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Computerized machine knitting and felted-knits

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A Thesis Submitted to the Faculty of
The College of Fine and Applied Arts
in Candidacy for the Degree of
MASTER OF FINE ARTS

COMPUTERIZED MACHINE KNITTING
AND FELTED-KNITS

By
Marie Scheponick

June 5, 1991
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PREFACE

Continuously being drawn to the limitless variety of textures available in fabrics, especially knits, was a motivating factor and inspiration to begin this study. From the narrowest perspective of the thesis conception a goal was to create a fabric unique to the marketplace. There were three major qualities, among others, that were sought. It was to possess different layers of texture, display the sensitivity the designer had for the utilized fibers, and potential for mass production after some modifications.

Over months of research, which preceded an official beginning to thesis work, there was a continuous flow of tiny samples from the knitting machine. Each piece was then felted through various techniques. This experimental process continued until the time of an instinctive, aesthetic conclusion. A few results from the sample making became the models for the yardages that would later be produced. From this initial research the scope of the thesis naturally evolved.

Hopefully, by reading the following pages the enthusiasm and almost addictive challenge felt towards this project will be communicated.
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INTRODUCTION

One of the highest priorities throughout the thesis process was to incorporate knowledge of fashion design with the most important elements learned in the past two years for my personal and professional growth.

As an undergraduate there was a fascination developed for the process and techniques involved with computer knitting machines. Attention and experimentation were quickly absorbed in this method of creating fabrics and clothing because it is a way to create infinite textures. This technique is one that was explored in more depth throughout graduate studies and later became a large part of the thesis.

Felting is also a method of producing cloth that was naturally appealing. The nature of the fusing process allowed different types of texture to be combined with the felt. Through experiments and practice it became a method that could be controlled to some extent. For these reasons it became evident that felt would also somehow be combined as a material for garments. Brainstorming continued until the idea of felting the knits developed. Completing one large sample of a felt-knit combination made it evident that this would be pursued to produce yardages of fabric. It possessed the unique qualities of texture and drapability that lend themselves nicely to clothing.

Whenever there was a lack of motivation or inspiration to proceed with work, Indian miniature painting, costumes of this culture and fashion designer Issey Miyake filled the
void. Indian art and clothing from the 17th and 18th centuries is filled with natural forms and colors which are extremely appealing. Issey Miyake’s clothing and philosophy about design are refreshing and unconcerned with the current trend. In the past both of these sources have always been successful in providing a fresh beginning.

The garments designed from these fabrics are meant to become individual statements about the wearer. Each piece is relatively simple in its patterning and construction. The intention is to have the beauty of the fabrics regarded equally as much as the forms and the imagination of the person who assembles the outfit.

It has been both rewarding and challenging to design a group of garments from fabrication to construction. At times the work became more complicated than initially expected, but, never boring. The next chapters will take you through this journey.
CHAPTER 1
FASHION DESIGN

It would be virtually impossible to cover all aspects in the history of fashion design in one chapter. The most effective method is to discuss the points which relate directly to this body of work.

Between 1876 and 1888 a Frenchman, Albert Racient, produced a six volume History of World Costume. It is one of the earliest books on the subject and has never been surpassed in its scope and detail. In order to redefine and simplify a complicated topic he separates many important cultures he considers to be uncultured, and deviant from mainstream European style and fashion into separate sections. One of these sections includes China, Japan, India, American Indians and Africans, only to name a few.

Cultures that were then thought to be barbaric, unwesternized, or slower to change, are today envied for their ability to keep intact a sense of distinct heritage. These historical costumes and societies are inspirational to the trends and styles that develop in the fashions coming out of America and Europe today.

"The House and Clothes have answered the human requirement for shelter and, whether we will or not, they also express the individual and the national ideal of beauty in colour and in form, satisfying in this way the demands of the aesthetic instinct. The degree of satisfaction these things give the cultivated aesthetic sense is the measure of their artistic value,
it is not their period, their oddity, or their cost that determines it."¹ This statement from Frank Parsons, in his book the Art of Dress, ties the historical value of clothes to the many other influences that affect what people have worn throughout history.

