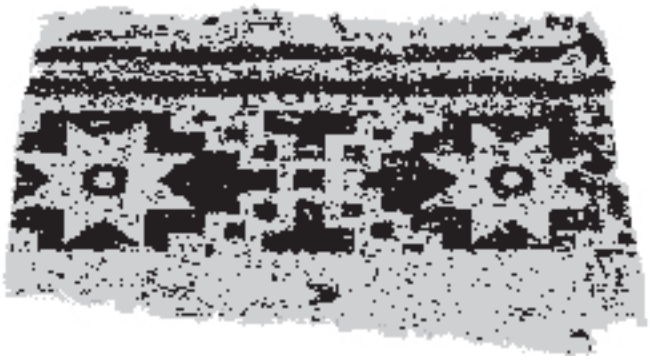
Chapter 1

A Brief History of Figured Textile Production

It is a wonder that any textile has survived the influences of time, to reveal its beauty to the present, proof of the long history of human ingenuity. Cloth is vulnerable to the effects of time, stained and thinned by use, eaten by insects, rotted and ravaged by wind, rain and other natural elements. Fortunately some textiles have survived. There are reams of plain linen shrouds lining the shelves of museums around the world that testify to the productivity of weavers in the Middle East. There are also fragments of figured textiles dating back to the 6th or 7th centuries B.C.E. (see E.J.W. Barber, *Prehistoric Textiles*, page 3 listed in the Bibliography). This mended cloth is evidence that patterned weaving was already a known commodity to those people. Though we probably will never know exactly when weaving began (Barber dates spinning technology to before 20,000 B.C.E.), we know it is an early technology that was practiced in many disparate cultures.



1-1 Fragment of Byzantine Samitum Cloth

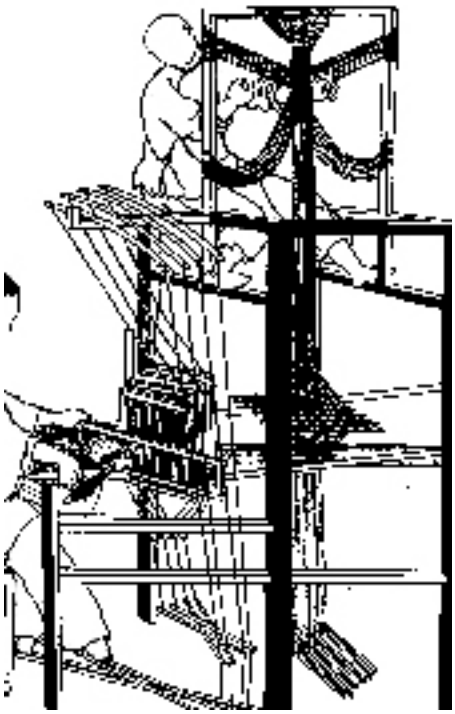
It is also interesting to note that the history of textiles is the history of world trade and influence; as long as man has traveled there has been trade, theft, and adaptation. The fabled Silk Road, from Xi'an in Western China to Constantinople (modern Istanbul, Turkey), carved a path for exchange that began around 200 B.C.E. and continues to this day. It brought silk and spices and religion as far west as Rome. Like an extended game of "telephone," reality was morphed into fiction over the miles. Clouded in mystery (silk is a fruit that grows on trees, right?), the physical beauty of silk incited the desires of the West. In the 13th century C.E., Marco Polo was one of the first people to travel the full length of the Silk Road. His writing created a new craze for all things Asian, including damask fabric. To this day, waves of desire continue to travel around the world. While wealthy professionals in Beijing

wear Prado, indigo-dyed lacquered cloth, aged in the night air of the Chinese village of Lunjiao, is seen on wealthy women in Santa Fe.

