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APPLYING SYMMETRY IN FIGURED VELVET DESIGN

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Pickett, B. S. (2012) Velvetweaving Today: A Worldwide Overview. International Textiles and Costume Culture Congress Proceedings.
Pickett, B. S. (2005) Symmetry Proportion and Scale: Tools for the Jacquard Designer and Weaver of Silk Velvet. Bridges: Mathematical Connections in Art, Music and Science Conference Proceeding.
Pickett, B. S. (2003) Deep in Velvet one-person exhibition AVA Gallery Astoria, Oregon.

Abstract: *As an artist I design figured velvets and weave them on multi-shaft dobby and Jacquard looms. I collect design ideas by studying textiles, tileworks and pavement patterns. Symmetry helps me see through the bewildering detail and complexity to discern the underlying organization. This paper describes the role symmetry plays in my design process from initial design sketch through the point paper translation onto the mechanics of weaving geometric patterns in my figured velvets.*

Keywords: Velvet; Jacquard; Weaving; Looms; Geometric Patterns.

INTRODUCTION

My art and research centres on velvet handweaving techniques learned from the remaining masters at their ateliers in Italy, France, England, Japan, China, Turkey, India, and Uzbekistan. Velvet is a pile weave where the cloth's surface is fully or partially covered in tiny tufts that can be cut or left as uncut loops. In figured velvet, areas with cut and uncut pile contrast with pileless areas, voids, creating designs in textures. In my velvets geometric pattern evokes feelings of order, beauty, solace, and joy. Shapes like stripes, squares, diamonds, right and isosceles triangles, weave easily, and operations of translation and reflection are frequent. But when pattern veers off the grid and careens down 60-degree slopes or attempts circles, then I turn to eye-fooling tricks. Operations of rotation and glide reflection are challenging. Although I apply only the rudiments of symmetry, I am deeply indebted to those who made me aware of these powerful analytical tools. Two books have become indispensable resources: Stevens' *Handbook of Regular Patterns* and Washburn and Crowe's *Symmetries of Culture*. They enable me to get beyond stupefying detail and see the underpinnings of regular pattern. My journals are full of drawings of textiles, pavements and tiling patterns. Discovering that all band patterns fit in one of only seven groups and that all field patterns, in one of only 17 planar groups helps me see the framework. Flow charts tracking color symmetries are now part

of my tool kit with color pencils and graph paper. Symmetry aids working within a loom's constraints and maximizing design motif potentials to get more bang for my buck.

WEAVING BASICS

Weaving is the interlacing of warp, threads tensioned on a loom, with weft, a sequence of crossing threads. Plain weave, the most basic structure, is one-thread-over, one-thread-under of burlap. It is the strongest weave with the most interlacements. It can be done picking up every odd warp passing a weft, then every even warp and passing the next weft. For speed and sanity, weavers invent labor-saving devices. The evolution of the loom traces this history. The heddle was revolutionary. It is a loop of string held on a shaft through which a warp passes. When a shaft moves, all its threaded heddles act as one. The weft passes through a shed, the space between the over and under planes of warp. Plain weave alternates shaft 1, the odd warps, with shaft 2, the even warps. Its two shafts make two sheds. But for more visual and tactile excitement, texture and complexity new weaves arose. All these new weave structures derive from floats, when a warp or weft skips systematically over or under more than one. Four shafts increase design options dramatically. A warp, threaded in straight draw, like in a musical scale, goes warp 1 on shaft 1, warp 2 on shaft 2, warp 3 on shaft 3, warp 4 on shaft 4, warp 5 back on shaft 1, and so forth. The shafts can lift singly or combine in pairs or three against one for 14 different sheds. Threadings and shed sequences can vary like melodies. Twill, basket, herringbone, waffle, use four shafts with one set of warps and one set of wefts. More complex patterns use multiple sets of warps and wefts. Satin weave takes at least five shafts. I weave on 16 and 24-shaft dobby loom, but more shafts can soon become unwieldly.