Below, is a list of things that will always influence fashion:

1. Religion
2. Monarch government
3. Commercial interests
4. Social
5. Geographical
6. Time
7. Principles of art

Nothing is more important in studying costumes than the silhouette. Although the details change often, the silhouette changes more slowly and defines the character. The silhouette remained basically the same from the Egyptian to Byzantine periods. As civilization developed, changes occurred more rapidly. Between the 12th and 18th centuries a slow transformation in silhouettes is evident. Now, the silhouette is redefined every year or two.

It is impossible not to believe that clothes reveal a lot about a person and the culture to which they belong. Being familiar with the changing silhouettes through the ages uncovers intricacies about societies and cultures rather than the superficiality many people
associate with clothing. From an economic standpoint, the production of clothing and textiles has grown from a cottage industry, to one of the most significant industries in the world.
CHAPTER 2

COMPUTERIZED MACHINE KNITTING

Today, computerized machine knitting can produce most traditional designs and structures of traditional hand knits. These machines also have the capability to make knits which are too complex or fine for hand knitting. The commercial industry has become highly competitive because modern technology must meet the demands of fashion and usage. There is a unique involvement between the knitting industry in garment and fabric production. This relationship has provided the knitting industry with the need and appreciation to respond to consumer demands. Knitting technology provides a wide range of facilities to achieve this goal.

In order to understand how complex this industry has become, it is first necessary to learn some facts about its origin. The invention of the stocking frame is credited to Reverend William Lee of Calverton in Nottinghamshire in 1589. It proved to be ten times faster than knitting with hand held pins and was the foundation of modern weft and warp knitting. From this invention the technology to produce machine lace was developed, and although still in its crude stages the results were of poor quality. It was encouraged to improve the frame in order to knit silk.

Elizabeth I and James I made it impossible to obtain a patent for the invention because they feared it would cause unemployment for hand knitters. The frame was moved to France, where improvements could be made without any interference and then returned to
London after the assassination of Henry IV. Until 1810 the industry expanded rapidly which resulted in over-production, stagnation and then unemployment. Conditions did not improve until the second half of the nineteenth century with new innovations and inventions in knitting technology. Improvements were encouraged along with practical applications.
CHAPTER 3
FELTING

It is unlikely we will ever know the causes for the invention of felt, but its earliest form is of a textile found in the Central Asian Steppes dating about 600 B.C. Literary references in China date back to 2300 B.C. Warriors protected themselves with felt shields, hats, clothes and felted boots. The Greek word "pilos" refers to felt cloth or anything made from felt. In the Iliad felt caps were described and Odysseus was said to have worn a helmet lined with felt. Central Asia has the most abundant felt references in writing, connecting it to all aspects of life. The earliest recorded illustration of felt making, was a wall painting outside Verecundus' workshop in Pompeii. Unfortunately, felt has a low survival rate in archeological conditions.

"Although it is now such a common product in the West, apart from its use as underfelt or roofing felt and other industrial demand, it was, up to the nineteenth century, very widely used, especially in the hatting industry."² The use of felt can be followed up to the nineteenth and twentieth centuries. Not until the nineteenth century were there any social distinctions between the users of felt, it would be found in a palace or a circular felt covered tent. Only in this century when so much ritualistic belief of the sophisticated classes was eroded by outside influences and modernization has felt become the fabric of nomads. This
textile is found in the nomads’ thoughts and beliefs and was originally of fundamental importance to their physical well being.
CHAPTER 4

FELTED-KNIT YARDAGES

Before explaining the processes used to create this work it will be helpful to state that the order of Chapters four through seven is not necessarily the way in which the work was started or completed. The paper is arranged in this manner to make it as organized as possible for the reader. Nothing has a title as seen in most thesis. This collection is divided into sections only for technical and descriptive purposes.