The technology of the loom plays a key role in determining the type of cloth woven and used throughout history. The backstrap loom, attached to the weaver at one end, allowed for patterning through brocading or the use of pattern rods, but limited the width of the cloth. The shaft loom removed this restriction, but still has limited figuring capacity. A weaver willing to manipulate threads through hand-picking of different structures, brocading, or weft tapestry processes, can create intricate figured cloth, but these processes are slow and exacting, certainly not the stereotype of a weaver rapidly throwing the shuttle back and forth. The love of pattern and the penchant to find more efficient methods of production probably contributed to changes in technology that led to the drawloom.

The Drawloom

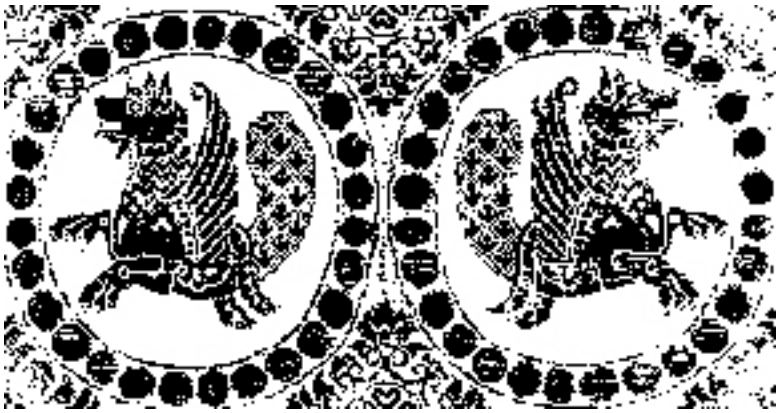
Nobody knows exactly where or when the drawloom (sometimes called a pattern loom) was first used. Scholars used to place 7th century C.E. Syria or China as the likely birthplace. However, recent research (see Kuhn, *Silk Weaving in Ancient China: From Geometric Figures to Patterns of Pictorial Likeness*) indicates that a type of drawloom was already in use in the state of Chu (China) prior to the pre-Han period, and that the use of the loom was established by the early 2nd century C.E. There are variations in the set-up of a drawloom, and with time more changes evolved. Usually a master weaver would handpick the original pattern, row-by-row, tying-off the group of warp threads which would rise for each pick of the cloth. This series of "lashes" could then be lifted in sequence to make the sheds for the weft. Once a pattern was created it could be repeated. The actual weaving needed a person to sit at the loom and throw the shuttles (the weaver) and a person to sit on top of the loom (later at the side of the loom) and pick the lashes in the correct sequence (the drawboy–who could be a man, a woman, or a child). Some illustrations show two drawpersons sitting on top of the loom, emphasizing the fact that this was hard work and probably the labor of adults more often than of children.



1-2 A Chinese Drawloom

The type of imagery produced on a drawloom reflected both the fashion of the times, as well as the restrictions of the loom. Symmetrical images were created when the warp was threaded in a point draw, which also increased the width of a pattern. Depending on how the loom was configured, designs could be full width with no repeat, or smaller units duplicated across the web of the cloth. Bands of designs in Sassanian fabrics (Iran, 224-651 C.E.) often had confronting motifs that are mirror images of each other, woven in polychrome compound weft-faced twill (samitum). With time, the motifs became framed by a circular band with interior pearls, called roundels. These textiles

with fantastic hybrid animal images were popular and imitated by other cultures. Byzantine fabrics often had motifs similar to those in earlier Sassanian fabrics, but their roundels were larger and sometimes incorporated inscriptions and monograms.



1-3 Motif from Byzantine Samitum

Using fine silks and other costly yarns, production of these figured textiles was always laborious and expensive. The weavers themselves could not afford their own products, but worked to satisfy the desires of their wealthy clientele. Beautiful lampas textiles from the Safavid era (Iran, 1501-1722 C.E.) depict the lives of the nobility—hunting with falcons, drinking wine, reciting poetry in flowering gardens. By changing the weft color used in portions of a repeated design (a coat will be red, then yellow), the weaver relieved the design of monotonous repetition. Numerous pattern wefts, sometimes more than 7, were used both as continuous selvedge-to-selvedge wefts and discontinuous brocaded wefts.

