ADVANCES IN THE STUDY OF ITALIAN RENAISSANCE SILK VELVET DESIGN THROUGH CONTEMPORARY DIGITAL TECHNOLOGY IN EDUCATION

by

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DEDICATION

I dedicate this thesis to my wife Harriet, whom I love and admire. It has been her dedication, encouragement, help, support, and tolerance that made this work possible.

ABSTRACT

A group of Italian Renaissance velvet textiles, created over three centuries as part of the mercantile system, were traded over time in Europe, until 1927, when they were shipped to the U.S. as educational objects. Traded again, they eventually came to rest, as the Cranbrook Collection, lying undisturbed for over fifty years in the archives of the New Brunswick Museum in Saint John, New Brunswick. These fragments form the basis for this thesis, which outlines a process of digitally recording textile fragments, illustrating a procedure for creating a "virtual silk mill" for museum display and Internet use, showing how a digital collection of textile images can be used in a virtual museum setting. The importance of digital technology in the learning environment, as a tool for classroom and online course delivery in crafts, textile design and museum study is also discussed, including a sample lesson plan using digitised textile designs.

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List of Symbols, Nomenclature or Abbreviations

2D	Two dimensions
3D	Three dimensions
CD	Compact Disk
CUASA	The Cooper Union for the Advancement of Science and Art
dpi	dots per inch
GIS	Geographic Information Systems
Jpeg	Joint Photographic Experts Group
NBM	New Brunswick Museum
ppi	points per inch
Tiff	Tagged Image File Format
U of M	University of Michigan

Background

Section 1 – Historical

The historical section provides a summary of the new textile technologies used in the manufacturing process of silk velvet (A.D.1500-1800) and their effect on the systems of trade and consumption in Italy, France and other selected European countries. I explore the textiles' creation and how the Renaissance technologies affected the lives of Europeans from that era. I address the later exchange of Italian textile samples in the mid-1920s from the owner in Florence, Italy to the United States of America and their eventual home in the NBM. The journey of the textile fragments to the NBM represents a significant case study of design exchange and artefact collection.

Section 2 – Technical

The technical section is composed of a comparative study of the textile fragments' technical structure, design and manufacturing techniques in the context of fabrics from other European Renaissance textile centres. Following research on similar textile designs in library records and museums in Canada, the US and Europe, I analyse selected textile fragments from the NBM's collection describing the design, style, manufacturing process, and time period of manufacture, establishing a basis for comparative design research, an area of growing international research as illustrated by articles published in the *Journal of Design History* and *Textile*.

Section 3 – Digital

I research several processes for digitally recording the textile fragments and document a procedure for creating a "virtual silk mill" for museum display and Internet use. I show how a digital collection of textile images can be used in a virtual museum setting and how, by using a digital 3D setting, the user can move an image from the digital textile collection onto a sample image to recreate a virtual representation of silk velvet as it would have appeared in a Renaissance scene. The new technologies in digital printing will change current textile production methods. This project will be part of that technological change.

Section 4 – Educational

I discuss the importance of new digital technology in the learning environment including the structure and design for lesson plans, and using these digital textile designs as an educational tool for classroom and online course delivery in crafts, textile design and museum studies. As a long time instructor of textile design and as an experienced developer of online courses, I document how virtual simulations of the Renaissance period can assist in textile studies when access to primary and even good secondary source material is limited.

Section 5 – Conclusion

Statement of Purpose

The New Brunswick Museum in Saint John has in its possession a collection of silk velvet textile fragments that are tentatively identified and classified. It is the purpose of this study to explore the history of the fragments, identify the motif development, the construction techniques, the special characteristics associated with the Renaissance period and the particular localities represented by the fragments. The textile fragments housed in the NBM archives comprise an extensive collection of 300 pieces. They have been grouped first by country of origin then subdivided into textile types and construction. A final sample group of silk velvets has been selected for study, with regard to their motif development, technical structure, materials content, and age.

From this sample range a set of digital images was recorded and manipulated to create an educational multimedia lesson. Although only a small group of fabrics will be intensely analysed in this study, the project provides a basis for expanded work in this subject area.

Method of Procedure for Historical Study

Prior to identifying the techniques used in the creation of the fabrics, it is necessary to study the background in which these fabrics were created and the phases of the Renaissance that have a bearing on textile manufacture. I summarize the history of the trade, design development of the techniques within that industry, the technology development and the techniques employed in the creation of the textiles. Another element

of importance to this study is the story of how the textiles were traded and how the textile fragments came to be part of the NBM collection.

A fuller understanding of the materials, design scale and structural information can be obtained by selecting a group of the textiles and digitally recording them at two different resolutions for study. Of further benefit to learners in the field of woven and printed textiles are the visual demonstrations themselves, enabling a clearer understanding of woven and print design theory.

Foreword

The historical focus of this study is a group of textile artefacts that travelled from their conception in Italy in the fourteenth century to a Canadian museum. This history weaves a path through time involving craftsmen, merchants, scholars and commoners alike; it addresses how the textile creations came into being, how they have survived and how they continue to inspire new design directions to this day. It is a tale of artistic growth and talent, stemming from a time of religious authority and empire states, when the arts were experiencing a rebirth.

In the spring of 2000, I took a group of second-year students from the Surface Design Studio of the New Brunswick College of Craft and Design to the NBM in Saint John to view the Cranbrook Collection, textile fragments contained in the museum's archives. This educational field trip was arranged so that the students could draw upon primary source material for design inspiration. The textile collection, originating in Florence,

Italy, spans three centuries of Italian Renaissance silk textile manufacture; it has never been publicly displayed, but has been partly catalogued. After discussing the history of the collection and how it had arrived in the museum's archives in the 1940s, I recognized the significance of such an educational resource. Later in the summer of 2000, Peter Larocque (NBM curator) and I discussed ways to open the collection for student use at any time of the year. I suggested that we consider a joint digital cataloguing project and the development of a virtual gallery where universities, colleges, and public schools could learn about this rich resource. Subsequently, in mid-2001, I met with museum staff to outline a plan and consult with them on gaining access to the textile collection. I researched possible funding options and set in place a framework for a joint proposal to our respective departments. In early spring of 2002, successful talks with Employment Canada led to the funding of two college graduates under the Youth Employment Initiatives Program and, in October of 2002, two applicants were hired to digitise the collection. From this project a record of low resolution images was compiled for use in the museum's archives and for Internet use; it is from these records that my selection was drawn. Next, I created a new image collection that has been used in this thesis. A description of the process I used in documentation of the digital images and the technical information can be found in Section 3.

The scope of the project was to digitally record the textile designs for future study by craftspeople and artists, and to enable the museum to catalogue the items and have them recorded in their database. Although the initial project includes a descriptive record of the movement of the textiles from Italy to North America and their subsequent travels from museums in the United States to the NBM in Saint John, there has not been any previous

attempt to record the history of the designs and manufacturing process in creating these textiles, the reasons for their creation, and their potential value for education. In Section one, the history of the manufacture and sale of this type of textile reveal the processes used in the manufacture of the silk velvet in Renaissance Italy and demonstrate their artistic and commercial value.

Section 1 History

Introduction

The Renaissance: the name is derived from the French for "rebirth," an age in which artistic, social, scientific, and political thought turned in new directions. This new era was in part financed by the manufacture and sale of textiles, and silk fabrics celebrated this epoch. The Italian Renaissance added a chapter to European history that celebrated fine art skills, leaving a legacy of splendour and luxury. It also gave a group of craftsmen, unrivalled in the art of silk manufacture, the opportunity to express themselves in their craft and it was the master weavers who fine-tuned the process for the manufacturing of silk velvet. The new technologies developed by these artisans allowed them to create textiles utilising the full splendour of the silk fibre and weaving. Then, with the introduction of new dye colours in the sixteenth century, and the ever-changing tastes of the consumers of luxury textiles in European society, a new era of design trends opened up which emphasized the richness and splendour of silk in its many variations, including cut and looped velvets, along with gold and silver brocades.

The Renaissance was a time of exploration for Italy's artisans, a time of artistic discovery for the luxury textile designers and master weavers. It was also a time for new commercial and technological achievements and it was in this environment that the powerful merchant families built empires and alliances. Through their aspirations, their religious beliefs and patronage they were instrumental in the building of the Italian arts. Cities and towns were transformed and flourished as a result of the growth of textile manufacturing, and Florence was at the hub of this growth (Figure 1). Renaissance silk

was foremost in luxury fabrics and it was the manufacturing and trading of silks that played a major role in the wealth of Florence and its inhabitants. Like the silk moth spinning its cocoon, Florence grew, and with this growth the artisans' skills spun out to touch the lives of so many others in so many ways over the centuries.

1. Florence and Central Italy, A.D. 1400-1600

The production of silk manufacture assisted in offsetting the decline of the wool trade in Florence as Raymond De Roover noted:

> Pagnini, who, despite his work being out of date, may very well be right on this matter, points out that the Florentine silk industry in the fifteenth century flourished side by side with the woollen industry; that the silk manufacturing might be considered more beneficial to the economy than cloth-making because in addition to employing as many people, if not more, the mark-up was much higher on silks, a luxury product.[1]

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[1] Raymond DeRoover, *Labour Conditions in Florence c.1400 in Florentine Studies* edited by Nicolai Rubinstein (London: Faber and Faber 1968) p.305

The history of Florence's silk industry, its development and the role its silk merchants played has been documented in other literary works, although only as a sidebar to Florence's commerceial history has silk velvet been mentioned. Overshadowed are the stories of these merchants and the families involved in silk manufacture, and the everyday lives of the workers and craftspeople who contributed to the maturing of Florence's history and the silk trade. In this opening section, I explore the development of the Italian silk industry from its introduction in Europe to the city of Lucca's involvement. In particular the focus is of the silk merchants of fifteenth century.

Before the Common Era

The cultivation of silk is believed to have originated in China and dates as far back as 2500 B.C. How silk made its way from China to Europe is not fully understood. Some say it was through the mission of Chang-ch'ien, sent by the Han emperor of China Wu-ti in 139 B.C. and that it took thirteen years for the monks to complete the journey.[2] Who the first merchants were remains unanswered but silk manufacture was carried into the Arab world and then spread throughout the Mediterranean regions. Records show that by the ninth century, silk was in Athens, Thebes, and around the Aegean. One story recounts how in 1146, Roger of Sicily invaded Greece and brought back rearers and weavers to Palermo. At the same time, the Moors were introducing silk to Spain.[3] Others believe silk first entered the Italian peninsula via Venice through trade with the East[4] and yet another

[2] Richard C. Foltz, *Religions of the Silk Road* (New York: St. Martin's Press 1999) p.2
[3] Sarah Bush, *The Silk Industry* (Risborough: Shire Publications 1987) p.3
[4] Fabrizio de' Marinis, *Velvet* (New York: Idea Books Inc. 1994) p.12

account describes how the Normans introduced the skills of silk weaving when they invaded Sicily.

By the thirteenth century, there was an established trade in silks and velvet in Italy, and the cities of Genoa, Venice, Bologna, Lucca and Florence had a large export trade in silk fabrics.[5] The favourable location of the town of Lucca was reflected in its early development as a leading Tuscan commune and from the twelfth century, as a major silk manufacturing centre.[6] Lucca's Court of Merchants, between 1376 and 1381, detailed regulations to ensure the silks were of the highest quality of workmanship and introduced measures to guarantee high quality by forbidding the use of inferior types of silk, gold and silver. Each weaver was to be registered and could only produce work for silk merchants.[7] This effort by Lucca to control the silk industry included the banning of cloth of gold and silk, which was manufactured outside of the city; in addition, instruments and tools used in the making of silk were not to be taken out of the city.

Despite these statutes, by the late fourteenth century Lucca's silk industry was failing and Lucchese technology had spread to cities such as Florence, Bologna, Genoa, Milan and, later, Venice. In an effort to control this loss of skilled workers, in 1381 and in 1389 decrees were issued forbidding throwsters[8] and weavers from leaving, ordering all who

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[5] Luca Mola, *The Silk Industry of Renaissance Venice* (London: John Hopkins University Press, 2000) p.3
[6] Louis Green, *Castruccio Castracani* (Oxford: Claredon Press, 1986) p.13
[7] Christine Meek, *Lucca 1369-1400 Politics and Society in Early Renaissance City-State* (Oxford: Oxford University Press, 1978) p.36
[8] The operation called throwing, is to twist and double the silk fibre into more substantial yarn. A throwster is a person who twists or spins silk, and prepares it for weaving.

had left to manufacture silk in other cities to return within four months.[9] This was to no avail and weaving in silk and velvet continued to gain strength beyond its city walls.

Soon other Italian cities were attracting silk masters and they in turn began developing their own industries in silk manufacture and, in a fashion similar to other branches of textile manufacture, contracting out of labour for various tasks was underway. "Well before 1300, the 'putting out' system of domestic manufacture was already fully attested, certain branches of the urban textile industry depended upon labour from the outlying rural areas."[10] Florence, on the other hand, in the thirteenth century was well entrenched in the textile industry and the city contained thousands in the textile trade manufacturing wool, which was of such high quality that the city's merchants commanded the highest prices in three continents.[11] Into this trade network silk fitted well. Soon the merchants of Florence set their sights upon a new product to blend into their growing list of commodities for trading.

The Sellers and Buyers of Silk

The city state dynasties and their patronage of the arts encouraged the growth of a new way of seeing, understanding and depicting artistic objects. In Florence it was Cosimo de' Medici's (Figure 2) patronage appointments that had artists and sculptors working on his new palace, and weavers working on great tapestries for its walls. One upstairs room in the palace, the *camera di Lorenzo*, had a velvet tapestry seven meters wide on the

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[9] *Ibid.* Meek, p.37
[10] Louis Green, *Castruccio Castracani* (Oxford: Claredon Press, 1986) p.162
[11] Gene Brucker, *Renaissance Florence* (New York: John Wiley & Sons, Inc. 1969) p.54

wall[12] that would have taken over a year to complete, from the creation of the design to the final weaving. Late fifteenth-century Florence was the centre of artistic and commercial development unparalleled in Europe and, socially, merchants were viewed as a type of nobility.[13] Indeed, merchant families such as the Medici, the Albizzi, and the Strozzi were all involved in the silk trade and the church was the dominating factor.