It had been established through sample making that knitted lace and some tuck stitch patterns were the most effective knitting technique to use in knitted-felt. Additional fibers could be added along with the roving in the felting process and the resulting fabric would retain the qualities of knits as well as the stability of felt. Knit patterns with the largest holes were also used which helped its drapability.

The first yardage knitted was very experimental in terms of color, and the proper amount of roving added for felting. To add variation to the knit, about every twenty rows the pattern number of the lace was changed in the computer. Metallic yarn was combined with the wool yarn in the knitting process in the first third and last third of the yardage. The center of the fabric was knitted entirely of wool. Metallic yarn is very brittle. Evenly spun and pliable yarns result in the best machine knit with the least mechanical problems. The metallic yarn made knitting a tedious process because it breaks as a result of uneven tension.
The sections in which the metallic yarns were used are visibly and tactiley stiffer than the center.

Clothes would eventually be made from these yardages so it was necessary to make it as wide as the bed of needles on the machine, approximately one yard. Each piece was four or five yards in length before being dyed or felted. It was taken into account that the yarn used in the piece would shrink tremendously in the felting process. Five yards shrank to about three.

Next, the fabric and roving were dyed along with some silk strips that would be combined in the felt. Silk strips and metallic yarn were used to contrast the dull color of wool. The fabric was laid out and the strips and yarn were pulled through the holes in the knitting with a crochet needle. After this, the wool batting could be added in a bottom layer, underneath the yardage of fabric and a layer on top of the fabric. Both layers enclosed the added elements. Batting is carded wool fibers in a flat form prepared for felting.

Felting took about one hour. The secret was to find a time limit long enough to fuse all the fibers together into one fabric but not felt too long. If this happened the yardage would be stiff and lose its drapability. Unfortunately, too much roving was added and the fabric was a little too heavy for the end use. In order to correct the situation the fabric was combed with a wire brush and the loose fibers were cut off the entire piece. A desired thickness was reached.
From this initial yardage it was possible to calculate that metallic yarn would not be knitted into future fabrics because of the problems it created. Thinner layers of wool had to be used when felting to eliminate the heaviness of the first piece. More contrast needed to be made between the color and texture of the knit, and silk strips. Overall, this yardage met the initial goals, but it was possible to improve the next fabric with a few minor changes.

The second yardage was produced in the same way as the first but with some minor adjustments. There were divided opinions on the peach-pink color of the first fabric so it was decided to move toward earth tones. A satin weave silk was used for the silk strips because, this type of weave creates a lot of sheen when dyed. This added the needed contrast between the wool and knit. Also, along with the metallic yarn and silk strips a gold color seed rayon yarn was added. More contrast was added by laying this yarn on top of the knit yardage in a swirling pattern before felting.

Another fiber change took place by using camel, mohair, and cashmere roving in this fabric, as compared to using only wool and mohair in the peach piece. Utilizing these wools resulted in a softer, lighter fabric with more color variations from dyeing. It had been planned to make these surface changes before starting the second knit fabric. The same tuck stitch pattern was used throughout the entire knitted piece.

The second piece was more than satisfactory. Looking at both fabrics it was obvious that they would work well together. The colors complemented each other and the
peach color of the first piece brought out rose tones in the second. No clipping was necessary for the brown fabric because much less bating was laid down for felting.
Figure 1
First Felted-Knit Yardage
Figure 2
Second Felted-Knit Yardage
CHAPTER 5
KNIT YARDAGES AND SWEATER

Originally one yardage of knit large enough to cut out two pairs of pants was to be made. Considering the short amount of time left for the thesis to be completed and the nature of the knit which was to be made, the construction technique of cut and sew was the best option. This is the same method used when woven pieces are cut out for sewing. Joining knit pattern pieces together by sewing eliminates the need to construct the piece entirely on the machine. Another way of making knits for garments is to graph out each pattern piece and calculate the number of stitches per inch. When the pieces are finished they can be put together by hand, sewing through the salvages. Depending on the type of knit, and the garment for which it will be applied, either type of construction is appropriate.

