least once a year.

Formula No. 1:

Borax:	6 pounds
Boric Acid:	5 pounds
Water:	12 gallons

Dissolve boric acid in a small amount of water to form paste. Add borax and remaining water. Stir solution until clear. Soak fabric in cool solution until thoroughly wetted. Hand wringing will leave add-ons of 10-12%. Effective add-on 8-12%.

Advantages: Heavy application by spray or brush are reasonably effective (2 or 3 coats needed). Can be used for theatre scenery. Recommended for rayon.

Limitations: Discoloration by heat.

Formula No. 2:

Borax	7 pounds
Boric Acid:	3 pounds
Water:	12 gallons

Mix the same as you would Formula No. 1. Water should be varied depending on absorbtive capacity of the fabric to be treated. Hand wringing gives add-on of 8-10%. Effective add-on 8-10%.

Advantages: Flexibility and softness retained. Excess moisture and dampness not attracted. No loss of strength under normal conditions. These chemicals are non-poisonous and do not promote the growth of micro-organisms.⁷

Formula No. 3:

Borax:	7 pounds
Boric Acid:	3 pounds
Diammonium Phosphate:	5 pounds
Water:	13 gallons

Make paste with boric acid, add borax, diammonium phosphate and water. Stir until clear. Hand wringing leaves add-ons of 10-12%. Effective add-on 7-15%.

Advantages: Good flame resistance.

Good glow resistance.

Limitations: Slight reduction in strength.⁸

Formula No. 4:

Borax:	6 ounces
Diammonium Phosphate:	6 ounces
Water:	2 quarts

Add chemicals to water. Stir until clear.

Advantages: Satisfactory flame retardation.

Good glow retardation.

Limitations: Reduced strength if not washed out after three or four
9
month period.

Formula No. 5:

Diammonium Phosphate: 100 pounds

Water: 50 gallons

Dissolve chemical in water, stirring until clear.

Effective add-on 10%.

Advantages: Good flame retardation.

Superior glow retardation.

10

Limitations: Weakens treated fabrics during long periods of storage.

Formula No. 6:

Diammonium Phosphate: 75 pounds

Ammonium Chloride: 5 pounds

Ammonium Sulfate: 5 pounds

Water: 12 gallons

Either dissolve chemicals in water or make starch sizing. Hand
wringing leaves add-ons of 16-18%. Effective add-ons 10-18%.

Advantages: Good for curtains.

Good for cotton fabric.

Limitations: Ammonium chloride is hygroscopic, therefore, this
treatment is not recommended for places where exposure
11
to dampness is a possibility or in humid climates.

Formula No. 7:

Ammonium Sulfate: 13 ounces

Water: 2 quarts

Household Ammonia: small amount

Add ammonium sulfate to water: Stir until clear. Add just enough household ammonia to give faint odor. If fertilizer grade ammonium sulfate is used, strain through cloth to make clear.

Advantages: Satisfactory flame retardation.

Good glow retardation.

Limitations: Slightly reduces strength of fibers.¹²

Formula No. 8:

Ammonium Sulfamate: 80 pounds

Diammonium Phosphate: 20 pounds

Water: 50 gallons

Stir chemicals in water until dissolved. Effective add-on 15%.

Advantages: Good flame retardation.

Good glow retardation.

Limitations: Deteriorates when heated.¹³

Formula No. 9:

Ammonium Sulfate: 8 pounds

Ammonium Carbonate: 2.5 pounds

Borax: 8 pounds

Boric Acid: 3 pounds

Starch: 2 pounds

Dextrin: 6.5 pounds

Water: 12 gallons

Dissolve boric acid in small amount of water to make paste. Add other chemicals. Stir until all are dissolved. This mixture should be applied at 86° - 100°F. Hand wringing leaves add-on of 28%.

Effective add-ons: 14-28%.

14

Advantages: Particularly effective on laces and curtains.