2. Cosimo de' Medici (1389-1464)[14]

It was the church that played the lead role in the direction of the industry and how the designs would be developed as explained by Dupoint-Auberville: "Handcrafts of all sorts became a clerical pursuit, practised under the shadow of church by wealthy and powerful associations."[15] Dupoint-Auberville further noted that "The bishops and abbots encouraged the manufacture especially of those ornamental fabrics that enhance the

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[12] Eilean Hooper-Greenhill, *Museums and the Shaping of Knowledge* (London: Routledge 1992) p.28
[13] Peter Burke, *Culture and Society in Renaissance Italy1420-1560* (London: B.T. Batsford Ltd. 1972) p.245
[14] http://www.museoscienza.org/IdealCity/english/zoom/life1_8.htm accessed 04/06/2004
[15] M. Dupoint-Auberville, *Classic Textile Designs* (London: Studio Editions 1989) p.8

pomp of the religious worship. Hence those marvellous copes still jealously preserved in the churches." Philippa Scott in *The Book of Silk* reinforces this point:

> Apart from the demands of royal courts, the church was the most important customer for silks. Precious woven stuffs were used as wrappings for relics of saints, which were so numerous in medieval times that they were akin to tourist souvenirs, *de rigueur* for any traveller returning from the holy land.[16]

From this blend of society documented accounts of two silk merchants emerge to illuminate the operation of the silk trade during this time in Florence. Through the works of Florence Edler de Roover and William Caferro the mechanism of Florence's silk industry can be understood. From fifteenth-century Florence, silk merchants Andrea Banchi di Francesco di Banco (1372-1462) and Tommaso Spinelli (1399-1471) amassed their fortunes. Both were silk merchants whose paths inevitably crossed on a number of occasions in their business lives.[17] Florence Edler de Roover described Banchi, as belonging

> to a family of silk merchants (setaioli). His grandfather, Banco di Ser Bartolo, matriculated in 1328 as a setaiolo in the Arte di Por Santa Maria, or the Arte della Seta (Silk Guild). All of Banco's six sons joined the guild, but the three eldest died early and without heirs. Andrea's father, Francesco, the fifth son, became a member of the Silk Guild on July 24, 1364, and served as consul of the guild in 1378. He and his two brothers, Lodovico and Michele, owned three shops (botteghe) in Via di Por Santa Maria, where most of the silk shops were located.
>
> Andrea di Francesco di Banco was born September 20, 1372, and lived to be a nonagenarian, dying on October 12, 1462. Nothing is known about his early years. His father and his uncle Lodovico both died of the plague in 1430. Andrea probably worked from 1390 onward for his only surviving uncle, Michele. On February 4, 1401, while his uncle was consul of the guild, Andrea applied for membership as a setaiolo and was matriculated on April 28.[18]

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[16] Philippa Scott, Book of Silk (London: Thames & Hudson, 1993) p.155

[17] Both silk merchants shops were located as others were on the Via Por Santa Maria.

[18] Florence Edler de Roover, 'Andrea Banchi, Florentine Silk manufacturer and Merchant in the Fifteenth Century' in William M. Bowsky, *Studies in Medieval and Renaissance History Volume III.* (Lincoln: University of Nebraska Press, 1966) pp.224-225

In contrast, William Caferro described Spinelli as coming from a quite different background, less prominent and more humble in origin:

> The origins of the Spinelli family are somewhat obscure. According to an official family history written in the eighteenth century, they moved to Florence in the twelfth century from Pontassive, a *contado* town located in the Mugello, the region from which the Medici also originated.
>
> Tommaso was the youngest son of Lionardo Spinelli, a man of modest means and influence. Details of Tommaso's life first emerge in 1419, when, as a young man of ether nineteen or twenty-one – depending on which *catasto* declaration we believe – we find him working for the Alberti, then under the sentence of exile, at their bank in Rome.[19]

The silk merchant business system in medieval Florence was made up of partnerships and as Armando Sapori noted, "powerful individuals were the exceptions – partnerships were the general rule."[20] Likewise, these two merchant business cases were similar in structure to most operations in Florence at the time. Silk shops operated on a three to one partnership ratio[21] and the Banchi and Spinelli businesses were structured in a similar fashion. Both operations started as sole proprietorships but in their later years they were comprised of partnerships with agreements being set in place for three-year terms.[22]

Competition among silk merchants was fierce. The purchase of raw materials, supplies, and labour in Florence in the fifteenth century required astute business skills. Yet, like other astute businessmen of the time, the records show silk merchants were not influenced by the tax collector's power, and it was not unusual for them to avoid paying their taxes by finding many ways to cover up their true income. Spinelli's tax declaration

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[19] William Caferro, "The silk business of Tommaso Spinelli, fifteenth-century Florentine merchant and papal banker. *Renaissance Studies* Vol. 10 No.4 (1996) pp.417- 418

[20] Armando Sapori, *The Italian Merchant in the Middle Ages* (New York: W.W.Norton & Co., 1970) p.42

[21] *Ibid.,* Edler de Roover, p.226

[22] *Ibid.,* Elder de Roover, p.228 and Caferro p.423

of 1430 showed he had no taxable wealth.[23] Moreover, Banchi had managed to reduce his (evident wealth) by confusing the tax collector with his astute form of bookkeeping.[24] Banchi deceived the tax collector by falsely reporting the rents he collected from a shop he rented to Piero Petrini and Co. in the Via Por S. Maria.[25] Caferro described 'Tommaso Spinelli's declaration of 1457, like all citizens, probably minimized his assets'.[26] Examples of this can be seen by the increased buying of rural land by the merchant families done in part due to the new laws introduced during this time which provided the land owner a twenty-five year exemption from taxes and personal debits whether or not they worked on the land. Other records indicated some merchants reporting heavy losses being incurred due to the decline of wool sales at markets in Flanders. This in turn caused a fall in production back home in Florence causing a further backlash by showing up as a decline in rental property for manufacturing needs.

To Trade or Not to Trade

The local market for silk was limited in Florence, only playing a part in overall income of city businesses; it was the export market that the Florentine merchants depended upon for most of their income.[27] This export trade came with the added expense of agents that the merchants relied upon to market their goods, but over whom the merchants had no control.[28] As in all aspects of the silk industry, it fell upon the silk merchants to bankroll the operation, which could represent a heavy financial toll at times. Sales of silk goods

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[23] *Ibid.*, Caferro, p.421
[24] *Ibid.*, Elder de Roover, p.281
[25] *Ibid.*, Elder de Roover, p.281
[26] *Ibid.*, Caferro, p. 432
[27] *Ibid.*, Elder de Roover, p.259
[28] *Ibid.*, Elder de Roover, p.262

were made in a number of ways: by barter for other goods such as raw materials, by lines of credit, by bills of exchange,[29] and with currency from other city states and countries.[30] Similarly, each of the merchants contracted agents and dealers for export sales. If the market were brisk enough to afford a good return the merchants would partner with the dealers and open retail outlets in some of the locations.

Through prior banking connections made while in Rome, Tommaso Spinelli developed a clientele among the cardinals (a market similar to that the Medici developed) who would pay handsomely for their church vestments.[31] Tommaso held favour with the papal courts where his silks sold to the inner circle of the papacy, including to Francesco Muzarilli, the pope's auditor, to notary of the auditor, Gerardo da Pescia, to the "scrittore"[32] of the penitentiary, Nicclo degii Albizzi, and to the high-ranking officials of the camera.[33] Andrea Banchi, who not having the same contacts as Spinelli and the Medici, had difficulty in finding agents who could obtain the profits needed to sustain his sales.[34] Cutting his losses, Banchi concentrated on the fairs of the Abruzzi where he sold silk cloth, belts, church vestments and ribbons.[35] Banchi's shops held every kind and colour of velvet from rich polychromes to monochromes, in two and three pile heights, to crimson velvets brocaded and looped with gold threads.[36] Ultimately, it was the royal

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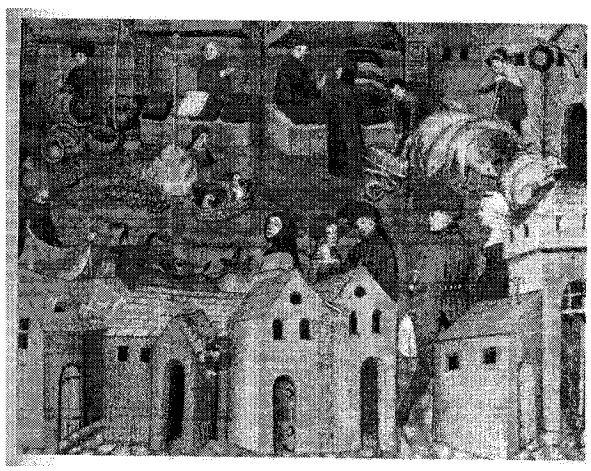
[29] Which could run over a number of years and sometimes fall victim to bills of exchange and drafts being dishonoured when drawn upon.
[30] *Ibid.*, Elder de Roover, p.275
[31] In 1435 Spinelli was a papal banker to Pope Eugenius IV.
[32] The writer or notary.
[33] *Ibid.*, Caferro, pp.434-435
[34] *Ibid.*, Elder de Roover, p.263
[35] *Ibid.*, Elder de Roover, p.259
[36] *Ibid.*, Elder de Roover, p.266

courts where Andrea Banchi found success and for a decade he sold his velvets to cloth retailers and royal courts in Mantua.[37]

As with most silk merchants of Italy, Banchi and Spinelli depended upon the trade fairs and barter to increase their business income. It was in Geneva that silk merchants from all of Italy vied for sales of their silks to merchants, preachers, monks and travellers from nations far and wide. The Geneva fairs were held four times a year and were among the best attended in Europe.[38] Here, both merchants sold their silks and woollens alongside competing Florentine merchants such as the Medici, receiving in exchange coinage and goods from France, Holland, Germany, England and Spain (Figure 3). These fairs coincided with the church holy days and, as Florence Edler de Roover described:

> Each year silks were sent around October 10 for the fair of All Saints; the next shipment was usually in December, before the snow completely blocked the Alpine passes, for the Epiphany fair in January. The third largest shipment was for the fair of Easter or of Quasimodo, and left Florence early in the spring but after the passes were clear. There were usually one or two shipments in mid-summer, scheduled to arrive for the fair of Saint Peter in Chains (August 1).[39]



3. European market scene c.1400 depicting textiles, baskets and farm livestock on sale.[40]

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[37] *Ibid.*, Elder de Roover, p.263
[38] *Ibid.*, Elder de Roover, p.266
[39] *Ibid.*, Elder de Roover, p.267
[40] Peter Spufford, *Power and Profit* (New York: Thames & Hudson, 2002) p.97

The Geneva fairs involved a different trading practice for each of the silk merchants. These were the times when fine silks and velvets woven with gold and silver would compete against other textiles and spices, from the silks of Asia in the east, to the fine woollens of England in the west, north from Flanders came fine linens, while from the south came the spices of Egypt, all vying for the buyer's attention. For Banchi this trade meant using credit over cash or bills of exchange, which entailed dealing with the Medici bank. He was not as fortunate as Spinelli who, as a banker like the Medici, could afford to bankroll his own operations.

Despite the favourable location of the Geneva fair, being situated on the crossroad of the north-south route between Flanders and Italy and the east-west Germany and Spain, the fairs faced competition from the French in nearby Lyon and, by 1456, most of the Florentine merchants had abandoned the Geneva fairs completely. There were a number of factors that caused this move by the merchants: first the Geneva fairs held unfavourable monetary relations with Italy and Florence in particular;[41] second, King Louis XI of France and his aggressive encouragement of local industry promoted the Lyon fairs.[42] When dealing in Geneva Tommaso drew upon his bank in Rome.[43] But, Spinelli, seeing the Geneva fairs were losing favour and attracting fewer merchants, moved into markets in Lubech. Tommaso held an advantage in that he used the Spinelli bank in Venice. Andrea Banchi, as a merchant, relied on the bank of the Medici, and when they moved from Geneva to Lyon his banking arrangements were moved also.

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[41] *Ibid.*, Elder de Roover, p.267
[42] *Ibid.*, Elder de Roover, p.437
[43] *Ibid.*, Caferro, p.438

In spite of these commercial challenges and upheavals, by the time they died, both of these merchants had amassed considerable wealth. However, having only daughters as successors neither could pass along their business fortune to sons. On the other hand, the teachings of the church told them that upon their death they would be guaranteed a seat beside God in heaven, and only believing in, and being benefactors to the church could accomplish this.

The Roman church understood the fears of death and the unknown which plagued the people in fifteenth-century Italy. In the case of Tommaso Spinelli, Caferro describes how,

> He gave directly from his profits to the church of Santa Croce, particularly to the building of a new cloister. According to his accounts of March 1461, Tommaso spent the formidable sum of 486 florins on the cloister at Santa Croce. He also gave to other pious institutions, such as the monastery of San Benedetto, the monastery and convent of San Miniato and the monastery of Santa Maria degli Angeli.[44]

Similarly, de Roover described how Andrea Banchi, "Spent considerable sums on the oratorio in the church of Santa Maria at Montaguto and on the chapel in San Niccolo in Florence where he is buried."[45]

Along with this church legacy, by the time of their deaths, both merchants had created a comfortable life in which they enjoyed the fruits of their labour. Through the wealth generated by his banking accomplishments and his silk enterprises, Tommaso Spinelli had acquired farms in both Rignalla and Compiobbe, palazzos in Rome and on the Grand Canal in Venice, and two large homes in Florence.[46] Andrea Banchi, while trebling his

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[44] *Ibid.*, Caferro, p.433
[45] *Ibid.*, Elder de Roover, p.277
[46] *Ibid.*, Caferro, p 422.

fortune over thirty years maintained a townhouse and a palace in the country. It was abundantly evident that as merchants both Spinelli and Banchi excelled in their businesses and traded throughout Europe and the Ottoman Empire, that the Florentine silk trade was flourishing by the second half of the fifteenth century and that both of these merchants amassed small fortunes before their deaths, leaving a legacy of silk textile creations for future generations to enjoy.

Families, Connections: A Who's Who in the City-States

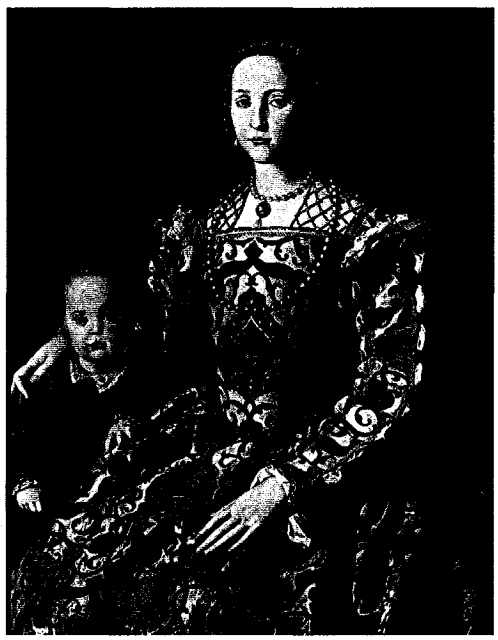
With the introduction of silk manufacturing into Italy, Lucca became the founding city-state for this trade; before long, however, other cities reaped the benefits by developing their own silk industries. The Arnolfini family, for instance, was an incredibly important merchant trading family from Lucca. The most successful and most powerful member of that family was Giovanni Arnolfini (Figure 4), who moved to Bruges in his youth, and then lived the remainder of his life there becoming spectacularly wealthy. He traded in costly fabrics, tapestries, and precious objects offering them for sale throughout the city, including luxury items of silk that were prized by the church and nobility.