Finding a suitable yarn to create leggings became the biggest obstacle. The yarn needed to be elastic, relatively strong, shinny, and above all, textured. After producing a lot of swatches for possible combinations of yarns, texture and pattern, a decision was made. The yardage would be made from a mixture of a seed rayon and a 10/2 cotton. This choice solved one problem but created another. There was only enough seed rayon to make fabric for one pair of leggings and more cones of this yarn were not available. The second pair of pants had to be made from different yarns.
A plated tuck stitch pattern derived from the computer was used. This method produced the most texture on one side of the fabric while the other side knitted stocking, or plain stitch. It resulted in a lot of surface interest. The slubs in the seed rayon stayed on one side and created a random pattern.

Once the yardage was completed it was dyed in the piece dyer. This method of dyeing fabric was the most efficient for almost all of the thesis. It ensured an even dye and a chance to match colors as closely as possible.

After the fabric was dyed it was a little disappointing, because this type of rayon produced a greenish hue. It was close to the old gold used on the silk strips. There was a concern that it might clash with the rest of the woven silk garments which were also to be dyed old gold. Something that became even clearer were the technicalities involved in dyeing. Even if the fibers are the same there are many other details to consider in order to reach a similar color.

Many long floats emerged throughout this piece because a highly textured yarn was used. Mending these mechanical errors was a very time consuming process. Excluding the concern about the color, and the mending that had to take place, this was a favorite piece. It was exciting to imagine the fabric as a pair of leggings.

Examining the amount of texture in all of the finished yardages, the choice was made to use a smoother textured yarn for the second pair of pants. A smooth texture would unify the pieces instead of adding a new element. With this in mind, a thicker cotton yarn with
Figure 3
Textured Gold Knit
rayon twisted in the center was used. The rayon would add luster to the yardage and pick up the qualities of the silk. This yardage was knitted in a stocking stitch. To add a subtle difference, the purl side, normally considered the wrong side of knits, would be on the right side of the finished garment.

Fortunately, knitting this fabric resulted in the least technical or mechanical problems of all the yardages. The process is straight forward and the use of the computer is not required in knitting stocking stitch. It is a completely manual operation. The color was very close to the gold in the silk strips in the knitted felt fabrics. Dying with the piece dyer was very successful for this piece.

The only garment knitted entirely on the machine was the silk sweater. It was constructed using the method previously described. All increasing and decreasing of stitches was done on the machine according to a graphed pattern. Although this approach tends to take longer, it is visually, the best method to construct a stocking stitch sweater of silk yarn.

Instead of piece dyeing, as done with the other knit fabrics, the skeins of yarn were dyed before knitting. A slight variation, similar to space dyeing occurred. It reflected light in an unusual way but this was not considered a problem. Compared with the silk that had already been dyed gold, this yarn came very close to the same shade.

The most trying aspect of finishing the sweater was finding the most appropriate method of finishing the edges. A sweater this elegant looking requires the seams to be as
hidden as possible. Hand sewing seams is time consuming but it adds the most professionally constructed look to certain knits.

Unbelievably, the sweater came out to look almost exactly as planned. Except for the slight variation in color the garment would work well with the rest of the fabrics.
Figure 5
Silk Sweater
CHAPTER 6
DYED YARDAGES

Before beginning to construct any of these garments it was decided that much of the thesis would be made of silk charmeuse. This particular woven fabric was chosen for important reasons. It would add a lighter element to the heavier knitted and felted pieces and also, after being dyed it would have an incredible luster. One side of the fabric is plain weave and the other side is satin weave. Satin weave produces diagonal lines of warp yarns which reflect light. The same silk was also used in the strips of cloth in the knitted felt fabrics so this would tie all of the pieces together.