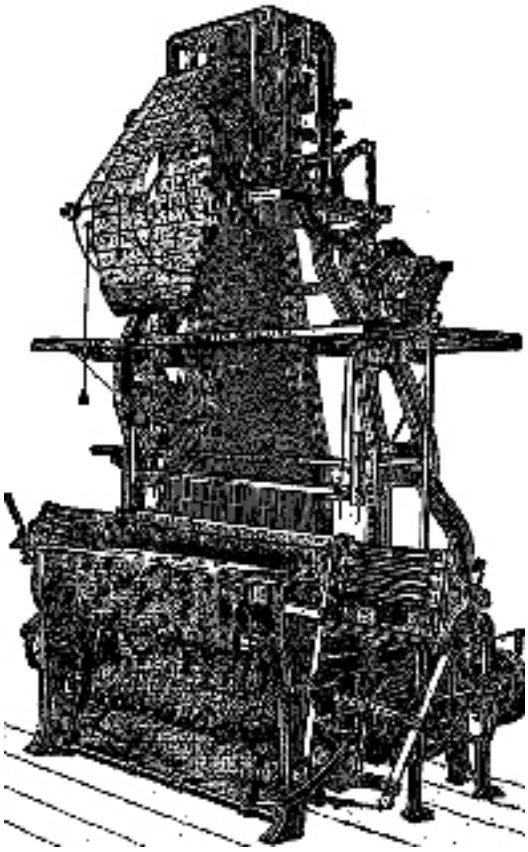
1-4 Motif from Safavid Lampas

In the Netherlands, in the 16th and 17th centuries, damask fabrics made with linen had repeats of enormous heights, often filling a large tablecloth with an image that constantly changed from one edge to the other. Biblical scenes were popular, but also scenes of banquets and the pleasures of daily life such as ice skating.

Development of the Jacquard Loom

Lyon, France has been an important textile city for centuries, both for manufacturing and for trade. Drawloom technology was first brought to France in the 15th century under the supervision of Jean le Calabrais. Over the years, improvements to the loom were ongoing; Jean-Claude Charlin has recently written a fascinating book detailing the developments that became the jacquard loom (see Charlin, *The Story of the Jacquard Machine*). Although most histories credit Joseph-Marie Charles, known as Jacquard, as inventing the jacquard loom in 1804, as early as 1725 Basile Bouchon had a loom with a system of perforated paper and needles for selecting the cords which raised the warps. Jean-Philippe Falcon began to use rectangular punch cards on his loom in 1728, and "opened the way to the future machine known as the 'Jacquard'" (Charlin, page 45). Jacques de Vaucanson (1709-1782) used the knowledge of these other inventors, and in 1745 created the first automated loom for figured weaving. His loom used a perforated cylinder on top of the loom, along with hooks and needles.

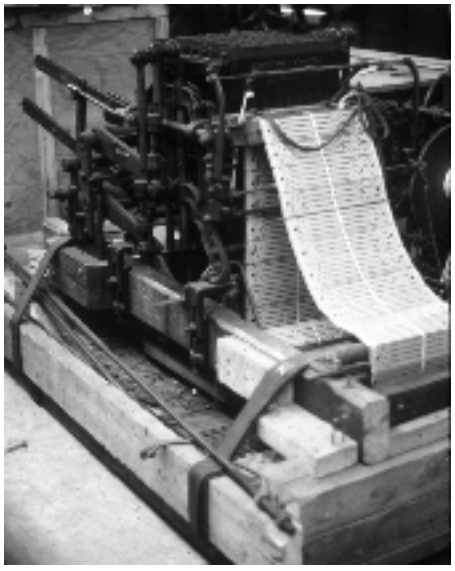
History has obscured the names of these important men, while a questionable inventor, Joseph-Marie Charles, known as Jacquard, is not only given credit for one of the most important inventions of the 19th century,