DRAWLOOM AND JACQUARD LOOM BASICS

The drawloom, then later the Jacquard, empowered weavers to design large patterns with repeating design motifs. Here symmetry flourishes. These looms coupled the bank of shafts that ensures a firm ground weave with a figure harness that nimbly selects individual warps, one pattern weft row at a time, to build large design motifs. To me the shafts act like a hardworking corps de ballet while the figure harness is the agile prima ballerina dazzling us in the spotlight. This harness controls special suspended heddles or leases, not anchored to shafts but individually weighted or contrived able to freely engage whenever the design dictates. They get instructions from cords on a drawloom or hooks on a Jacquard whose number determines its design capacity. Often Jacquards come with 100, 200 or 400 hooks. Larger machines like the *Verdol* have more than a thousand. Each hook can control a number of pattern heddles. For example, when a Jacquard loom is mounted with four repeats in translation, then four heddles obey the commands of one hook for that exact spot in the design

repeat. When a Jacquard is mounted on point, the design on the left of centre is reflected on the right. Here a hook governs two pattern heddles for the same spots in the repeats. Looms can have more than one Jacquard. For example, one Jacquard could control the border while a second does the centre. I have been told it is far easier to build a new Jacquard than change the existing mounting.

VELVETWEAVE STRUCTURE, DESIGN AND MECHANICS

Velvet has two sets of warps, the ground and the pile. The ground weave provides the firm foundation on which the pile can display. The pile is made by jumping piles over a velvet wire, like a hurdle, then securing it with several wefts. Often three wefts hold the wire with the second interlacing in the pile. After several wires, the first can be cut free by inserting a slim blade into the miniscule channel in the wire and drawing it down its length cutting the tops of the loops. Or the wire can be withdrawn leaving uncut loops. Ciselé figured velvet, composed of cut and uncut pile areas and voids, uses pairs of wires. The first wire, round in profile, goes under all the piles needed in that design row. The second, the grooved wire, selects only the piles to be cut. It enters, rides up and sits on top of the round wire. Both are secured. The top wire is cut free then the lower is withdrawn. The pile has two heights, the cut high and the looped low (Figure 1).

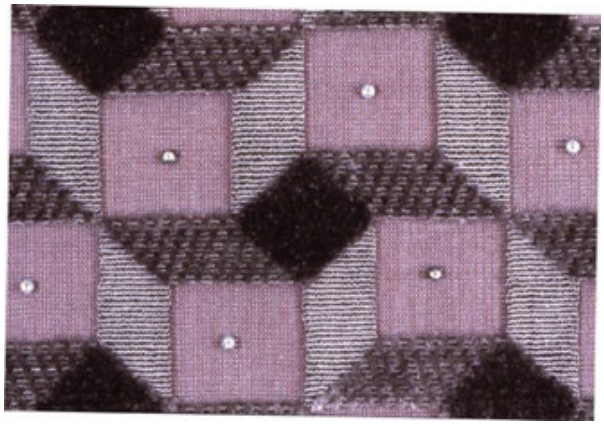

Figure 1 Ciselé figured velvet detail,
Sempre Diritto by author

I weave figured velvet at the Foundation Lisio in Florence, Italy, where I did my Fulbright fellowship on velvetweaving in 1986/87. Lisio uses manual Jacquard velvetlooms for major commissions from haute couture, museums, and restoration projects. During my residency, Vittorio Rettori was my maestro. We first assembled a production velvetloom with two Jacquard heads, a 100-hook Jacquard worked like a dobby to control the 8-shafts ground weaves. and a 400-hook Jacquard, the pile. The pile design was 400 piles wide. The loom was mounted two pattern repeats in translation. Each hook lifted two piles at corresponding points in the repeat. The 800-pile warp was held in a creel positioned below the horizontally stretched ground warp. Each pile, wound separately on a