GLOSSARY

- Add-on - The added weight of dry flame retardant chemicals as compared to the original weight of the fabric.
- Afterglow - The embers that remain after the flame has disappeared. This phenomenon usually occurs when heavy finishes are used. It can slowly cause combustion without flaring and is often accompanied by the formation of toxic gases and vapors. Secondary fires are easily started by afterglow.
- Afterglow time - The time from when the flame disappears until the embers cool to form char.
- Char - The burnt remains after the afterglow has gone. Usually this area is black.
- Charlength - The length from the source of ignition to the farthest charred area. (Usually measured in inches)
- Combustibility - The ability of a fabric to burn once the source of ignition is removed.
- Combustion time - The time it takes for a fabric to burn once a source of ignition is provided.
- Edge ignition - Refers to the location of the source of ignition during flammability tests. The flame is placed on the edge rather than the surface of the fabric.
- Flame retardant finishes - are those treatments which appreciably slow down combustion compared to the untreated fabric once the source of heat is removed. The best result is immediate disappearance of flame, with no subsequent flaring or afterglow.
- Fusion temperature - The temperature at which fibers melt. (Usually refers to synthetics)
- Ignitability - Refers to degree and amount of heat required to set fire to a fabric of a given fiber composition and construction.
- Surface Ignition - Refers to the position of the flame during flammability tests. The flame is placed on the surface rather than at the edge of the fabric.

MY WORK

Most of my designs are inspired from nature; from walks in the mountains, or on the beach. Walks along the beach give me a peace of mind, rarely found elsewhere. The mountains, gurgling brooks, and streams are the closest approximation to the serenity of the ocean to be found inland. The continuous lapping of the waves, the sense of endless time, the trillions of particles of sand making problems seem trivial in comparison to those of the masses of the universe. The expanse of beach and ocean, its tranquillity, the neutral colors contrasted to the small colorful bits of shells are representative of life.

When walks on the beach or in the mountains are impossible, I enjoy reading and leafing through magazines and books. When I have a few minutes to spare I usually head for the scientific section of the library. Books on shells, butterflies, and rocks as well as scientific journals, especially illustrated articles interest me.

In my compositions, the color, texture and division of space are all inspired from nature. I thrill in discovering nature's division of space; in small details, the matrix of rocks, the inner skeleton of shells, the segments of a butterfly or insect wing. Nature's textures arouse the tactile sense. The fine translucence of an insect's wing dictates smooth, delicate, silk embroidery, while velvety moss indicates neatly trimmed rya. Rough bark and the jagged rocks of the Maine coast can become combinations of looped and cut rya of varying lengths. The patterns found in nature also provide stimulus. The patterns created in

the sand by wind and water, the wormeaten patterns in wood, the patterns created by mold on leaves, the concentric circle patterns on fungi all provide inspiration.

My colors are also chosen from nature. I favor the neutrals and grays of November. They represent a time of rest and peace in nature. The colors are soft, perhaps even bleak, but I find them enjoyable because winter is a time of rest, a time to reflect on the past and to prepare oneself for growth in spring. The bright colors of spring flowers or summer vegetable gardens, and the brilliant color of autumn leaves are also used in many of my compositions.

Fibers are not only chosen by their color but also by their texture. I choose the fibers according to my design, generally preferring natural fibers. Wool is my favorite but cotton, linen and silk I also use. The nubby yarns with their inherent textures enhance the rya knots. I choose strips of fur to be woven into the tapestries. The fur with its natural pile provides for a nice transition between the flat tapestry woven areas and the longer rya sections. Rayon is a fiber I recently discovered and is to my liking. Its shiny surface is a pleasant contrast to the softer wools and fur. Novelty rayon fibers brighten the surface with their many loops and nubs. Fibers of varying colors and textures are important to my designs.