1-5 A 19th century Jacquard Loom

his name is attached to it—the jacquard loom. Charlin's research implies that perhaps it should be a man named Jean Antoine Breton who actually made the workable loom, and whose memory should have been immortalized. In any case, the 19th century marks the beginning of a new loom, the jacquard loom, that has been the primary means of manufacturing figured textiles until the late 20th century. It never completely replaced the drawloom but it definitely took center stage. (In fact, it can be said of all weaving technology that somewhere in the world every method of production is still being used.)

Essentially, a jacquard machine has a group of hooks and needles that are associated with the warp threads. A series of rectangular cards are punched with holes, laced together, and hung on the machine. One by one these cards are presented to the needles. One card represents the lifting of warp ends for one pass of the weft in the cloth. The cards must be cut in a very precise manner, so that the holes and the needles will line up with one another. If a needle is presented with a hole, it enters, and the hook associated with it will lift, as will the warp it controls. If there is no hole, the needle will be pushed back, and the hook will not rise, nor will the warp associated with it. In 1883 Jules Verdol patented an improved machine, known as the Verdol, which used continuous paper instead of punched cards, as well as some other modifications.



1-6 Jacquard Head with Cards

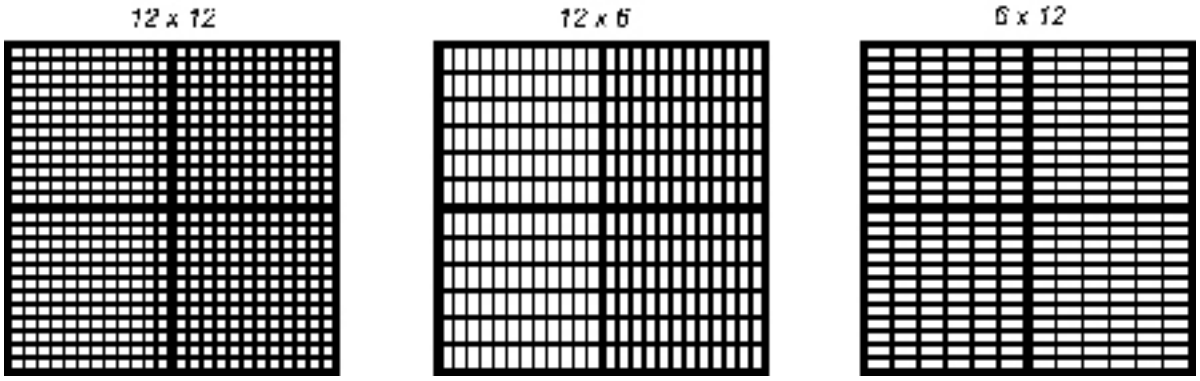
The Effects of Loom Mechanization

Although the means of manufacturing figured cloth was changing, the actual cloth itself was not a different species. Manufacturers made damask, lampas, shaded satins, and all the other types of cloth previously woven on the drawloom. If you are trying to resolve how a fabric was made, and you know it was produced after 1804, it might be the product of either a drawloom or a jacquard; if it was produced before 1804 you can be sure it was woven on a drawloom (or the prototype looms that evolved into the jacquard).

As production became faster and cheaper, figured textiles that were previously available only to the wealthiest clients, became available to all segments of the population. Rayon supplanted silk, synthetic dyes replaced natural dyes, and eventually polyester became widely used in both home furnishings and fashion.