4. Portrait of Giovanni Arnolfini c.1435.

Another vitally important Italian merchant family was the Medici of Florence who through their associations with the Vatican as bankers developed a mass of sub-industries of which the silk industry was one. Although the Florentine weavers are credited with perfecting the manufacturing process of silk velvet, as well as the technology used in the production of silk velvet, it was the Venetian "Corte da Paragon"[47] who established the extremely high standards in the manufacturing process including the ruling that 'simple and ornate velvets must have no fewer than three hundred threads per ligature and no fewer than eighteen ligatures (at least 5400 threads) must have a gold selvage to read the types of dyes.'[48] While it was the Florentine weavers who were especially famed for their fine velvets, as well as orphreys and braids used in the borders of vestments and alter hangings,[49] it is this history of the manufacture of silk velvet and the technological development that will be examined below. Florence's silk industry in the fifteenth

[47] The 'Corte' was an office that presented and sold only textiles of quality.
[48] *Ibid.*, de' Marinis p.15
[49] Frank Lewis, *Florentine Fabrics* (Brighton: Dolphin Press 1959) p.10

century was one that developed and flourished alongside the other textile trades in the city. But due to its luxury status and the higher mark-up value the silk merchants could charge, it was considered very beneficial to Florence's economy.[50] The profit margin from silk trading assisted in the building of merchant dynasties in all the Italian city-states, and Florence was no exception. Family banks such as the Medici, Strozzi, and Spinelli became silk merchants trading in lands beyond the realm of Florence. Florence's silk velvet manufacture of the fifteenth century afforded its silk merchants the luxury of maintaining a status system like no other, as Peter Burke described (Figure 5). In Florentine processions, knights walked first, followed by lawyers, then merchants and notaries; and the processions of the time, given the stress on precedence, may be regarded as materialisations of the social hierarchy.[51]

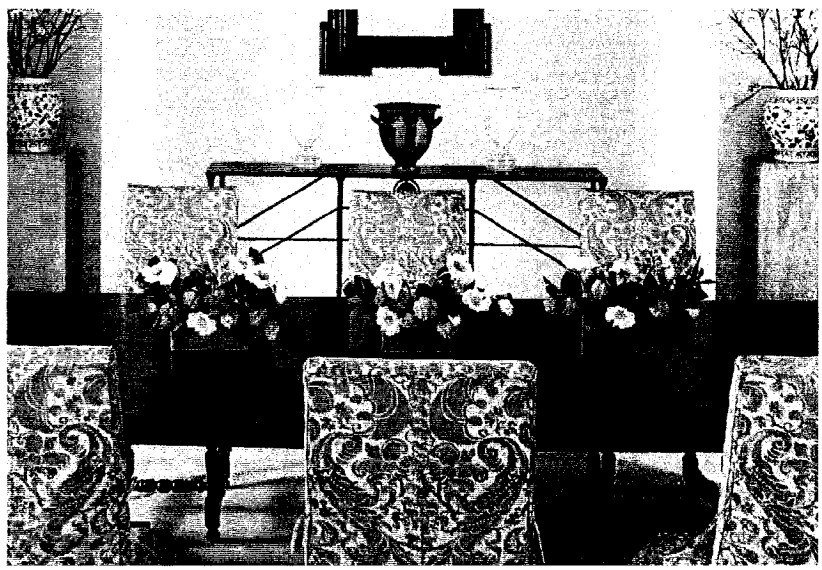


5. Eleonora of Toledo with her son Giovanni de' Medici
The painting depicts the luxurious textile design style of the period.

[50] *Ibid.*, Raymond de Roover, p.305
[51] *Ibid.*, Burke, p.245

The silk merchants and the workers of the silk industry of Florence have played a major part in the development of European culture. From the artists of the Florentine silk industry, masterpieces were created in textile art which royalty and papal courts treasured. Italy remained uncontested as the leading silk manufacturing country in Europe during the sixteenth century and it was the silk merchants of Florence and the silk workers who created a legacy of splendour in textiles that has been enjoyed and cherished over the centuries. [52]

To this day Florentine merchants trade in the same silk and velvet textiles. Now the antique merchants cater to the collectors and educators by selling fragments of the original woven cloth to manufacturers at trade shows, for designers who reinterpret them into new usable designs for today's marketplace (Figure 6), and to educational institutions as teaching tools for examination and study. It is from these same merchant families that the textiles for this research have come.



6. Example of a Renaissance design reinterpreted in contemporary furnishings.[53]

[52] *Ibid.*, Von Falk, p.42
[53] Veranda Magazine May-June 2003 (Atlanta: Veranda Publications, Inc)

A Rebirth from a Previous Era.

The Cranbrook Textile Collection, as the NBM's textile group has come to be known, was assembled in Italy and acquired in 1927 from Guiseppe Salvador of Florence who described how the fabrics were "bought throughout Italy and abroad since 1895".[54] Later, in 1927, Salvador divided the fragments and sold them to George G. Booth, founder of the Cranbrook Academy of Art in Bloomfield Hills, Michigan, along with four terracotta bas-reliefs 'Scenes of Christ's passion by Gianbologna', a late XVI century Lucca walnut chest and a reproduction ivory crosier.[55] The collection was intended for museum and educational use within the textile studies department of the Cranbrook Academy.[56] The divided set of "sister" textiles made its fame as part of the Textile Museum Collection in Prato, Italy and by travelling through Europe on exhibition and being documented by Rosalia Bonito Fanelli.[57]

In April of 1945, an evaluation of Booth's collection was carried out by an Adele Weibel the textile curator at the Institute of Arts in Detroit, Michigan. While doing so Weibel noted that the collection "contained many fine specimens that will always be of great value to the Cranbrook Museum." [58] One month later Booth sent an envoy to Detroit and offered some from the original collection of the 500 pieces which included Peruvian and Coptic samples. A selection of fourteen velvet textile fragments containing Spanish and Italian samples from the collection were donated to the Detroit Institute Salvage of Arts in 1942. Why Mr Booth sent these items is not clear, possibly in payment for services

[54] Appendix 1. Copy of ledger
[55] Appendix 2. Original Shipping documents May 16th, 1927
[56] Appendix 3. Plan for Use: Cranbrook document
[57] Rosalia Bonito Fanelli, *Five Centuries of Italian Textiles: 1300-1800* (Prato: 1981)
[58] Appendix 4. Letter to Booth, p.1

rendered.[59] Prior to this, a draft letter was drawn up offering the complete collection to University of Michigan. It is not clear why Booth was considering this action.[60] A possibility could have been to form an educational link for the Cranbrook Academy of Art.

In June of 1945, Harriet Dyer Adams, curator of the Cranbrook Academy, offered the collection to Peter Ruthven, Assistant Curator of Michigan University who, on August of 1945, declined the offer on behalf of the University of Michigan.[61] Peter Ruthven was then recruited as an envoy for the Cranbrook Academy and was sent on a mission to locate a new home for the textile fragments. In September 1945 in correspondence in the form of a handwritten letter from the Hotel Van Rensselaer in New York he suggested to Harriet Adams that possibly the Cooper Union for the Advancement of Science and Art in New York (now the Cooper-Hewitt) might be interested in the textile fragments.[62] Two weeks later on, September 25th, he again wrote to Harriet Adams confirming the "Cooper Union people" were interested and that she should arrange and express shipment to him at the Metropolitan Museum of Art.[63]

On October 19, 1945, the textiles arrived in New York at the Metropolitan Museum of Art where, apparently, they caught the eye of someone. A request was made for the Metropolitan Museum of Art to keep pieces for their own collection and in February,

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[59] Appendix 6 payment for examination
[60] Appendix 5 request of interest to U of M
[61] Appendix 7 decline in interest by U of M
[62] Appendix 8 hand written note concerning possible Cooper Union interest
[63] Appendix 9 Cooper Union interest confirmation

1946 a letter was sent to the Cranbrook Academy thanking them for the donation.[64] Retaining 122 fragments, the Cranbrook Academy of Art sent the bulk of the remaining textiles along with others to be shared between the Metropolitan Museum and the Cooper Union. The balance was forwarded to the Art Department of the New Brunswick Museum in September 1947.[65] The decision to send the fragments to New Brunswick appears to have been made following a request made by Mrs. Clarence Webster, then president and wife of John Clarence Webster (1863 - 1950), one of the founders of the Saint John Museum, and Mr. Avery Shaw, the curator of the museum. Staff of the museum related how Mrs. Webster, a cousin to Charles Lewis Tiffany of Tiffany and Company of New York, requested the fragments in order to further craft development and study of textiles by craftspeople in New Brunswick. This request was granted and Cooper Union retained twenty-eight of the fragments.

In 1951, at the request of Miss Eva Ingersoll Gatling, a curator for the Cranbrook Academy of Art attempted to build a catalogue of the collection and trace what had happened to the fragments. From that time until the present, the textiles lay dormant in the NBM's archives, as shown by correspondence between the NBM's curator Avery Shaw and Miss Gatling. From information obtained personally from the Cranbrook Academy in 2001, it appears that in 1951, Miss Gatling was conducting a search of the Academy's archives when she discovered the textile fragments were missing and she contacted Harriet Adams for the information, then the Cooper Union, and in turn the

[64] Appendix 10 letter of thanks from Metropolitan Museum of Art
[65] Appendix 11 details of NBM gift

NBM.[66] Correspondence between the Cranbrook Academy, Cooper Union, the NBM and the University of Chicago shows that there appeared to be an effort at tracking down what now had become, through lack of accurate record keeping, missing parts of the collection.[67] While archivists within the Cranbrook Academy believe that the original textiles fragment count stood at 500 pieces (according to the original shipping manifest) they were still unsure where the remaining parts of the collection were located.

Unbeknownst to the archivists within the Cranbrook Academy, a gift of 96 pieces had been donated to the Boston Museum of Fine Arts. This was carried out on two occasions: the first in 1942, and the second five years later in 1947, from the items held by the Cooper Union. While visiting Boston on a research trip, I discovered the missing textile fragments, with the records in the Boston Museum of Fine Arts' archives erroneously recording the second donation of textiles as being made by a Mr. Booth of New York. I believe the first group of fragments was sent along with a group of six English Ivory bobbins, and that a second donation came from the group of fragments that had been sent to New York in 1945. In my research I also discovered that the Cranbrook Museum's staff never realized that such a large percentage of the original collection found its way to the NBM, and nor had they estimated the collection's value. For over four hundred years this group of silk textiles travelled the market places of Europe where they were manufactured into garments and articles of adornment for the commoner, gentry and church, with fragments ultimately being used as educational and research tools in Europe and North America.

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[66] Appendix 12 Harriet Adams request to the NBM
[67] Appendix 13 letter requesting information about missing parts of the collection.

Section 2 Technical

Introduction

During the Italian Renaissance, workers in the silk industry, like other tradespeople in Europe, were tied to guilds, which were comprised of three classes of workers: the masters, the journeymen, and the apprentices.[68] Not only the silk workers but also the merchants were entrenched in the guild system. The principle of the weavers' guild was to ensure that the members were creating the best work they could, thereby ensuring quality, which would be associated with the guild. The influence of the guilds played a role similar to a governing body in the silk trade, which offered the membership a protection and security in a similar way to today's trade associations but with a tighter control over quality and production. The guild would encourage (or restrict) young people's entry into their industry and, in turn, the industry would benefit and grow from this arrangement.[69] While the structure of the guild system allowed for the workers to possess their own raw material and their own machinery, such as spinning wheel and loom, in the domestic system the workers had the equipment but were supplied raw material. Later, in the factory system, the worker was provided both equipment and material.[70]

The first merchant guild was established in Florence before 1182, and it was the *setaioli* or silk manufacturers who owned the raw material. Although artisans performed most of the work at home or on the premises of merchants, the small independent weaving

[68] *Ibid.*, Von Falk, p.27
[69] This act led to the first apprentice system being established.
[70] *Ibid.*, Lipson, p.5

masters assisted by journeymen and apprentices changed the silk trade in the early Renaissance. The records show the weavers as being guild members while, in fact, they were working in a system similar to the domestic system. By 1472 there were no fewer than 84 workshops in Florence and the records show 16,000 operatives were employed in the making of silk.[71] The focus of this section is on the development of the silk velvet industry and the design process in the manufacturing of textiles, and describes the considerations that a tradesperson in textile manufacturing would have to address in the process of creating textile designs.

Velvet (Italian: Velluto)

Characteristics: Piled fabric[72]

Velvet in Renaissance times could be either one, or a combination of, the following:

a. Cut velvet (tufted pile),
b. Uncut velvet (looped pile),
c. Cisele velvet (pile comprised of both tufted pile and loop pile),
d. Pile-on-pile velvet (velvet comprised of varying heights of pile),
e. Polychrome velvet (multiple piles in two or more colours),
f. Voided velvet (no-pile background, pattern in cut, uncut or combination piles),
g. Brocaded velvet (with introduced gold and silver wefts).
h. Gauffering or stamping (another method of decorating).

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[71] Cyril G. E. Bunt, *Florentine Fabrics* (Leigh-On-Sea: F Lewis Publishers 1959) p.10
[72] Loop pile (uncut) or tufted pile (cut)

The Creation of Silk Velvet Fabric.