As a fiber artist I can visualize the finished piece, its colors, textures, shapes and size. The images I visualize in my head are not the same as those I create on paper when working with a medium I am less adept at, such as water colors, pencils, pens, ink and charcoal. The raised relief is absent on paper. The image of cut fibers viewed on end,

such as in rya, is difficult to achieve. My visual images are very clear, concise and easy to work from. I fully realize the importance of drawings especially in the apparel and industrial design areas of textiles. Some hand weavers need and enjoy working from drawings. I rarely work from a finished drawing. Once an idea is conceived it is reworked mentally using visual imagery. I work from a rough sketch or cartoon which graphs out portions and shapes. I find this way of working more effective than weaving from drawings. When working from a detailed drawing I feel compelled to adhere to the drawing which results in weaker pieces than when I work from my head with only a rough sketch to assist my visual image.

My thesis research has been very helpful, in that I learned that many other fiber artists work from visual images. Although there are only a few American weavers who work in this way, there are great numbers of Polish weavers who work from visual images.

Piece No. 1: STRENGTH

The first piece of my thesis was conceived after looking at rather gory photographs of a new muscle operation. The strength of these smooth undulating muscles was what I wanted to depict in this work. Rya weave was chosen to add depth to the composition, to make it more dynamic and to give it the strength and mass the muscles conveyed. Although the muscle operation was only a photograph, the impact of the exposed muscles made a considerable impression on me. I felt that the usual, somewhat flat wall hanging would not do justice in depicting my emotions when viewing the photograph of the muscle. I wrestled with the problem and felt that substantial variation in depth of the piece could best illustrate the strength of the muscles.

Red is an extremely strong color for me, and for that reason I chose it to dominate this piece. Oranges, cranberries, and maroons were added to highlight the red and to add to the undulating effect.

The depth of the piece and the undulating were further accented by stretching the tapestry over a carved base. This added to the sculptural effect of the wall hanging. The shaped base not only enhanced this piece as a wall hanging but also took it out of the realm of being considered a rug.

While I was working on this piece, my research had not progressed to a level where flame retardation was considered. Although the wall hanging is primarily wool and naturally fire retardant, it does contain some

nylon which makes the piece much more flammable. If I were to weave this piece again and fire retardation was a major concern, the nylon would be omitted and the rayon would have been treated before weaving.



Piece No. 2: THE DUNES BENEATH CASTLE HILL

My design for this piece originated on Crane's Beach in Ipswich, Massachusetts. The miles of sand, the rolling dunes, the broken bits of shells, the driftwood all in harmony with the lush nature preserve of bayberry, wind tortured pines and deer is in sharp contrast to the Crane Castle and formal Italian gardens raising on cliffs above the shore.

The flat tapestry area represents the hard, wet sand near the ocean's edge, while many of the pile areas symbolize the dunes. The bark of the pines was depicted in the short looped dark brown pile. The abundance of wild life is represented by the rabbit fur.