bobbin, unwinds when the design calls. Each pile has four ground warps, two on either side. Perforations in a pattern card selects hooks for the next pile lift. Each card has 400 points, 50 by 8. When a point is punched, a needle, connected to its hook, enters the hole triggering the pile rise. One by one, the cards are presented on the wooden cylinder for the needles to read. The number of cards equals the velvet wires needed in one repeat. The last card laced to the first forms a loop so the pattern repeats. I transpose my design sketches to point paper, a technical graph paper 400 cells wide in 50 columns of 8 cells. My velvet has 14 piles per centimetre to 11 velvet wires. 11 divided by 14 equals .7857, so 8/10-point paper most closely matches these proportions. The cells are slightly tall rectangles. Proportions are crucial in designing geometric patterns. Ground weaves that compact more need another point paper. For ciselé velvets, I punch two sets of cards. The first set reads the point paper, row by row, punching all points with pile. The second set rereads the row, punching only the points for cut pile. The sets are combined to make one chain. In 1994 I returned to Lisio to study polychrome velvet with Eva Basile, the head of education.

I have continued to benefit from her expertise and insight. Her classroom has a Jacquard velvetloom and six or seven other Jacquards dedicated to teaching complex silk weaves. The velvetloom is mounted two repeats in translation, but instead of a single pile color, there is a choice of pile colour. The creel is also divided into two sections, one for the first color pile and the second, alternates two more colours. Between the four ground warps are two piles, one of each color. The pattern card is also divided in half with 200 points for the first color and 200, for the second mix (Figure 2). My first design used only one pile color. My sketch was a field of blocks over a chasm (Figure 3).

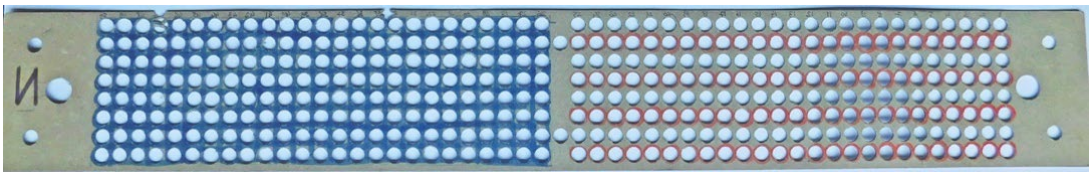

Figure 2 Control card for polychrome velvet for blue pile on left and rose/gold on right side

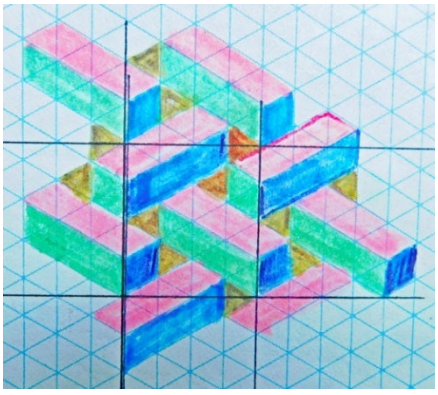

Figure 3 One Step identifying the fundamental region

The fundamental region repeated twice filled the point paper's 200 cells. For the 3-D illusion the top of the block is uncut pile, the highest value; the left side is cut pile, the lowest value; the right side, alternating cut-and-uncut pile, a midtone. The full repeat takes 72 pairs of velvet wires. Finding the correct slopes was difficult. The angle stepping over one cell, up one was much too steep. Two cells over, one up, still too steep. Eventually a combination of two or three steps over, one up made the desired slope. Repeating that combination drew parallel lines. Reversing the directions yielded the opposing slopes. The voids made equilateral triangles (Figure 4). The title *One Step* comes from a Broadway lyric, 'I'll build a stairway to Paradise, with a new step every day' (Figure 5).