Point Paper

The designers of the original jacquard fabrics were masters of their process. They understood structures and the layout of images as appropriate



1-7 Examples of Point Paper

to the equipment at the mills where they worked. They designed on graph paper with various size grids, some with vertical rectangular spaces and some with horizontal rectangular spaces. These grids, known as point paper, used the same ratio as the size of the warp to the weft. This meant that the drawings would be in proportion to the yarn and sett that would produce them. A convention was created where each color in a design represented a specific weave structure. The design for a damask fabric would be drawn in two colors (or one color with the ground of the paper representing the second color); the design for a shaded satin fabric with seven structures would be drawn in seven colors. The colors were not imitating the actual look of the cloth, but were chosen for contrast, to make the work of the person punching the cards easier. Today you can find these point paper drawings selling at auctions and hanging in frames on people's walls.

Textile mills would have looms dedicated to specific constructions, and designers often used the same groups of weave structures for projects intended for those looms. One design might be a floral, another a novelty pattern with cats, but both fabrics would be woven on the same loom using the same group of weave structures. Eventually specialization occurred at the mills, and designers split into technical designers, who decided on the structures and other production issues, and the artists who drew and arranged the motifs. This division still exists in today's textile industry.

1-8 A Card Cutter

Card Punching and Lacing

Punching the cards was originally done by hand, with a card placed in a form and holes punched using a spike and a hammer. Later, machines such as the piano cutter were invented. Here the card cutter, reading from the painted point paper design, uses

both her hands and feet to press buttons and push pedals that cut holes in the card. These gave way to automated machines that cut cards or perforated paper, allowing duplicate sets of one design to be made so more than one loom could weave the same design. Cards had to be carefully laced together and placed on the jacquard loom. The stacks of cards for one design could be quite heavy, so it is no wonder that perforated paper became more widely used.

A Tradition of Copying

The textile industry has always been one of intrigue and fierce competition. History books are full of stories of one government forbidding the importing of cloth from rival countries, in an attempt to help their local manufacturers. Despite sumptuary laws, people of fashion always found a way around them. Sometimes spies were sent to study the manufacturing of cloth and designs in one location, and came home to help local manufacturers produce similar cloth. Copying almost became legitimized in the textile industry, where the word "knockoff" is still in use. Designs were copied and imitated so often, bounced back and forth between countries and manufacturers, that what was originally sublime and beautiful often became crude and cartoon-like. The jacquard loom might have increased production capability but quality was not always improved.

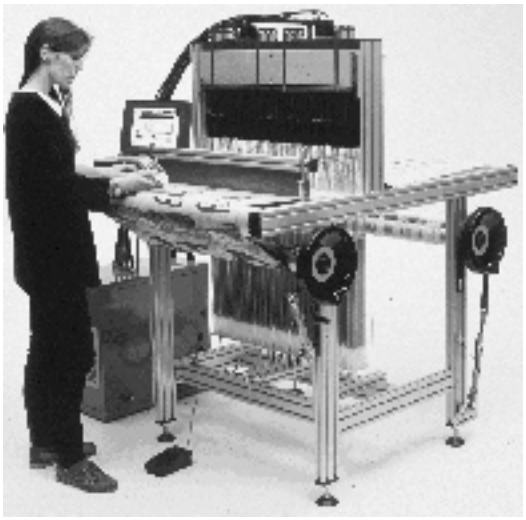
1-9 Stäubli Jacquard Controller on a Somet Electronic Loom

Development of Electronic Jacquard Equipment

In 1979 the first electronic jacquard equipment was made available to industry. It marked the end of an era. Soon the products of the industrial revolution were being retired, replaced by these new, highly efficient looms. Jacquard cloth had always been slower to manufacture than cloth woven on dobby or shaft looms, and thus, more expensive. The new electronic jacquard looms no longer required punched cards or tape but were controlled by computers, electromagnets and solenoids. Designs could be changed in a matter of seconds, and the speed of the mechanism increased until today some looms run at speeds greater than 1000 picks per minute.