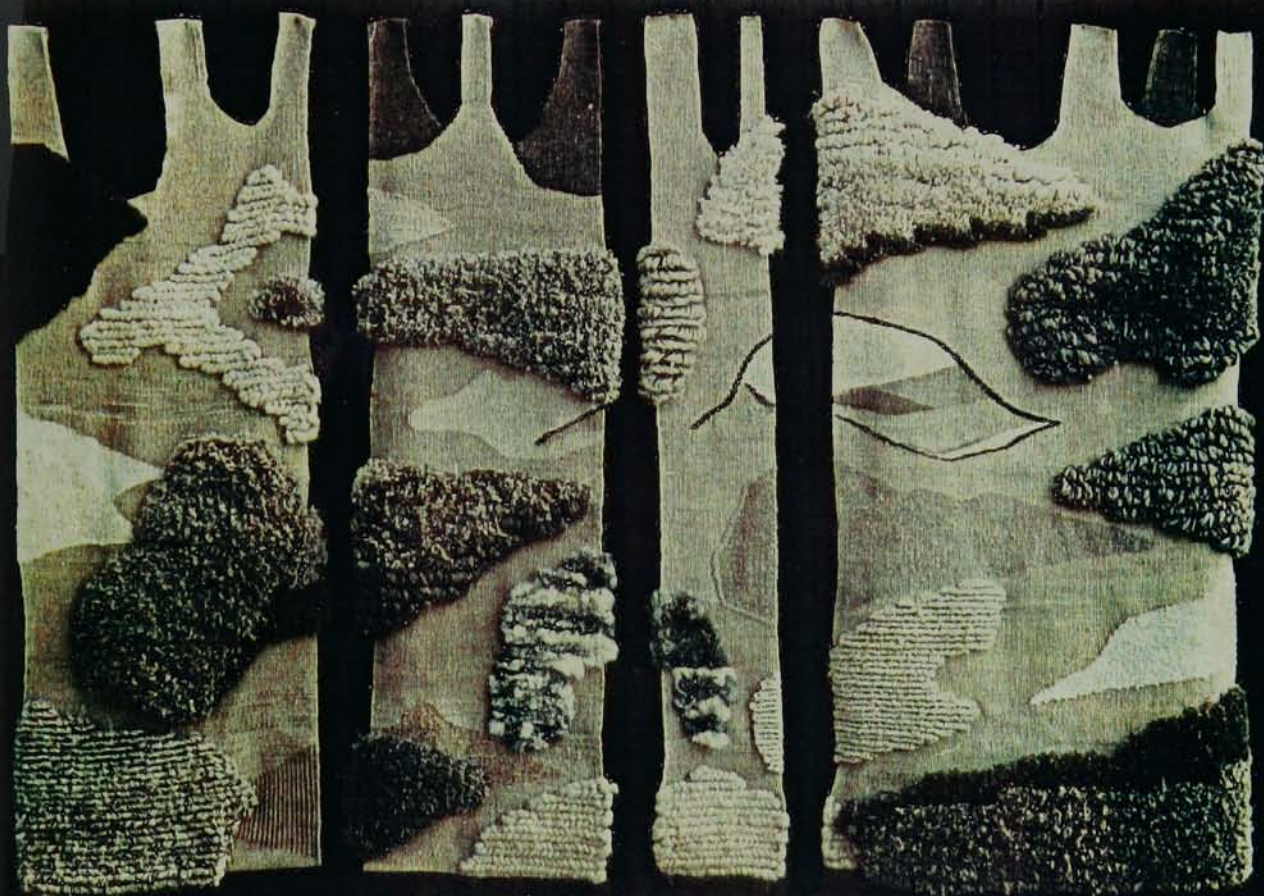
Wildlife is an integral part of the eco-system of the beach. Therefore, it was important that the fur be woven in and not have the appearance of being appliqued. This was accomplished by alternating the direction of the pile so that it did not lie in the same direction as it would normally. It was important for the color to appear natural, undyed, and to blend with its environment. The white-grey surrounding colors acted as camouflage and helped the fur become an integral part of the wall hanging.

This piece was woven mostly of wool, but rayon was added to depict the sun shining on the mother of pearl and mollusks that the waves washed ashore.

Although this piece is primarily wool, it is not fire retardant. There is rayon, cotton, silk, and linen included, which increases the flammability. If my flame retardation research had been completed prior to my weaving, all the cellulose fibers could have been treated before they were woven.

I am happier at Crane's Beach than anywhere else I have been in the world. The ability to get lost amidst miles of dunes and yet discover small treasures, shells, beach glass, old lobster pots washed up in a storm of some forgotten day is what attracts me to this beach. This piece of my art work is derived from feelings, impressions and experiences.

There are many subtle treasures woven into this piece that the casual observer will not find. But like those who walk the beach searching for unbroken shells, and rare red beach glass, the astute viewer will find secrets tucked away amidst the dunes.



Piece No. 3: OCTOBER IN ASHOKAN

The design for my final thesis piece comes from my most vivid childhood memories of a piece of property in the mountains that has been in my father's family for seven generations. It is on this mountain in the Catskills that my appreciation of nature began. We took Saturday afternoon hikes down through the white birch, magnificently tall, and straight, to the stream where it was necessary to teeter, step by step across a log. I must have been fifteen before I made it over without a splash. Just on the other side of the stream, a path began. An old gnarled tree surrounded by an eight foot pile of well worn rocks served as a picnic place. We had made a fireplace out of a few rocks, and after lunch we would walk along a velvety knoll and roll in the moss.