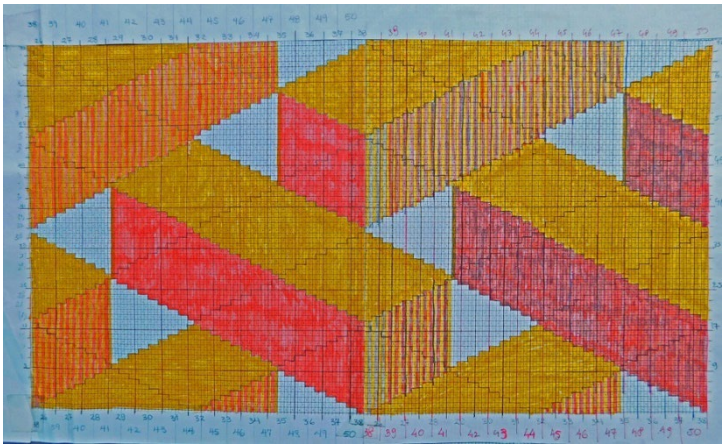

Figure 4 Point paper for One Step, two repeats, 200 cells

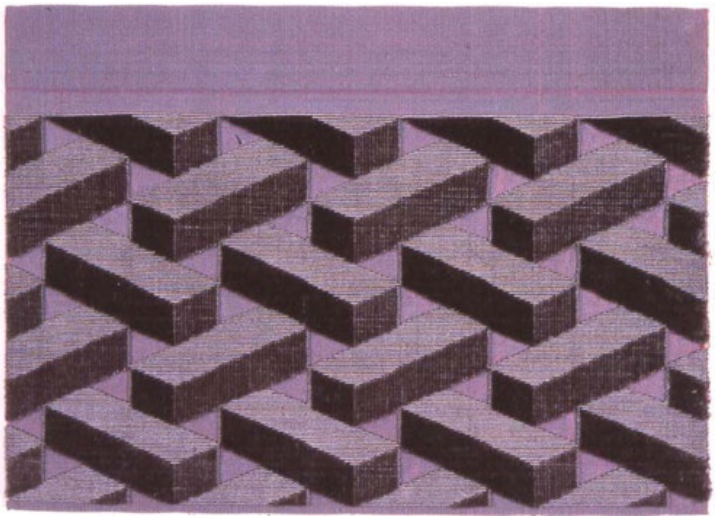

Figure 5 Figured ciselé velvet One Step by author

My polychrome velvet started with a 6-point star like the Japanese hemp leaf motif. I drew the wireframe, printed copies and made a colouring book. I could dramatically alter the image by emphasizing different shapes and color symmetries (Figure 6). Next came the transfer to point paper. The two repeats had to be 200 cells wide. Drawing parallel lines through the centres of stars gave me guidelines to speed up drawing. From this I discovered a net four diamonds wide. Bisecting these lines made lattice that could handle all the shapes in the sketches (Figure 7 and 8). With these nets, work became play, just filling in shapes. I chose one with stars, hexagons, and triangles. The

blue stars and rose/gold triangles are cut-and-uncut pile. I wanted the rose/gold pile to look like three-sided pyramids, but the values are off. The lighter and darker blue stars alternate all-cut with half-cut. The star reverses direction in the next row up (Figures 9 and 10).