About seventeen yards of fabric had to be dyed old gold in the piece dyer. The color was very uniform after the process and appeared as if it would work well with the other gold pieces.
CHAPTER 7
SKETCHES, PATTERNS AND CONSTRUCTION

SKETCHES

One of the most significant aspects of fashion design is to visually communicate ideas for designs with croquis. Transferring concepts onto paper is a way to redefine and expand upon good ideas, and leave the weaker ones behind. Sketches are also necessary to accurately start drafting patterns. Having a croquis in front of you when making patterns eliminates a lot of mistakes and problems.

A basic concept for the silhouette, and mood of the collection was formulated before fabric production began. Transforming these ideas onto paper and making them clear to other people is always challenging. Ink sketches were made. After choosing the ideas with the most potential and adaptability to existing fabrics, color croquis followed. These exhibit fabrication, silhouette, color and texture for each garment. From these sketches ideas approach reality.
PATTERNS

Drafting patterns has never been the most exciting part of fashion design. It is technical, time consuming and repetitive. As with most technically related creative processes, proficiency comes with practice. Accurate patterns make the transition from two dimensional pictures, to three dimensional garments much faster.

Nine patterns were made. As usual the process began by starting with slopers, or blocks, which are the basic patterns from which garments are made. Pattern adjustments were made according to the sketches. From past experiences, four or five separate pattern adjustments were made before beginning to make the final garments. Considering the amount of time left for construction, it was impossible to make that number of corrections. Previously, the construction of garments involved sketches, patterns, muslins and construction. This thesis was more in depth because the fabric was also made.

Therefore, it was important to make patterns that needed little adjustment. After the patterns were completed the next step was to make muslins. Muslin, is a term used to describe a mock up of what the actual garments will look like. They are made of fabric approximately the same weight and hand as the final fabric but much less expensive. Taking this step ensures the exact fit and silhouette of the final garments. In this phase, hash marks can be made on the muslins for pattern changes and details can be checked.
Analyzing the muslins made is clear that only small adjustments needed to be made. This was great because it meant staying on the planned schedule. Minor adjustments had to be made to hems and sleeves. The rest of the problems would be solved as they surfaced. There was no need to make second muslins because the corrections that were to be made did not affect the silhouette of the garments.

CONSTRUCTION

Constructing the nine pieces in this thesis involved attacking each problem as it arose. Each piece is unique in its construction and fabrication so most of the problems were different. Each garments required test samples of stitches until the correct combination of hand sewing, surging and machine stitching was reached. It is important to keep in mind that these were not garments that were to be mass produced and keep them on an experimental level, as far as fabrication and construction were concerned.

There were no major problems putting the woven pieces together. The major challenge was finishing the brown jacket with the collar. If the jacket were to be completed as originally planned the entire piece would have been made from felt. To substitute for the lack of felt it was suggested to use only knit for the sleeves and collar. It was dyed a similar but slightly contrasting color and lined with silk like the rest of the felt pieces. Surprisingly, after the problems, this solution made the jacket one of the strongest pieces.
CONCLUSION

Working on this thesis was the most consuming and complex creative project ever experienced. The most rewarding aspect was creating the fabric from which the jackets and vest were made and exploring the possibilities of the knitting machine.

Having the facilities and opportunity to produce a color palette for the collection expanded upon already established ideas about the importance of color in clothing. Some pieces are stronger than others but they work together as planned. The felt-knit fabric is now a reality. The process and idea can be researched further sometime in the future. If one thing could have been changed it would be to have more time. Details and finishes of the pieces probably could have been more refined.

Unifying fashion and textile design in this body of work clarified the belief that these two disciplines are interdependent. Being surrounded by a variety of creative people and processes for the past two years has had an extraordinary effect on this thesis. Hopefully, the creative growth experienced working on the collection will continue after school.
Figure 6

Group 1

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NOTES


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