The hikers had to cross a marsh before we would get to the mountain. We tramped up the old road, scuffing through leaves eighteen inches deep, thrilling in the noise they made. Then at the first level we would find the old stone foundations laid by our forefathers. The barn with its large round stone feeding area came first, next was the house, and finally we would come upon the well where we would drop pebbles, and my father would inevitably look down to see if there was water, and in so doing, lose his sunglasses.

My sister and I would scurry around looking for "treasurers", old bottles, horse bits, parts from two antique Fords, pine cones, and winter-green berries. There was one last knoll to climb, up to where my grandparents had a summer camp.

It was always a long hike, but we thrilled in seeing the beavers build their dam. The frogs, snakes, rocks, and wintergreen berries all have special memories. Feelings are also tied up in the fact that my forefathers cleared and farmed the land. All the stone walls, miles of them, were built by them. My relatives had left the mountain and moved into town long before my grandfather was born. My grandfather's mother was up on the mountain picking blueberries when my grandfather was born prematurely. He was kept alive in the wood stove.

The first recognition I received as a student came from science projects done on this mountain. I took first place in both fourth and sixth grades, in the first project for preservation of small animals and bugs in formaldehyde, and two years later for encasing them in plastic.

Christmas was a favorite time to visit the mountain. We would collect American holly, evergreens, pine cones and other decorations for our home. During recent years we have dug up our Christmas tree from those planted when I was four. My favorite time to visit the mountain was in the fall when the trees were alive with color. The October colors and my emotional ties to the homestead of my forefathers inspired the third piece of my thesis. The gold, reds, rusts of autumn dominate the piece but the dark rich browns of the woods and the color of the evergreens is also there.

The pile has the richness and smoothness of that velvety knoll. The brown paths, well worn by generations of men and wildlife that have inhabited the mountains, are also represented. The colorful view of other mountains through the trees is expressed by the intense color. There is a vibrance in

color and yet because the piece is woven entirely out of wool, the softness and quietness of the nature on this mountain is preserved. The stability of seven generations and the inevitability of the seasons is expressed by the fact that the piece is contained in a square. The regularity in length of the pile is also in accordance with the predictable recurrence of the seasons. This piece is woven entirely out of natural fibers, which is in keeping with the fact that the mountain has been left to return to its natural state. Because the weft and pile are totally wool, this piece is inherently flame retardant.



CONCLUSION

My thesis research into flame retardation has brought to my attention different technical and legal problems in weaving wall hangings. Studies in this area will continue to be of interest to me until a flame retardant is found that can be used on many fibers and that does not damage the fabric in any way.

While I have become more acutely aware of the flame retardant problems the technical problems of weaving have diminished thereby freeing me to express my emotion rather than dealing with the technical aspects of weaving. This has been most gratifying.

I will continue to explore rya with its vitality and richness that is created by the blending of fibers of different colors, textures or sheens. This artistically rewarding technique has depth and warmth that I will continue to use as expression of my emotions.

FOOTNOTES

- 1 "Flammability of Textiles", Ciba Review, 1969, p. 49
- 2 R. W. Little, Flameproofing Textile Fabrics, p. 6
- 3 J. W. Lyons, The Chemistry and Uses of Fire Retardants, p. 170
- 4 Ibid., p. 171
- 5 Ibid., p. 229
- 6 Gordon P. McKinnon, Keith Tower, (ed.) Fire Protection Handbook, p. 58
- 7 Ibid., pp. 60 - 61
- 8 Ibid.,
- 9 Ibid.
- 10 U. S. Department of Agriculture, Making Household Fabrics Flame Resistant
- 11 Ibid.
- 12 McKinnon, et al, op. cit. p. 61
- 13 U. S. Department of Agriculture, op. cit.
- 14 Ibid.
- 15 Smithsonian Institution Traveling Exhibition Service, Twenty-Two Polish Textile Artists, pp. 14, 16, 30, 50

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