Italian merchants employed a number of people at various stages of the silk velvet production process. Considering the various processes that silk went through from the raw material stage to the finished product, silk merchants employed a considerable number of workers. Florence Edler de Roover notes:

> there were forty-seven silk merchants operating in Florence in 1472. One such, Andrea Banchi, had on his payroll accountants and agents who sold and bought raw silk and dyes in Turkey and Spain. He also employed sorters, runners, winders, throwers, soap manufactures, dyers, warpers and weavers.' [73]

Matthew Gream writes that:

> A survey taken at the end of the 1470s – which unfortunately doesn't include painters or masters of figural sculpture – indicates that there were 270 *arte della lana* workshops; 83 silk weaving firms; 84 ateliers for wood carving and *intarsia*; 54 workshops for marble and stone decoration; and 44 master gold and silversmiths. This can be compared to 70 slaughterers and butchers; and 66 spice merchants, to illustrate the breadth and depth of the artistic profession at the time.[74]

William Caferro describes how Tommaso Spinelli employed an equivalent number of workers and contractors as Andrea Banchi, which would have numbered approximately one hundred.[75] This did not include the journeymen employed by the weaver. Accounting for journeymen and apprentices, a merchant business of Spinelli or Banchi's size could have employed as many as one hundred and fifty. Although these operations were large, an average of seventy-five workers and contractors would not be an overestimation for the typical company, giving an estimated 3,375 specialised silk or silk-related workers in Florence at this time. These figures stand in contrast to Bunt's findings in "Florentine

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[73] *Ibid.*, Elder de Roover, p.226
[74] Matthew Gream, *The Production of Art During the Florentine Renaissance.* http://matthewgream.net/Professional/HistoryOfArt/workshops_1.pdf accessed 10/11/2003
[75] *Ibid.*, Caferro, p.431

Fabrics," although he may have included wool-manufacturing workers.[76] Nevertheless the production of silks in all forms of manufacture were considerable and played an integral role in the Florentine economy and also in Italy's merchant and textile development in Europe during this period. The "Mariegole" or velvet weavers of Venice and the weavers of Florence and Genoa are believed to have been the first to industrialize the manufacture of velvet. This was accomplished by the influx of skilled silk weavers fleeing Lucca and the siege of the city in 1342 during the wars of Castruccio Castracani.[77]

Since the beginning of textile manufacture, decoration has played a major role and it is evident from the records that this process was linked in ways to appeal to the observer; but during the Renaissance a rapid change in the design process occurred. Manufacture of silk is believed to have begun in China spreading westward through Asia and into Italy via the Middle East. And, while the manufacture required a number of steps, the process changed little over the centuries. First the silkworm cocoons, having been sorted for colour and texture, were steamed or placed in warm water to soften the natural gum. There were several processes for removing the silk gum called "degumming", "stripping", "boiling off", or "schapping."[78] After degumming the cocoons were unwound; each cocoon may have given from 2,000 to 3,000 ft (610 – 915 m) of fibre. From this fibre four to eighteen monofilament strands were then reeled or twisted together making a thread strong enough to handle. Next came the winders. Women were used extensively in this phase, which in itself was a specialised process as each type of

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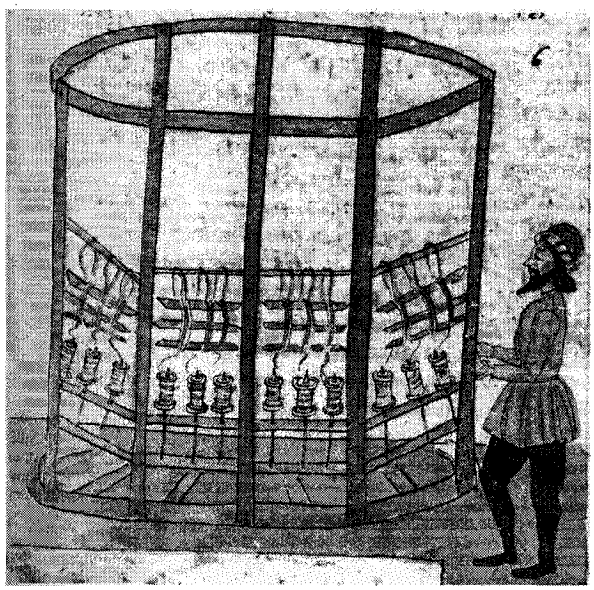
[76] Cyril George Edward Bunt was the author of a number of books on Italian textile design which were published by F. Lewis, Leigh-on-Sea, England.
[77] *Ibid.,* Louis Green, p.53 and Christine Meek, p.27
[78] Cheryl Kolander, *A Silk Worker's Notebook* (Colorado: Interweave press, Inc. 1979) p.16

silk was sent to a specific worker to create a specific type of silk yarn.[79] The winder wound spools that fitted the throwing machines.[80] It is believed that the first throwing machine was developed in Italy in 1272 (Figure 7).



7. Silk throwing machine believed to have been invented in Bologna 1272.[81]

After throwing, silk could have three forms: singles, which were untwisted, and were used for the warp of very delicate fabrics; tram, two or more singles, twisted and doubled, used for the weft of various fabrics; and organzine, made of singles twisted one way, and then doubled and twisted in the opposite direction, used for the warp of heavy fabrics.

The thrown silk was collected once again by the runners and delivered to the dyers. It was common practice for the merchants to supply the soap needed for the first stages of the dyeing process,[82] along with the dyes to the dyers, who would then dye the silk yarn in a number of colours, red, crimson, blue, purple, yellow, black and green according to

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[79] *Ibid.,* Caferro, p.426
[80] A runner from the shop would retrieve the wound silk spools and deliver them to the throwers.
[81] *Ibid.,* Spufford, p.249
[82] The silk first had to be boiled to remove natural gum.

the merchant's specifications. During the thirteenth century crimson-dyed sandal used in linings for dresses and banners made the silk industry of Florence famous, while green was never used in Venice for men's clothing, presumably because of its associations with Islam.[83] Once dyed the silk was wound and sent to the warpers, then on to the weavers. Unlike other weavers, silk weavers were beholden to one manufacturer at a time. However they were free to switch employers provided they were not indebted to the merchant.[84] It was common practice for a weaver to specialise in one type of weaving such as velvet, and also in a specialised style of weaving such as *briccio.*[85] Although it took longer to weave a *briccio* of brocaded velvet, the weaver earned much more than one who wove plain taffeta. Furthermore, it was not uncommon to specialise in one colour.[86] Francesco di Martino worked black damask, while his colleague Jacopo di Piero worked patterned velvet in vermilion.[87]

The majority of silk fabrics were woven in strips in small repeating motifs, displaying biblical designs, birds or other animals on a plain or geometrical background which were cut up and used for ecclesiastical vestments. The exception to this practice was the work produced by Florentine weaver Francesco Malochi who created single, unique pieces to order. Each vestment was commissioned especially for the Cathedral in Florence, made of gold brocade with a velvet pattern and was un-seamed. Therefore, it had to be of a matched design.[88] Another favourite technique of this period was figured silk resembling

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[83] Stella Mary Newton, *Dress of the Venetians* (Avon: Scholar Press, 1988) p.107
[84] *Ibid.,* Elder de Roover, p.246
[85] One briccio was equivalent to an arm length or 23 inches.
[86] *Ibid.,* de Roover pp.306-307
[87] *Ibid.,* Caferro, p.427
[88] Otto Von Falk, *Decorative Silks* (New York: William Helburn Inc. 1922) p.41

damask usually monochrome, or monochrome with metal thread. If needed, a designer would be contracted to create a cartoon.[89] In the case of Banchi the records show that the merchant hired Giovanni d'Antonio and his son Balassarre di Giovanni for this work.[90] Additionally some companies would take the putting out a step further and contract tailors to create church vestments for resale. Vestments of this type fetched a higher price and commissioned work was common practice with priests and the cardinals.

The Design, the Process and What it Entailed.

As previously explained, the medieval textile industry was organized according to the 'putting-out' or 'wholesale handicraft' system. The merchant purchased the raw materials, and the various stages of manufacturing were put out to self-employed artisans. The shop (*botteghe*) sold silk and, in some instances, finished silk textiles also, but its main function was as a storage room for raw materials, semi-finished products (between the stages of manufacturing) and finished goods. The processing of silk at the time often included importing the raw silk: although silk manufacturers in Italy produced finished goods, insufficient quantities of raw silk were being produced locally. Therefore importing was a common practice of the Florentine and Lucca merchants in the fifteenth-century with the larger volumes of raw silk coming mainly from Spain and Astreabad in the Caspian Sea.[91]

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[89] Cartoon was a name given to a technical drawing of a motif, (a floral for instance) which would be then transferred to graph paper to create a repeated pattern.
[90] *Ibid.*, Elder de Roover, p.256
[91] *Ibid.*, Elder de Roover, p.237

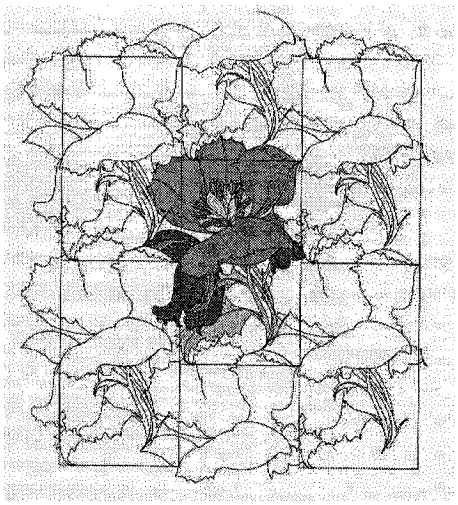
An historical path of the Italian silk trade could be compiled from the designs that were woven during the Renaissance period in the workshops of Lucca, Florence, Bologna, Genoa, Milan and Venice. Likewise the NBM collection of woven silk textile fragments provides another historical path and uncovers the developments of the design process itself. In order to use these fragments, one consideration has to be accounted for: that of colour. One of the most important appeals of textile is colour, but unlike today, where the technical process of formulating new dye combinations and colours lead to an almost limitless colour range, Renaissance Italian dyes and colours were limited and often costly. As seen in the previous section, trade in dye commodities was as valuable as any and it was conducted alongside the sale of finished silk fabrics, as skillful dyeing provided great challenges to the artisans. During the Renaissance, red, green white and blue were used singularly or combined in the creation of patterned velvets. In the second half of the fifteenth century, by weaving the loop pile of the velvet, reds in various hues were applied on a base ground of yellow creating the colour combinations which assisted in the illusion of depth. By the sixteenth century, gold and silver were used along with other metals to accent the colours, while, by the seventeenth century, colours; such as pink, lime green, turquoise, blue and sombre dark greens, blues and dark reds were used. During the sixteenth century, a quality standard was developed by which the manufacture of velvet required gold to be woven into the selvage, in order to read the type of dyes used.[92]

[92] *Ibid.*, De' Marinis, p.15

The Design Process

The creation of a new fabric design involved the process by which a design was conceived, refined and then created, a process that has varied only slightly over history. First the artist or cartoonist, as they are still known to this day, created the patterns and in fourteenth century Florence it was famous painters such as Vittore Pisano and others who did this work. The second step, known as the pattern layout, composed the pattern in two ways, either as a continuous pattern, with elements of their compositions arranged to be repeated endlessly, in various directions; or as pictorials composed as one single unit such as the design used in tapestry.

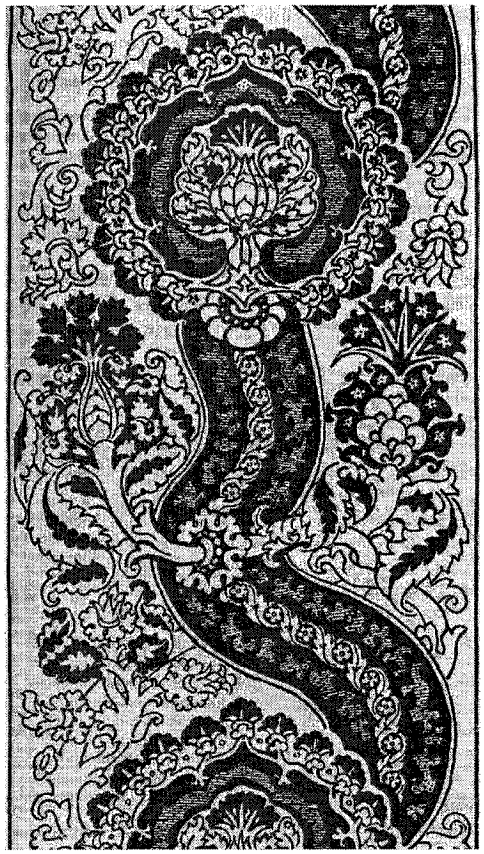
Theoretically, a continuous pattern extends endlessly in all directions. The success of the repeat is judged by assessing the use of formal elements of composition with an understanding that the pattern is continuous. The motif should not hold the eye in one place too long, thereby preventing it from scanning the entire pattern; repeat units of the best patterns are difficult to notice. This is where the skill and success of the designer comes into play. In order to analyse the layout of the repeats of a continuous pattern, one must first determine the unit of the repeat as in the sample below (Figure 8).



8. One unit of the repeat pattern shaded. [93]

Repeat units are designed with no boundaries so that elements of the composition interact when adjoined edge to edge, while some technical repeat units can be subdivided into smaller areas contained in a larger motif, each of which has within its boundaries all the elements of the pattern. To avoid a straight up and down appearance designers added a feature in the form of a motif and then offset the vertical line to break the symmetry, as shown (Figure 9).

[93] Peter Philips, Gillian Bunce, *Repeat Patterns a Manual for Designers, Artists and Architects* (Thames & Hudson, London 1993) p.13



9. Layout for sixteenth century velvet

The next step involves the draftsman who lays out the cartoon by setting the chart. [94] It is the draughtsman who produces the weaving drafts and drawings, which will be used as a basis for any fabric, and the weaver who will choose among his proposals the drawing that is appropriate for him. The design is then taken back to the drawing board and redrawn on a graph paper, a process known as setting of the design in chart. The vertical lines represent the warp, the horizontal lines, and the weft threads. The chart with a floral motif shown represents only one quarter of the design (Figure 10), which in this case is symmetrical and provides a good example of a cartoon.

[94] The setter in chart reproduces the design on a graph paper, called chart. The vertical lines represent the waft, the horizontal lines the weft threads.

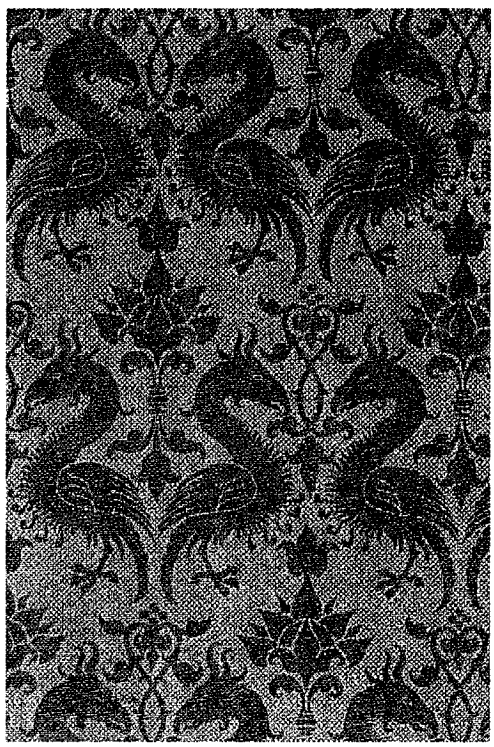
10. A set design this example is one quarter of a four way pattern.