Even more fantastic from the viewpoint of a designer is the increased width of the available repeat. The industrial standard for the width of a repeat in the late 20th century was 13.5 inches. Today there are electronic jacquard looms

running with widths of 72 inches that are one repeat. The designer always has the option to divide the width into smaller, duplicated components, but now there is the option to create an image with no repeats in height or width. We can expect even more advances to come on the market. Stäubli's newest jacquard mechanism, the Unival, which can control 20,480 warp ends individually, has so many incredible nuances and features, it will surely spark a flurry of competitive inventions (see Charlin, *The Story of the Jacquard Machine*).



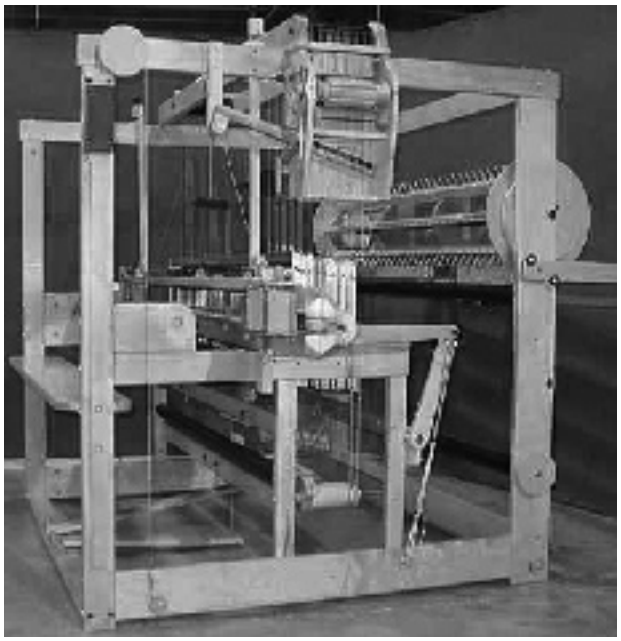
1-10 The TC-1 Loom and its Inventor, Vibeke Vestby

Jacquard Technology In the Weaver's Studio

A great innovation for the individual studio weaver has been the introduction of hand jacquard looms controlled by computers. The Thread Controller (TC-1), invented by Vibeke Vestby of Norway, eliminates the long cords of the jacquard mechanism, allowing people to put the loom in a room with normal ceiling heights. It probably is incorrect to call the new electronic figuring mechanisms "jacquards" because the electromagnets or solenoids used for hook selection are a new means of production, a new invention. Vestby recognized this, and distinguished her invention from the old by changing the name. It will be interesting to see if historians and other manufacturers come to a consensus on a name that will separate 19th century technology, the jacquard, from 21st century technology, the Thread Controller, the Unival, and other hand and electronic warp controlling mechanisms. Meanwhile, we will continue to use the generic term *jacquard* in this book.

Dobby Looms

Besides innovation in the textile industry, there have been advances made to looms available to handweavers. Dobby looms, used in industry since the 19th century, became a craze in the American handweaving community when manufacturers introduced dobby looms that could be controlled by a computer. The traditional dobby mechanism, like the jacquard controller, had hooks and needles that lifted the warp threads. The difference was that the hooks on a dobby lifted shafts, not individual warp threads. Essentially, they are shaft looms with the capacity to have any lifting combination possible within the number of shafts on the loom. The number of treadles on a shaft loom limits the weaver, while the dobby opens up the world of infinite lifting possibilities. It was not uncommon for 19th century jacquard looms to be equipped with both a dobby mechanism and a jacquard mechanism—the dobby to control the ground structure and the jacquard to control the pattern design.



1-11 An AVL Dobby Loom

The weaver on a traditional dobby loom pegs a series of wooden bars that will control the pattern. One bar represents one lift of the warp and one shot of weft. On the bar there is a hole for each shaft, and a peg in the hole will cause that shaft to lift (though some looms are programmed to do the reverse of this). If a particular structure needs 24 picks to be complete, then there must be 24 dobby bars pegged in a sequence and placed on the dobby mechanism. Like the cutting of jacquard cards, this can take time and long pattern sequences can be heavy. The computerized dobby loom made it possible to have much longer designs, and to change from one pattern to another quickly. (There are many manufacturers of dobby equipment today. We suggest you do an online search for more information.) Complex weave systems, like network drafting (see Schlein, *Network Drafting: an Introduction*) came into the vocabulary of the contemporary weaver because of computerized dobby looms.