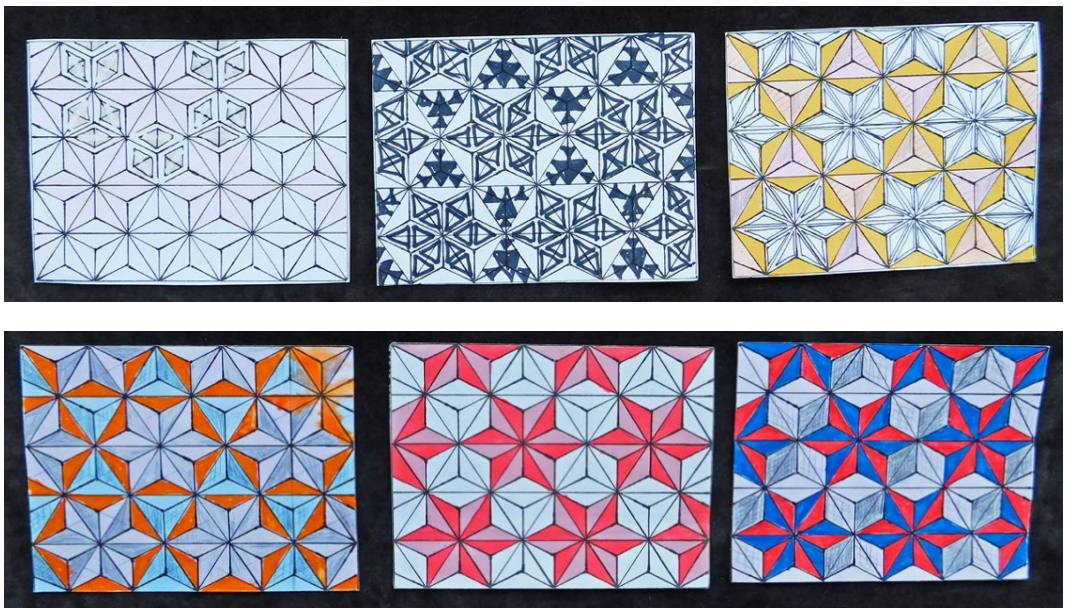

Figure 6 Colour symmetry variations for the 6-pointed star design

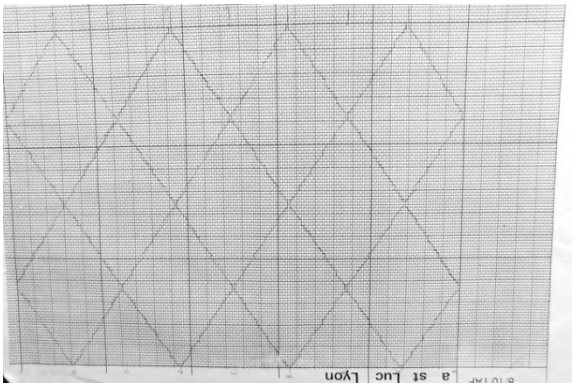

Figure 7 Underlying diamond network on point paper

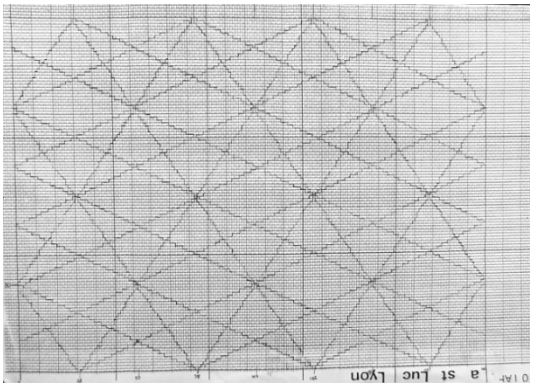

Figure 8 Bisecting the lines of the diamond network

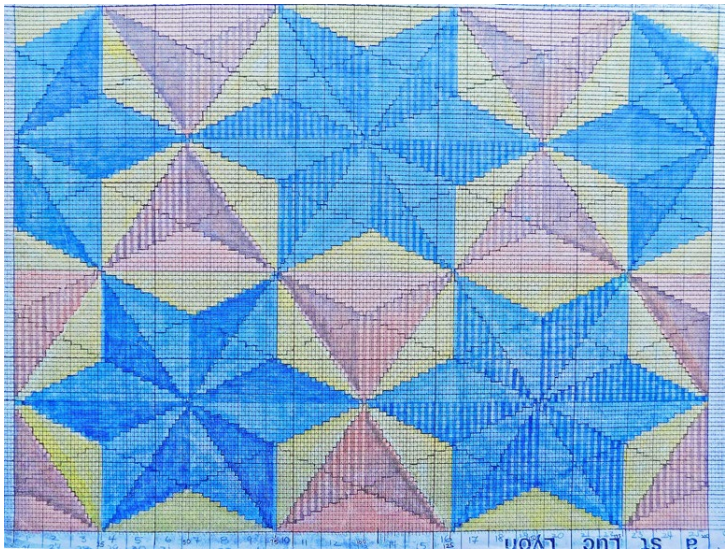

Figure 9 Stars and Pyramids point paper

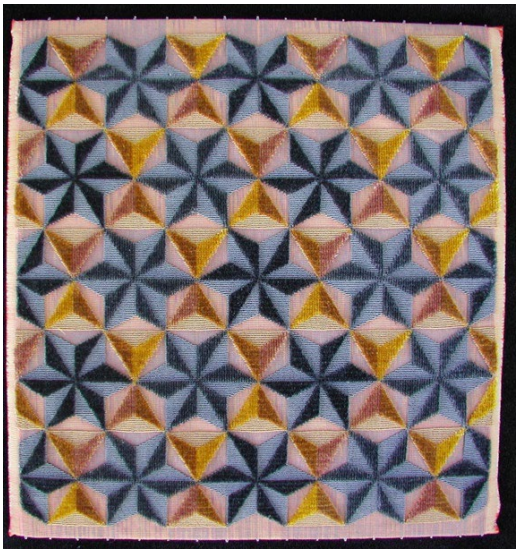

Figure 10 Stars and Pyramids ciselé velvet

My velvet *Girandola*, Italian for pinwheel, began as a right triangle with an inverted 'Y' making two trapezoids and an isosceles triangle. Rotating this motif two quarter-turns makes a square. Rotating this square, a quarter-turn gets a second square. In the next row of up, the squares switch (Figure 11). Four squares wide fit the loom. Out of this wireframe with 32 trapezoids, a pinwheel motif popped. Next came pile color. I struck a balance, 16 red and 16 blue trapezoids. Then I assigned values: 9 are cut; 11, uncut; 12 mixed. The mid value alternates rows of uncut with rows of pairs cut and uncut. The small triangles are voids (Figure 12). I played with color symmetry and finally chose to weave the version where the pinwheels appear to recombine and turn in opposite directions (Figure 13).