The Designs

In the thirteenth century, textile design depicted themes of animals and nature (Figure 11). The fourteenth century had seen the creation and use of particular motifs with influences from the oriental and Gothic styles. There was an evolution of fifteenth century decorative motifs together with an adaptation of architectural motifs. The fifteenth century witnessed the emergence of the pomegranate design as a prominent feature distinguished by the central flower alone.[95] With this came a succession of vegetative motifs such as thistles, lotus flowers, and pinecones in a vertical and wavy composition.[96] Then by the first half of the sixteenth century design trends shifted, symmetrical and mirrored shapes in the form of large double pointed ovals, trails of ivy, knotty tree trunks, and leaves enclosing pinecones and floral compositions were in vogue. Further characteristic elements of this period were the frames and the heraldic motifs

[95] *Ibid.,* Dupont-Auberville, p.19
[96] Pomegranates, it is believed, were used as a symbol of fertility because of their many seeds.

which were nearly always in gold. In conjunction with the evolution of fabric manipulation techniques, and the naturalism of the thirteenth century, an alternative approach developed characterised by the movement to multi-coloured designs. These creations took an elaborate turn with the introduction of pile on pile velvet with gold or silver brocade. From the first quarter of the fifteenth century to mid - sixteenth century, animals were being interspersed with the floral motifs, and vegetable motifs were placed in a horizontal straight line.

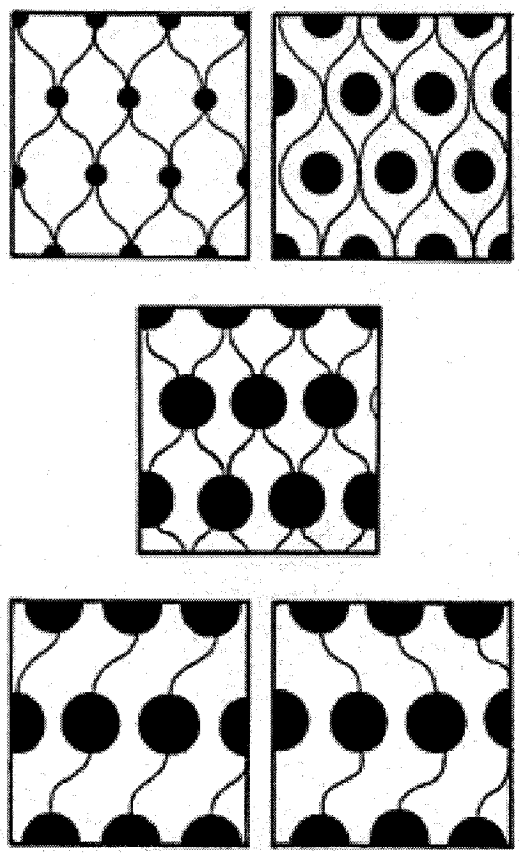


11. Florentine, 14th or 15th century.[97]

Towards the end of the fifteenth century in Florence, floral designs were in mode and shifts in preferences occurred. In this new development, animals were eliminated from textile design with the concentration changing to floral motifs. This change also witnessed the populating of the pomegranate design along with the thistle, and the

[97] Friedrich Fischbach, *Historic Textile Patterns* (New York: Dover Publications, Inc. 1992) p.26

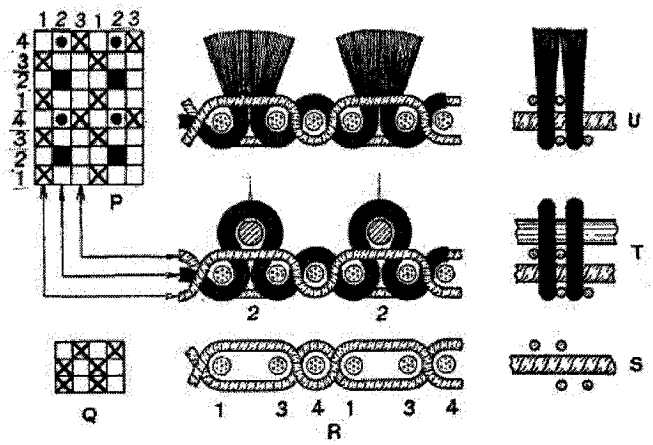
pinecone. This can be seen in a number of the samples from the NBM collection in which three basic layouts were followed (Figure 12).



12. All brick ½ drop vertical repeats.[98]

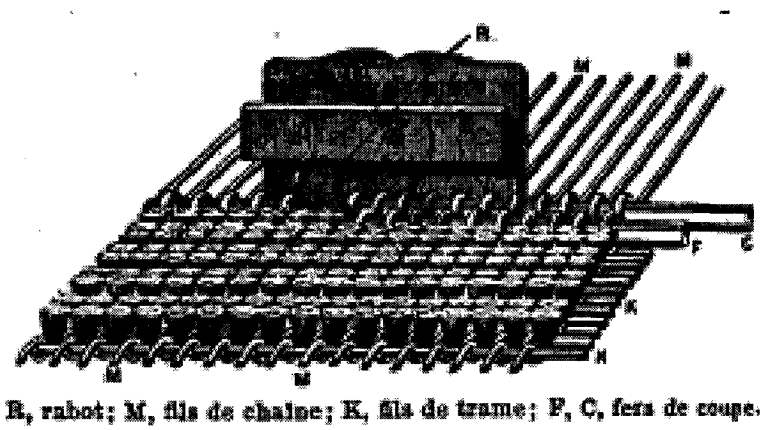
The simple, uniform pattern layouts allowed for ease of interpretation for the master weaver who converted the pattern to a technical chart for weaving. Because of the added texture of velvet, the patterns required were simple in structure. Velvet, prized by royalty and the church, was made of silk threads woven as a looped pile, which was cut to give a fuzzy texture. The effect was obtained by adding two warp threads at different tensions one under a high tension, the other a low tension. The warp pile was raised from the fabric by rods during the weaving process (Figure 13).

[98] The 'half-drop' and 'brick' patterns, have many uses, and are the standard repeats in textile design.



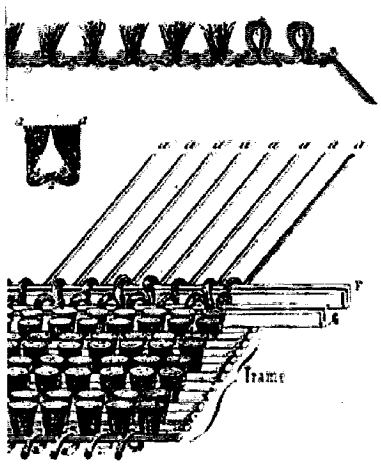
13. Line 2 shows the placement of the rods in the weaving process.

For a cut pile, a rod was inserted like a weft. The rods had a small channel facing upwards in which the weaver inserted a small blade that cut the thread. Should a loop pile be desired, a round rod was inserted and then subsequently extracted leaving a surface loop known as un-cut.



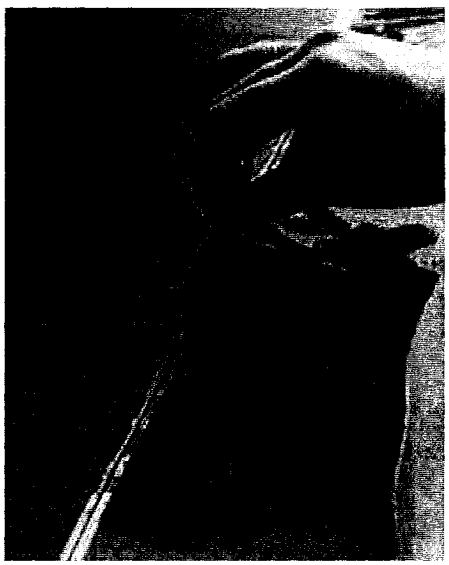
R, rabot; M, fils de chaîne; K, fils de trame; F, C, fers de coupe.

14. Cutting the loop pile.



15. Diagram showing the cut pile and rod set-up

In the case of velvets, supplementary threads were manipulated so as to form loops; they were passed over thin rods, which were inserted during the weaving process. The rods carried a channel into which a special knife was fitted (Figures 14, 15 and 16). By either cutting the loops with the sharp knife or by removing the rod and leaving the loops intact, cut pile or uncut pile was formed.



16. Velvet maker cutting the iron of half-compartment[99]

[99] Velours ciselé de Soie http://www.lanavette.com accessed 01/04/2004

Woven repeats were controlled on the loom by first threading warps in the appropriate harness, and by opening sheds or cords in the appropriate harness. Frequently, these techniques were used together. Two or more heights of pile could also be produced by means of variously sized rods; the product was called pile-on-pile velvets. Velvet designs included voided areas where there was no pile. The width of a repeat unit was limited to the number of warps available while the length of a repeat unit had no restrictions.

Even though continuous patterns were designed for endless coverage in all directions, they were produced in fabric as lengths. These lengths could then be joined along the vertical edges to extend pattern coverage. Selvage's [100] played an important factor in the overall planning of a design as they were used in the reconstruction of a continuous pattern. As described earlier, patterns of birds and animals were intertwined in the design along with floral elements and to achieve a larger overall appearance weavers doubled the width of the design with the use of a technique known as a 'turnover', described by Lewis Day:

> To the weaver the 'turnover' is a veritable god-send, enabling him, without increase of cost or trouble, to double the width of his pattern. It does not even involve the cutting of more ends; it is simply a question of the gear of the loom.[101]

Velvet produced by this technique became highly valued, and the royal and papal courts of Europe prized it for its allure and depth of colour. It was the "Corte da Paragon" that established that both simple and ornate velvets could have no fewer than 5400 threads per inch. The "Court" de'Marinis we are told "was an office that displayed and sold only

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[100] Selvage or Salvedge is the edge on either side of a woven fabric to prevent it from ravelling.
[101] Lewis F. Day, *Pattern Design* (New York: Dover Publishing 1999) p.92

textiles, after establishing the highest quality of the raw materials employed and of the manufacturing process."[102] This standard measure ensured the quality of the velvet.

To further enhance the pile-on-pile velvet, cartoonists and weavers developed a technique of introducing metallic threads in brocading. If the gold content was substantial, brocaded velvets were sometimes referred to as cloth of gold. Velvet designs included voided areas where there was no pile to create depth, while other designs were created by making small cuts or slashes and impressions. These were made with a heated metal tool exposing the fabric below. There were additional ways to decorate velvets. Often, supplementary patterning or brocading wefts were added to velvet structures and to further enhance the pile on pile velvets, weavers introduced metallic threads. These threads were composed of gold or silver adhered to parchment or leather and wound around a linen or silk fibre core. In the first instances gold or silver was hammered into thin strips and then wound on top of a linen or silk thread. During the fifteenth and the sixteenth century in Italy brocading on velvet was done only with metallic threads. The content could be either pure metal, or gilt. The earliest metallic threads used in textiles were not threads at all but thin strips of metal that had been cut from sheets of beaten or rolled gold or silver.[103] There were also spun threads, made by winding the flat strips around a core fibre of silk or linen, which resulted in a much more flexible fabric (Figure 17).

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[102] *Ibid.,* De' Marinis, pp.12-15

[103] These "threads" were then woven into a textile most commonly as a supplemental brocade weft.

17. Detail of rolled silver used as thread.

It was with these elaborate yet soft to the touch fabrics that Renaissance Italy and its merchants brought silk fabric to the height of glory and splendour, with the drive for new markets, an eye for detail, artistic encouragement and enlightenment. The 'touch' or 'hand'[104] produced in velvets, and the shimmering palette of light upon the gold and silver threads, afforded the merchants and the cities their fame.

A Journey from the Old World to the New World

Previously I discussed the importance of colour in textile design, the limitations in colour selections that were faced by early Renaissance designers, and how adding depth and shadow through varying the pile height of the loops and pile created illusions of colour. But colour and technology were not the only considerations with which the designer and artisans had to contend. Religious and cultural influences also played their part in the design process. The church was a major client for silk velvets and played a large role in its demand for splendour in all forms of artistic endeavours. For example, papal

[104] A common description for the feel of the fabric

inventories included 'Diasper' silks,[105] which were produced by use of tone-on-tone colours with gold brocading. In early Renaissance patterned fabric, velvets and brocades were more popular than materials of a single colour, from about 1480 to 1510, while red, green, white, and less commonly blue were used in the polychrome patterned velvets.

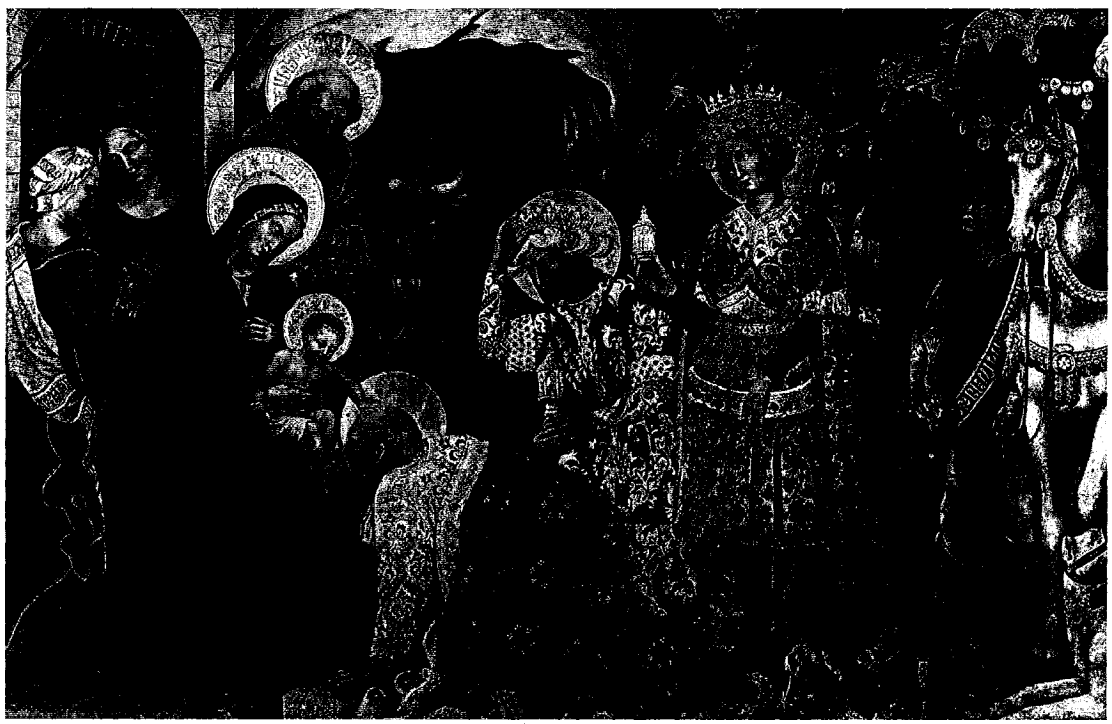
The first half of the fifteenth century witnessed an important change in the preference for monochromatic effects where the same colour of gold and pile-on-pile velvet was dyed with the expensive cochineal red dye. To maintain quality the Councils of the Silk Guild imposed rigorous standards for this prized textile. The texture of the pile and the design forms became more important than the colour and with this development motifs flourished. During the sixteenth century a prevalent use of gold and silver emerged to accentuate patterns in the design. The ground pattern was often of gold lame, or red and yellow with miniature patterns becoming more popular.