Dedicated Software for Jacquard and Dobby Design

The final element of the new weaving technology for jacquard and dobby is the computer and the software used for designing. If continuous punched paper was an improvement over individual punch cards, you can imagine the enthusiasm created by the ease of saving designs to disks and reading them into a computerized controller at the loom. Today, even this is obsolete technology. In most mills, designers network their designs directly to the loom controller, or e-mail designs from their studio to the mill (which can be in a different location, even in another country). Globalization is a reality in today's textile industry.

The first electronic jacquard looms, and the software for designing, were created for the ribbon and label industry (narrow-fabric weaving). The software designers adapted many of the conventions of the older technology, both in terminology and in restrictions, perhaps not recognizing that new rules could apply. Limits on the height of a design were soon changed as designers began to question why they were there. Even if most designs would still fall within a restricted size, why place these restrictions in the software?

By now companies have come and gone in the fast-paced world of software design. Prices too have plummeted. Some of the original software cost more than one hundred thousand dollars, and needed specialized hardware to run it. A new department developed at the mills, as the work of the design team got funneled to a smaller team who converted everything into loom-ready

files using dedicated textile software. Eventually companies made versions of their software compatible with personal computers, and prices dropped as more designers had access to the software.

For many weavers, learning weaving software for dobby design was their introduction to the world of computers. Although it was controversial at first as to whether computerized dobby weaving was handweaving or not, as more people moved into this way of working a whole new movement known as "complex weaving" developed. The weaving software demystified structure, allowing weavers to understand and try more complicated interlacements. It led to increased awareness of jacquard cloth and its possibilities. Students in university fiber programs around the country were also being exposed to both dobby software and looms and dedicated jacquard software. As more schools purchase hand jacquard looms, the knowledge is going from theoretical to practical. (See Appendix H for a list of schools with jacquard equipment and instruction.)

Adobe Photoshop for Jacquard and Dobby Design

Until the release of Adobe Photoshop CS, dedicated jacquard software had the exclusive ability to allow designers to set the size of the underlying grid of the design. In other words, they could make the pixel reflect the correct ratio of warp and weft size and sett, as point paper had done for designers in the past. This was a critical element for the textile industry, and a real stumbling block when considering Adobe Photoshop for jacquard design. Of course, some designers figured out ways around this (see Chapter 4 for Alice's method), but now Photoshop includes this feature too.

Many of the dedicated software vendors encourage their clients to use Photoshop for design work, and then allow importation of those files into their programs to make the loom-ready files. There are still features, like simulation of design, that are better accomplished in dedicated jacquard programs; for textile mills this can be an important reason to purchase dedicated software. For most weavers though, Photoshop offers more than you will need for dobby and jacquard design and its simulation possibilities are adequate. This book is intended to teach you the steps involved in using Photoshop for textile design. (Dobby and jacquard looms still need loom-driver software that recognizes the files generated by Photoshop and sends the correct information to the loom.)

The history of textiles is fascinating because the essentials of weaving have not changed, though the means of production has been modified. Although modern societies view handweaving as an archaic process, and separate industrial methods from home production, the computer has entered the world of weaving, revolutionizing production both by individuals and by manufacturers. Adobe Photoshop, recognized as the premier software for visual work in a diverse range of fields, can also be the primary software used

for designing dobby and jacquard cloth. We envision that ***The Woven Pixel*** will help you translate your knowledge of weaving into weaveable Photoshop files, making your work the most recent iteration in the long history of figured textile production.