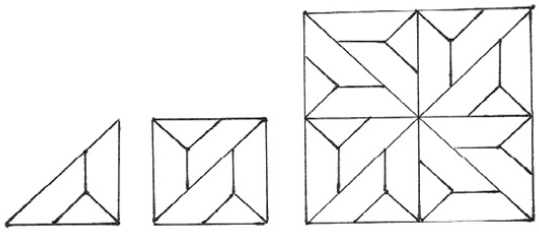

Figure 11 Building the design motif with rotation

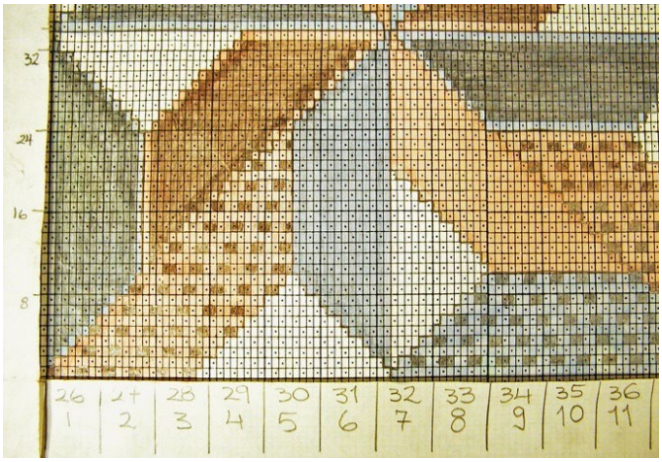

Figure 12 Girandola point paper detail

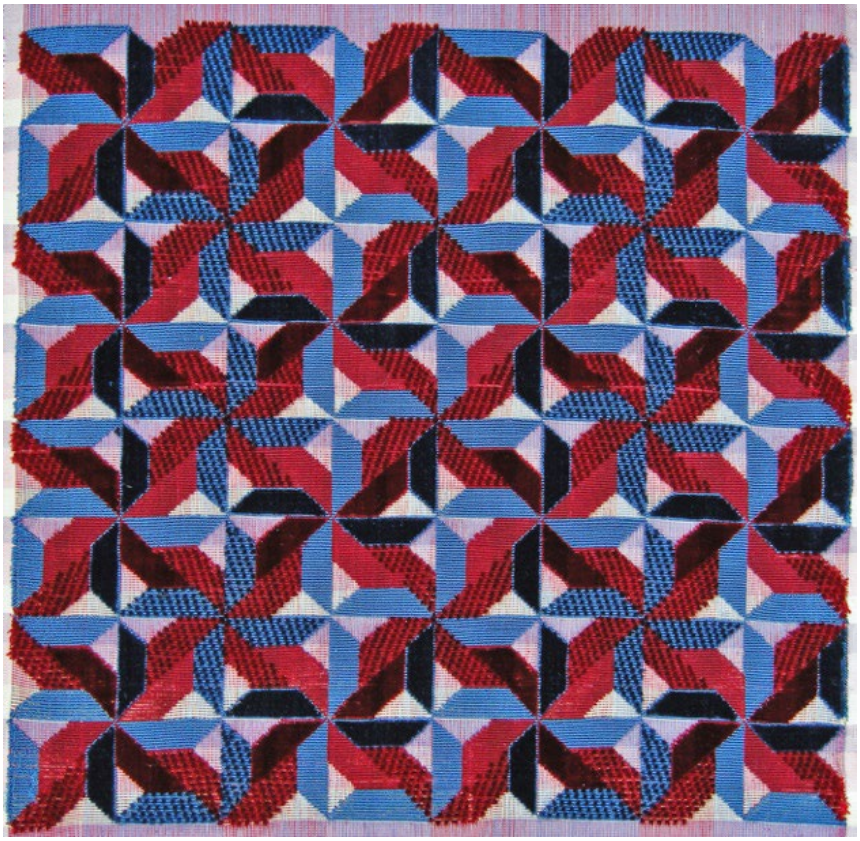

Figure 13 Girandola polychrome ciselé velvet by the author

CONCLUSION

My figured velvets woven on Jacquards are tributes to symmetry. What's next? Like a meandering stream, I seek the ocean following the inclination of my curiosity. Currently I play with fractals, equilateral triangles within equilateral triangles and am awed by the spatial tessellations of quasi-crystals. Musing about the source of flow, I recall a silk painted banner in the Central Asian Antiquities Hall at the National Museum, New Delhi. Fuxi and Nüwa, conjoined brother-sister, emerge from plied snakes. He holds a square with plumb bob and she, a compass. According to Chinese mythology with these tools they made humanity and kick-started invention.

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Barbara Setsu Pickett, an Associate Professor Emerita, Department of Art, University of Oregon, USA, focuses her art and research on handweaving velvet techniques, design for the Jacquard loom, shibori, book arts, and natural dyeing. She studied velvet at ateliers in Italy, France, Britain, Japan, China, Turkey, Uzbekistan, and India, and has received support from the National Endowment for the Arts, Fulbright Commission, Institute of Turkish Studies, Gladys Krieble Delmas Foundation, Rockefeller Foundation Bellagio residency, and Asian Art Museum in San Francisco. She has presented at Handweavers' Guild of America Convergence conferences, the Textile Society of America symposia, and Bridges conferences, and keynoted for Ars Textrina and the International Textiles and Costume Congresses. In 2013 she organized and led a Textile Society of America Velvet in Italy tour. She and her son Michael create highly textured silk scarves in their Mihara Shibori Studio and have taught workshops in Istanbul and Seoul.