The pomegranate motif believed to have been imported from the Middle East and the Orient, and regarded (in their religion) as a symbol of fertility and immortality, was produced in modified versions and reinterpreted by Italian designers. This pattern soon overtook and in some cases overpowered all other motifs. The pomegranate design was recreated in only the most expensive textiles and used in high-level ceremonies within the courts and churches. Samples were produced in a variety of colours in red, green, and blue.[106] The NBM collection contains sample fragments of cut voided velvets, brocade velvets of gold thread and red silk velvet, incorporating the pomegranate design in the

[105] "Diasper Silk" is silk fabric decorated with confronted birds alternating with pairs of beasts.
[106] Collection Catalogue number 113,126 and116

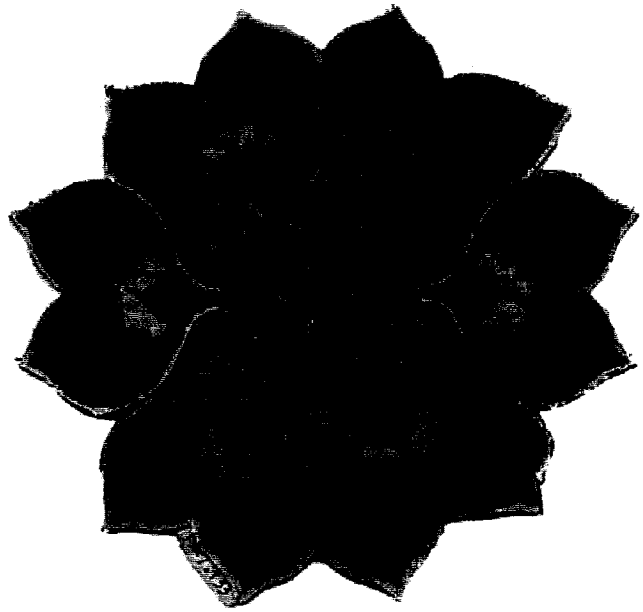
traditional layout. It was the high quality and technical drawing skills along with the technical perfection in the art of weaving that led to the exceptional quality of the velvet textiles.[107]

An example of how designs were incorporated into velvets and used in a family coat of arms can be seen in fragment number 133 from the collection (Figure 19). Here gold and polychrome velvet is reconstructed as a sampler. The design, believed to have been created for the Medici Family was recreated in the painting by Gentile da Fabriano titled "Adoration of the Magi" in 1423 (Figure 18). [108]



18. Adoration of the Magi c.1423

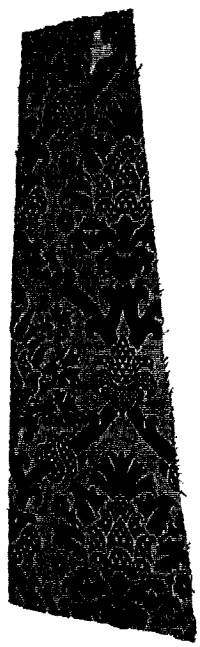
[107] *Ibid.*, Von Falk, p.40
[108] http://gallery.euroweb.hu//index1.html accessed 19/09/2004



19. Collection #133. Gold and polychrome velvet, reconstructed as a sampler.

Florentine artists created woven images with the primary function of being used for ecclesiastical borders and merchants such as Tommaso Spinelli, who specialised in selling to this market, ensured that both the master painters and cartoonist thrived. An example of an ecclesiastical design is demonstrated in the painting 'Tobias and the Angel' (Figure 20) by Raffaellino Del Garbo (1466-1524). A version of the design is depicted on the sleeve of the angel's outfit in the artist's rendition, while a sample of the woven design discovered in the NBM collection is shown alongside (Figure 21).

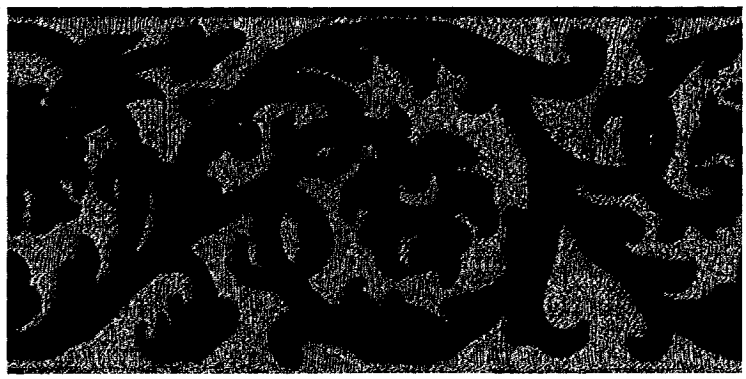
20. Tobias and the Angel.[109]



21. Catalogue number 158.

[109] http://www.wga.hu/frames-e.html?/html/v/velazque/1620/04adorat.html accessed 18/09/2004

The influence of famous sculptors and architects, such as Donatello and Brunelleschi, appeared in the Florentine motifs, and elements such as shells, garlands and scrolls were encompassed within the designs.[110] Then again in the early sixteenth century, a change in direction appeared in the designs of the Florentine weavers. The classic urn began to appear filled with floral decoration and gothic motifs were being depicted (Figure 22).



22. Velvet with Gothic design

By the late sixteenth century to the early seventeenth century a change occurred in the design structure of velvets. The wealthy consumers of Italian silk velvets considered it fashionable to change from the large-scale motifs, which were woven on voided backgrounds in contrasting colours[111] to designs incorporating geometric patterns, for their garments and wall coverings.

In Florence famous for its orphreys,[112] the floral motifs held fast.[113] Everyday velvets changed in composition from a closed network fashion (dense all over patterns) to a spacing out of the motif thereby exposing more of the background. This breaking apart of

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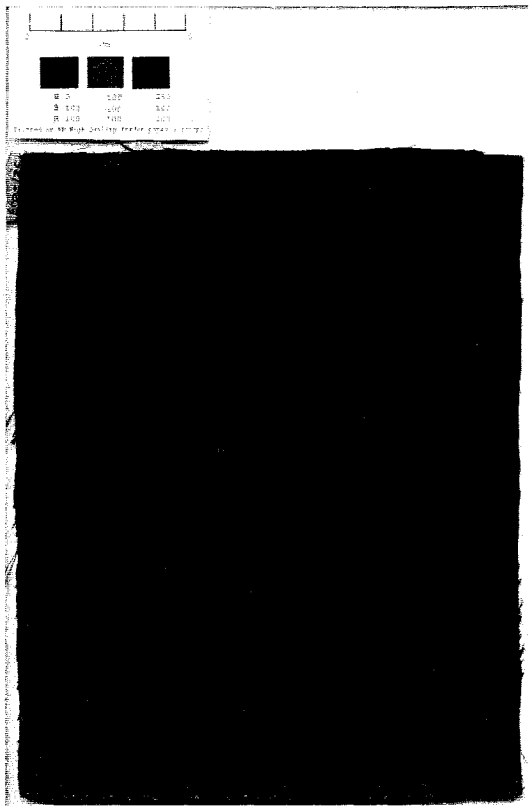
[110] Tilton John Kent, *Textiles of the Italian Renaissance* (New York: Scalamandre Silks Ltd) p.14
[111] *Ibid,*. Kent, p.14
[112] The most common scenes were the Annunciation, the Crucifixion and the Nativity.
[113] Scott Philippa, *Book of Silk* (London: Thames & Hudson, 1993) p.155

the motif and the shift to the small geometric pattern while retaining the floral design elements can be seen in (Figure 23).



23. Cranbrook Collection #209. A tronquee floral design.[114]

The floral motifs in which the ends appear to be chopped were known as a 'tronquee' pattern and others were known as 'reverse' having one row pointing up while the next row pointed down.

During the Renaissance, Florence reflected the wealth of the times. It was a city in which originality and individualism flourished; it was a city of bankers and merchants, a city where artists flourished and textile design and weaving held a place of esteem. Used in

[114] A sample of late sixteenth century Italian costume velvet, the voided background is a plain weave of contrasting colour.

every area of decoration from wall decoration to upholstery, silk velvets excelled in the market for fashionable clothing.

From festivals to banquets and from church ceremonies it was unthinkable for sixteenth century men and women of prominence not to flaunt their wealth and social rank by their public display, not only in their own dress but also in that of their servants where silk and silk velvets adorned all members of the household. In a similar manner, kings and nobles from throughout Europe sent agents to purchase the luxurious textiles fashioned from silk and gold and it is from these creations that many contemporary fabric collections are drawn.

Fabric samples and documented archives preserve the knowledge and design skills of these artists and designers. Colour, scale, and space between motifs were important elements of the layout structure and their mastery were essential skills for the designer and master weaver. In contemporary times, the computer has aided the modern designer in making design decisions. With today's technology and computer programs, by digitally scanning the NBM's textile collection, an educational opportunity can be created through which artists, students and scholar can study at close range the masters of the Renaissance velvet weaving techniques.

Section 3 Design and Digital Technology

Introduction

In this chapter I discuss the influence technology has had in the manufacture of velvet, how digital technology has changed current design processes in industry, and how external social influences changed the design processes both in Renaissance Florence and in contemporary times. I describe the techniques and technologies used during the Renaissance and today, and conclude by examining how digital technology is re-shaping textile and educational institutions.

Contemporary professional textile designers shape designs through their immediate decisions at the design table. A majority of designs are created by hand and then transferred to computers for completion, while others are created directly in the computer with Computer Assisted Design (CAD) software. Designs are also created in contexts dictated largely by the customer or commissioner. Contemporary designers work under a number of constraints that are influenced by a complex social structure involving end users often far removed from the concept on the design table. The overall process of design development, however, remains relatively straightforward, one in which the relationship is between "immediate designer" and the commissioner.

Silk velvet pattern designers of Renaissance Florence, directed by a stringent social and religious structure, developed their concepts as part of a "society design" that can be described as containing two main components. The first was the individual who established the design constraints, measures, and direction within which the designer

worked. The silk merchant set policies that established boundaries for the kinds of projects to be undertaken. More specifically the merchant's interventions shaped the financial systems within which designs were commissioned, while guild officials established codes, standards, and regulations.[115] As Luca Mola writes, "Despite all the regulations, it would be wrong to see government and guild policies as the principal driving force of the industry."[116] Ultimately the merchant agreement financed the project, supplied the raw materials, and marketed the goods in markets of the merchant choice.[117] Second, "society design" in Renaissance Florence signified that social norms included church values, reflected in the body of the design as portrayed in spiritual embellishment of the designs themselves.

The Technologies, Development and their Application

Design development and the eventual fabrics were limited by the technology of the day. Velvet weaving was a complex and tedious task prior to the invention of the Jacquard loom in 1804 by the French silk weaver Joseph Marie Jacquard.[118] Earlier looms required a complicated system of tie-ups[119] and a complete understanding of the weave structure by the cartoonist and master weaver. While silk weaving was complex in itself, silk velvet weaving contained a further set of challenges as it required additional sets of warp

[115] The velvet weavers' guild of Florence was founded in 1247 http://www.sca.org.au/tmi/showarticle.php3?article=20000125/060300&mode=threaded assessed 22/12/2004

[116] *Ibid.*, Mola, p.118

[117] The marketplace of choice would have been where the merchant could obtain trade deals using commodities other than the velvet textiles this may have been woollen textiles which combined with the velvets would have allowed them to purchase goods included the raw materials for velvet manufacture.

[118] Steven E. Schoenherr, *Jacquard's Punched Card*, Smithsonian National Museum of American History http://history.acusd.edu/gen/recording/jacquard1.html accessed 20/12/2004

[119] The tie-up shows the shafts that must be raised and/or lowered by each treadle to make each shed required by the weave structure.

threads. The "background", which was woven in a plain weave, formed the body of the fabric, supplemented by a second warp called the "pile warp". This supplementary warp created the repeated motif, with tufted piles, and/or loops interwoven with the background of the fabric. Pile on pile velvet was another specialty weave that created the illusion that the fabric was woven with a number of colours when in fact only one was used (Figure 24).

24. A low cut pile and uncut pile combined, creating the illusion that the fabric was woven with a number of colours.[120]

In this method the pile warp was raised and required a supplementary element to form the pile on a ground of plain, twill or satin weaves and the surface texture was one structural design dimension of the cloth. The length and width were other dimensional aspects to be considered in relation to the desired end use of the fabric. Once a loom was setup to weave, the cloth length was calculated and the warp setup accordingly. However, textiles were narrow because of loom width restrictions and so when a design required a width

[120] By combining a cut and uncut pile of different heights the illusion of mutable colours was achieved.

greater than the normal 54-60 cm, special looms and rods had to be built. An assistant was required to insert and remove the pile rods, as the warp shots passed from one hand to the other by the master weaver would not exceed the length of his arm.[121]

During the Renaissance the cartoonist laid down the weave design through the means of hand colouring on a grid (graph paper) forming an interpretation of the original illustration for the weaver to follow. As Walter Sondhelm describes,

> To illustrate a weave either in plain view and/or in cross-section, takes a lot of time, especially for more complicated weaves. A type of shorthand for depicting weave structures has therefore been evolved and the paper used for producing designs is referred to as squared paper, design paper or point paper. Generally the spaces between two vertical lines represent one warp end and the spaces between two horizontal lines one pick. If a square is filled in it represents an end passing over a pick whilst a blank square represents a pick passing over an end. If ends and picks have to be numbered to make it easier to describe the weave, ends are counted from left to right and picks from the bottom of the point paper design to the top.[122]

Contemporary designers follow the same basic methods as their Renaissance counterparts. Starting from a sketch, the designer illustrates the basic layout (cartoon) and then proceeds to transform the cartoon into a conceptual illustration, "one of the most important activities in the design and development of new products."[123] In contemporary design however, the layout process is shifted to computer technology speeding up the labour intensive girding process. Rather than using grid paper, the designer repeats the design by setting the display preferences at 300 dots-per-inch (dpi). The Renaissance cartoonist reconstructed the design on a graph at squares per inch, representing 300

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[121] *Ibid.,* De' Martins, p.28

[122] Walter S. Sondhelm, *Handbook of Technical Textiles, Technical Fabric Structures,* Woodhead Publishing 2000. http://www.knovel.com/knovel2/Toc.jsp?SpaceID=636&BookID=926 accessed 10/01/2005 4.2.1.2 p.3

[123] P. A. Rodgersa, G. Greenb and A. McGown, Using concept sketches to track design progress. EBSCO Design Studies Volume 21, Issue 5, September 2000 pp.451-464

threads per inch corresponding to the thread count of the textile. Of major importance to the Renaissance master weaver was the ability of the cartoonist to interpret a design into a workable document that the master weaver could use as a pattern from which to work. These sets of instructions were created in graphs equal in scale to the final woven cloth.

Choosing colours for a woven velvet textile was another stage of the design process. The colourist interpreted the design and determined the necessary colour palette. The challenge facing the Renaissance colourist was one of a limited colour palette due to the scarcity of dyes. During this period both the colourist and the weaver would have been one and the same person and each weaver specialised in working with certain colours and materials, such as gold thread. Precious metals like gold and scarce dye colours affected the prices of velvets. It was the mixing and diluting of dye stock that created trouble for some unscrupulous colourists and dyers of Venice in 1453, and caused an international scandal. They were "found guilty of 'fraudulently and mischievously' plotting to produce a large quantity of silk thread dyed with very little kermes[124] and altering its colour with brazilwood and other pigments in order to obtain a *paonazzo* shade."[125]

Crimson was the most expensive of materials to work with: therefore only the most skilled and trusted weavers were contracted for this work. 'Crimson was an especially popular colour. In 1560, 1,298 bolts of crimson satins and damasks were produced in Venice, while 1,161 bolts were of other colours. In 1554, as a means of quality control, the silk guild of Venice specified that if kermes was used to dye a damask fabric, no other

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[124] The dried bodies of the female scale insect (Coccus ilicis), allied to the cochineal insect.
[125] *Ibid.*, Mola, p.123

dye, such as brazilwood or orchid, could be used with it.'[126] During the Renaissance, red, green, white and blue were used singularly or combined in the creation of patterned velvets, and reds in various hues were applied on a base ground of yellow creating colour combinations that assisted in the illusion of depth. For instance, there were six different pigments for the colour red and so by mixing the pigments and by diluting the concentration of pigment a considerable variety of tints could be achieved. The Renaissance colourist's palette was small indeed when compared to today's digital chemist who has available over sixteen million colours on a computer from which to choose.[127]

Computer Assisted Design, the Advantages of Using Digital Technology.

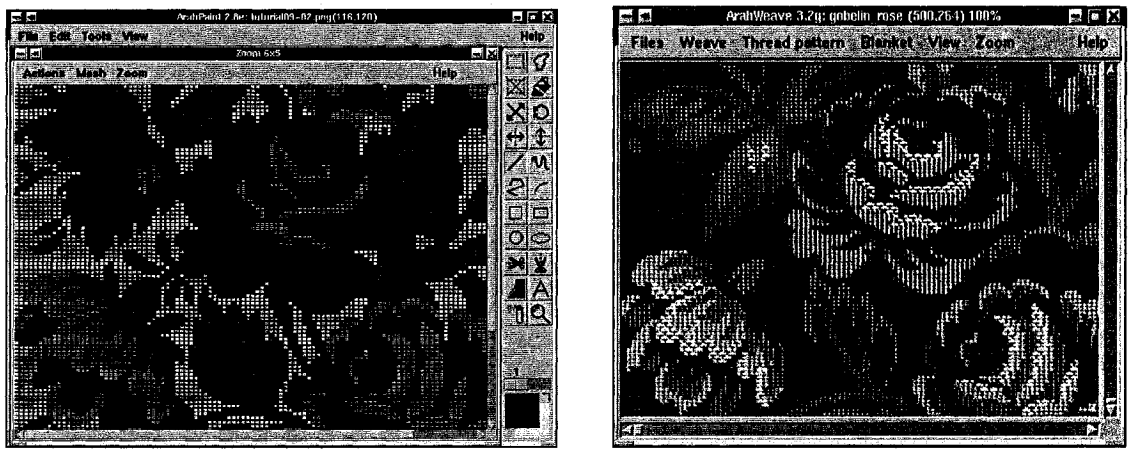
As noted, Renaissance weavers required the cartoonist to layout the design on graph paper for them to interpret and weave. In early 1800s, the French silk weaver Joseph-Marie Jacquard invented a way of automatically controlling the warp and weft threads on a silk loom by recording patterns of holes in a string of cards. In this way the graph acted as a control mechanism for producing the design. The cartoonist, now called the stylist, translated the artwork into a design that could be woven. A technician then punched the cards directly from the technical (stylist's) drawing. This innovation represented the first automated production application. It was not until the 1970s that the computer was introduced into the process. The technician who punched the cards now used a scanner to read in the technical design and the technical design was visible on a monitor and so

[126] Krystal Morgan, *Satin Damasks of Renaissance Europe.* http://home.att.net/~krystalmorgan/damask_history.htm accessed 05/01/2005

[127] A state of the art PC graphic card will display 1280 x 1024 by 16.8 million colours.

could be controlled and corrected. This stage of computerization ran from the late 1980s to the mid-1990s. Then the designer's sketch was read directly onto the scanner and special software was used to help separate the sketch into a technical drawing that was controlled and corrected by the technician. The process became simpler and more automated, translating the information into a picture that is similar to the final woven cloth.

Designers now transfer the conceptual sketch directly into the digital world of Computer Assisted Design, CAD where they can visually examine the creation before it is put into production. (Figure 25)



25. Cartoon set-up view and *ArahWeave* Integer simulation view[128]

In contemporary design practice, after having identified design trends, individual designs are generated first as concepts that progress to final artwork and eventually colourways. Design technology differs in a number of ways from that of the Renaissance. Hand building of designs and individually created colourways are almost gone as CAD software replaces these traditional skills. Colouring is accomplished by creating color

[128] ArahWeave, http://www.arahne.si/tutorial10.html accessed 23/12/2004

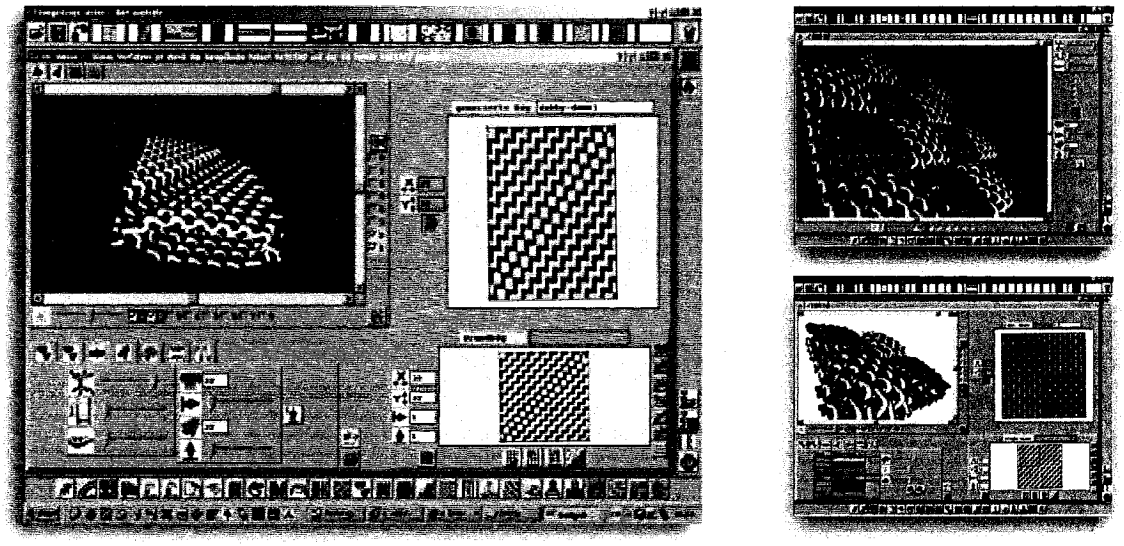
variations within the CAD program. By dragging and dropping the colours on the palette the designer can view and print the colourways together or separately (Figure 26). It is no longer necessary to redraw and recolour a design by hand, which previously required hours and sometimes days to complete. As a tool, the computer offers the opportunity to examine the design and provides an invaluable insight to the design's visual appeal in scale and in colour choice. Digital technology dramatically reduces time from concept design to production.

26. Design with 6 colourway variations[129]

Today there are a number of options open to the textile designer. Design based CAD programs can simulate woven fabric layouts similar to the graph cartoon of the Renaissance. There are more complex 3D imaging software programs where the weave structure can be examined at various angles (Figure 27). A designer can explore the weave structure by magnifying the image, travelling into the structure, turning it over and examining how the threads interlock. The software's functions enable the designer to

[129] Pointcarré, http://www.monarchcad.com/Produits/Plaquettes/anglais/TextileDesign_E.pdf accessed 05/12/2004.

develop and edit weaves by displaying them in 3D animated forms. The animation can then be rotated 360° and scaled to the designer's preference.



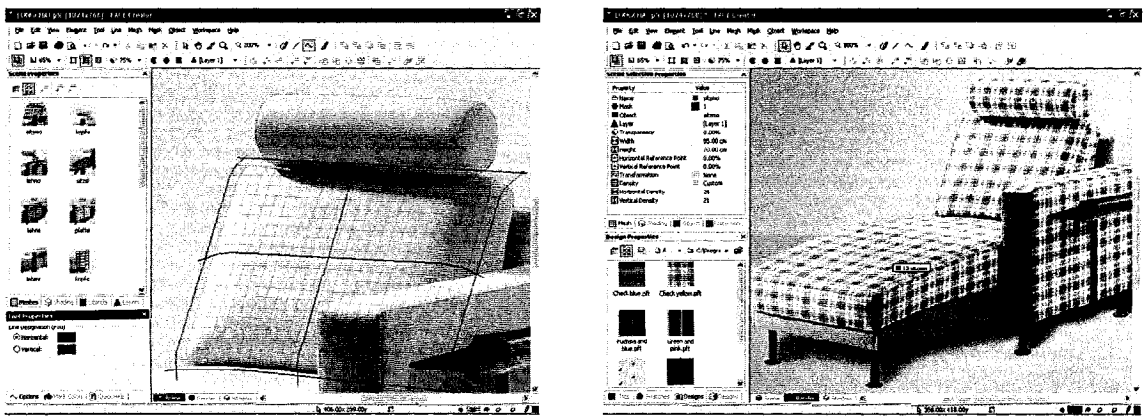
27. Two computer software 3D Weave images, one for Dobby the other for Jacquard. [130]

The designer is actually viewing a virtual textile, a concept of the future cloth. In the past the minute examination of this sort could only be accomplished after the fabric was woven, and only by magnification using a magnifying glass or microscope.

Another CAD tool for contemporary designers is the drape or texture-mapping program. This technology allows designers to transport photo-realistic three-dimensional (3D) renderings of designs, colours and textures to photographs or other images. Designers can generate life-like representations of products using scanned-in photographs of human models, furniture or interior/exterior environments. The software simulates the look of the cloth on a 3D surface using grids. The technique requires the user to identify areas on the image where a pattern will be applied, and to create a series of grid lines that "map"

[130] EAT GmbH - The DesignScope Company 3D weave software http://www.designscopecompany.com/ assessed 23/12/2004

the drape of the fabric across the various subdivisions. When the photograph has been prepared it may be stored and reused again with alternative designs or textures. Once completed the user can simply drag and drop a design, pattern or fabric onto the image, draping the form while maintaining the details from the original image like shadows, folds, or wrinkles. The result is a digitally altered image that simulates a real product (Figure 28). Although this is actually a two-dimensional (2D) image, it provides the user with a simulation of how the design will appear when applied to an intended 3D surface.



28. Illustrations of computer generated meshed area and simulated covering [131]

The NBM's Collection and the Digital Project.

Initial stages of the project involved identification of the textile collection. It was decided that the NBM Cranbrook Collection, consisting of three hundred textile fragments, represented a manageable group for assessment. Discussions into construction of the digital archive initially concentrated heavily on the practical considerations of hardware, software, storage media and how eventually it could be accessed. The next stage of the research project involved the creation of a successful information retrieval system that would integrate with the NBM's existing database. Research was carried out to determine

[131] PICARIO visualization software http://www.picario.com/cms/index.php accessed 23/12/2004

the types of cataloguing guidelines and software currently used within prominent museums, archives and libraries, and the feasibility of upgrading the museum's existing system. The results led to the construction of an appropriate system for the NBM's Cranbrook archive written to the following guidelines:

1. Scan at the highest resolution appropriate to the nature of the source material 100 dpi. Jpeg format for thumbnails, 600 dpi. Tiff format for master images.
2. Create and store a master image file that can be used to produce derivative image files and serve a variety of current and future user needs.
3. Use image file formats and compression techniques that conform to standards within the cultural heritage community.
4. Create backup copies of all files on CD's and Hard Drives.
5. Create meaningful metadata for image files or collections.
6. Store media in an appropriate environment.
7. Document a migration strategy for transferring data across generations of technology.
8. Anticipate and plan for future technological developments.

Computers

The quality of the computer equipment was critical to the success of the digitization initiative. A computer with a balance of reliable components, speed and storage was considered in order to increase productivity and overall effectiveness of the project. More memory allowed the computer to process more quickly the digital information and large amounts of image data. Personal computers with Pentium III processors were used to

optimize image manipulation, specialty Textile CAD software, Photoshop functions and high-speed data input through intranet connections. USB 2.0 was used along with a CD-RW burner. Nineteen inch display monitors (15" was standard at the time) increased the productivity of the project by providing more "screen real estate" to view and evaluate images. The monitor quality was considered of major importance as individual computer monitors interpret and display colours and tonal values differently, and even with careful calibration there is no guarantee that images will appear the same on other computers, particularly when delivered across the Internet to a wide variety of end-users.

Scanners

It was realized that scanners would have the greatest impact on quality of images for the majority of the digitization project. Recent developments had improved the selection options by increasing variety and availability while reducing equipment cost. The scanner for this project depended on a number of factors including overall project goals, format, size, and condition of materials to be scanned. Several technical factors influenced the selection including available optical resolution, bit depth, size of scan area, speed, connectivity, and ability to handle different formats and materials in the collection. At the start of the project, point-and-shoot digital cameras did not offer sufficient optical resolution for capturing archival quality master images.

Scanner Software

The link between the hardware and the computer hardware is the software that controls the scanner or camera and passes information to computer storage or image editing

software. By choosing a higher end scanner, it came bundled with software that allowed the operator to manually adjust resolution, tonal dynamic range, and colour channel values. Consumer model scanners frequently include pre-set software that does not allow careful adjustment of these values and can result in poor quality images.

Image Editing Software

The function of scanner drivers and plug-ins offers a limited array of features for the manipulation of images, acquiring professional image editing software for the creation of surrogates for delivery via the Web, print publications, or for in-house uses such as virtual exhibits. When selecting image editing software projects the following features were considered:

1. Ability to work directly with scanner software through TWAIN;[132]
2. Support for common non-proprietary file formats (for use with CAD textile software);
3. Tools for image optimization (colour adjustment, tonal adjustments);
4. Features for the optimization of images for web delivery;
5. Ability to convert colour (RGB to CMYK for print output);[133]

Optical Media Storage

Optical media included CD-ROM (Compact Disc – Read Only Memory), CD-R (Compact Disc – Recordable). The digital collections were stored on CD ROM, and then copied to hard disks. Using this media as a long-term solution, however, presents major

[132] The TWAIN originally launched in 1992 industry vendors recognized a need for a standard software protocol and applications programming interface (API) that regulates communication between software applications and imaging devices (the source of the data).
[133] RGB: ***Red-Green-Blue*** CMYK: ***Cyan-Magenta-Yellow-Black***

challenges. Consideration was made for the fact that CD-ROMs have a limited physical life span and the images stored on them are vulnerable due to physical deterioration, mishandling, improper storage and obsolescence. Studies have indicated that the physical lifetimes of the media are wide ranging – anywhere from 5 to 100 years. Both adhesive labels and permanent ink markers can cause early failure of CD-ROMs through chemical interaction with the CD's foil and so it was determined that best practice was not to write or label CDs directly.

Online Storage

Storing scanned images on "live" servers was also an elected option to archive high-resolution (TIFF) images on a stable platform that offers sustainability and easy storage and retrieval and to prevent the loss of data. This was carried out by linking to NBM's database via a secure Internet connection.

These guidelines provided the minimum standards I felt was necessary for achieving an acceptable level of image quality. As a rule, the method used provided quality scanning at a level that matched the information requirements. Decisions on image quality and resolution were based on the needs of end users, and the materials scanned (dimensions, color, tonal range, format, etc.) the quality and condition of the original textile fragments.

Spatial Resolution

Spatial resolution measures the frequency at which individual pixels or points are sampled and are commonly referred to as "dots per inch" (dpi) or "points per inch" (ppi). Higher resolutions take more frequent samples of the original and contain a more accurate representation. Since higher resolutions are capturing more information, files

sizes also increase. In the case of the NBM's collection the decision was made to scan at 600 dpi as the highest resolution in order that the weave structure could be easily magnified and examined by researchers.

File Formats - Images

Master digital images are normally stored in a file format that supports the fidelity and long-term preservation of the image. The format most frequently used for master digital images is the Tagged Image File Format (tiff.) and this was the format chosen in this digital archive project. It was determined that the master object file format should be:

- Non-proprietary / open source
- Uncompressed
- Have the ability to capture technical metadata as part of the file structure

Delivery/Access Images

The large high-quality master images were converted to smaller lower-quality Joint Photographic Experts Group (jpeg) format in order to be delivered across a network in a timely fashion.

The digital archiving of the NBM's Cranbrook Collection represents an educational opportunity through which students, scholars and artists can study in close proximity the Renaissance velvet weaving techniques. In so doing they may be inspired in their creation of new designs for tomorrow's textiles. By opening the collection to schools and colleges the museum will create an opportunity for students to explore the rich history of the

textile fragments, which in turn can lead to the creation of virtual exhibitions, and showrooms where the designs can be rendered on three-dimensional objects. The digital collection of textile images can be used in a virtual museum setting which will be described in Section four, and in a digital 3D setting the user can move an image from the digital textile collection onto a sample image to recreate a virtual representation of silk velvet as it would have appeared in a Renaissance scene (Figure 29). By understanding and recreating digital storyboards, students will possess the skills to enter tomorrow's textile workforce.

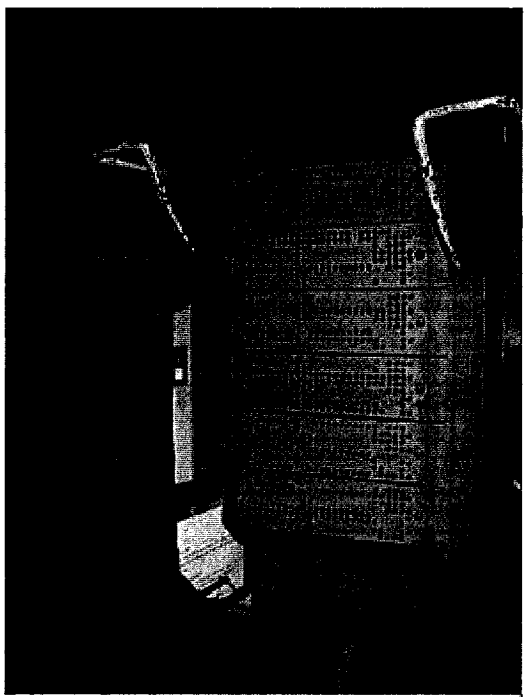
29. Two sketches of Chief Matrons of Florence with mapped samples of velvet fabrics from the NBM Cranbrook collection.

With the development of new textiles, faster ways to deliver concepts and with high-end technology, digital imaging will transform how designs will be created; and with the shift of international textile industries to developing nations, it will be the highly skilled individuals with multi-tasking abilities in all sectors of manufacturing who will break the barriers of limited local networking. Opportunities for the future are in a new arena; it is

the new digital technology that is the driving force of future textile designs, as discussed in European textile trade papers:

> We will see more the emergence of a market driven creativity based on cross-fertilization between disciplines with fashion and design becoming increasingly influenced by ethics, innovation and technology.[134]

The new consumer marketplace in the digital dimension is creating the demand and control for contemporary designers, as the Jacquard loom transformed the way silk velvet fabrics were created, in turn, shifting the control from the weavers of Renaissance Italy. It was the ability to change the pattern of the loom's weave by simply changing cards that was an important conceptual precursor to the development of computer programming (Figure 30). So too, today's digital technology is creating the shift in the processes of tomorrow's textile industry.



30. Close-up view of the 8 x 26 hole-punch cards.[135]

[134] European Research in the Textiles and Clothing Sector. http://www.euratex.org/download/publications/papers/rd-3-2002a2_-_research_strategy_paper_final.pdf accessed 01/03/2005

Section 4 Digital Technology in the Learning Environment

Introduction

In this chapter I discuss how computer technology can benefit students in the exploration of textile design, history and anthropology. Whether the environment is in a classroom, an individual's home or workplace, computer technology offers innovative methods to conceptualise a subject and embrace a range of learning styles. Recent surveys have shown the Internet, personal computers, and portable computers (laptops) rate in the top 10 inventions of the past 25 years and it should come as no surprise that students have readily adapted to these tools.[136]

Digital technology in the learning environment has led educational institutions to examine new ways to deliver programs and courses. There exist, now, smart classrooms, distance learning, information and communication technology, and lesson objects. With computer equipment readily available in many institutions, there is no substantial reason apart from economic disparity, for educational institutions to refrain from utilizing technology to assist learning in a comprehensive and integrative process. One of the best examples is the use of e-resources provided by university libraries. Through electronic highways, scholars and students can quickly avail themselves of the growing number of digital texts and e-journals.

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[135] http://en.wikipedia.org/wiki/Jacquard_loom accessed 28/06/2005

[136] CNN. The World was Different before the Internet. Tuesday, January 18, 2005 Posted: 4:08 PM EST (2108 GMT) http://www.cnn.com/2005/TECH/01/03/cnn25.top25.innovations/index.html

The methods used by learners to gather, retrieve and process information are expanding with computer and digital technology. Delivery methods, however, have varied over the years but research has shown that multimedia software improves learning by holding the attention and stimulating the interest of the learner. Therefore innovative educational design strategies incorporating multimedia applications can enhance effective learning. Perry and Perry concluded in their work on university students' attitudes towards multimedia presentations,

> ... our students preferred to attend a class that utilises multimedia presentations and that they found class more interesting and more enjoyable with multimedia. Our students also felt that multimedia held their attention better than other presentation methods. Finally, we concluded that multimedia can affect student learning in a positive manner. Our students indicated that when multimedia is utilised, (1) more material can be covered, (2) they learn better, (3) they understand difficult concepts better, and (4) they retain course material better.[137]

One goal of instructional designers should be to encourage interactivity whereas content designers should aim to assemble blended delivery modules in so doing. They will improve the student's cognitive learning experience.[138] Educational literature describes three possible approaches to instructional design:

1. The individualized approach or independent study, where instructional strategies and content can be designed to meet the educational needs and learning style of individual learners;
2. The content strategy: Most instructors and institutions centre on content as the basis for course design;

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[137] Perry, Timothy, Perry, Leslie Anne. *British Journal of Educational Technology*; Oct 98, Vol. 29 Issue 4 p.375

[138] The major levels of cognitive learning can be classified as memorizing, understanding, and applying.

3. The multiple strategy: The course is designed around course content and instructor strengths, but also incorporate strategies designed to meet the needs of a variety of learners.

Learning is a process not limited to the classroom. As The Royer Center states, "the concept is grounded in the idea that learning is a continuous process occurring inside and outside the classroom. In short, 'blended learning' intermingles with multiple learning strategies or methods with a variety of media."[139] While the concept is not new, blended learning including digital technology has tremendous implications for areas of study such as art, design, history and anthropology.

Delivering the message through the use of technology

A number of learning styles have been identified over the past decades but several questions still arise. Is there a better way to teach? Does "theory" require an educator to be present physically? Is knowledge able to be delivered understood in an acceptable manner using technology?

When considering how to teach to contemporary students thought should be given to a blended constructive delivery incorporating the use of self-paced digital technology.

> DISTANCE EDUCATION and especially online courses are increasingly becoming an accepted part of college teaching. A survey released in July 2003 by the United States Education Department announced that enrolment in for-credit distance education courses grew from 750 thousand in 1994-95 to 1.3 million in 1997-98 and to 2.9 million in 2000-01. In 2000-01 fifty-six percent of two and four year

[139] The Royer Center. Penn State's Commonwealth College https://royercenter.cwc.psu.edu/Faculty/blended.aspx accessed 27/01/2005.

> institutions and ninety percent of two year public colleges offered distance education classes.[140]

Although learning styles have remained constant, how students learn and multi-task as they study has changed. By using computer technologies they "chat" online, they interact with each other, writing papers and posting them for peer review in "blogs"[141], and they use computers to take classes over the Internet. While students learn to create images in the digital world with the use of CAD software programs, anthropology students explore virtual environments in Geographic Information Systems or Geographic Information Systems GIS's, and history students explore the past through Quantitative Databases. By examining the queries and searches, they compile information into data driven printouts for study, while others build 3D reconstructions of cities and buildings.[142] Still others explore alternate histories through computerised game playing. The age of technology has changed how we learn.

While today a number of learning projects are being conducted at higher levels of education where self-paced work can be carried out in isolation, it can be argued that self-paced learning also requires interaction time with others to receive their opinions, and feedback. This feedback does not necessarily require face-to-face contact. Today, whether in the workplace or studying on-line with their friends, there seems to be little requirement for individuals to physically meet or see each other. Questions and replies submitted in virtual classroom applications and delivered through "chat" software such as

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[140] John F. Lyons, *Teaching U.S. History Online: Problems and Prospects*. The History Teacher 37.4 (2004): 18 pars. 17 Jan. 2005 http://www.historycooperative.org/journals/ht/37.4/lyons.html.

[141] A weblog, Web log or a blog, is a web application, which contains periodic posts on a common webpage.

[142] John Bonnett, *Following in Rabelais' Footsteps: Immersive History and the 3D Virtual Buildings Project* http://3dlearning.iit.nrc.ca/3DVirtualbuildings accessed 01/01/2005

Microsoft Network Messenger and video conferencing software can be equally effective. As Yacine Atif described through discussions in an open modulated forum, examples and reference materials can be posted or hyper-linked for learners to view and study.

> Successful e-learning systems are based on two major principles: modularity and abstraction. While modularity divides the system into self-contained modules or objects, abstraction separates the description of these objects from their actual implementation. E-learning system architectures based on these design principles are scalable and flexible allowing easy integration of new learning resources.[143]

The delivery of history, anthropology and art/design education does not differ necessarily from other disciplines. It requires an understanding of theory and practice for the learner to comprehend the basic principle and progress to advanced studies. Historians, anthropologists and educators have become aware that contemporary learning requires interactive methods to complement the traditional modes of education, and it is timely to explore instructional designs that include multi-sensory experiences. While forward thinking educators are discovering new teaching territories by delving into virtual worlds where students learn through multi-sensory use, traditional educators should follow suit and investigate the possibilities in integrating computer technology. The major challenge to any educator is how to effectively teach students in ways that are clearly understood and retained while holding the attention of the learner through multi-sensory strategies. Students experience "feeling" part of a (virtual) three-dimensional understanding. They hear and see recordings of past events as they happened. While multi-sensory experiences enhance learning and understanding, students could further augment their learning

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[143] YACINE ATIF, Learning Objects Based Framework for Self-Adaptive Learning. Kluwer Academic Publishers, The Netherlands 2004. Education and Information Technologies 8:4, pp. 345–368, 2003.

experiences by developing their own supplementary constructive elements for collaborating and sharing with others.

The use of digital technology in the learning environment

True 3D CAD software allows the user to create objects that are constructed on three planes (X, Y and Z). A 2D drawing program is used to illustrate a 3D object. In order to interactively rotate an object for different views, it must be created as a 3D drawing in a 3D CAD program, which can increase the learning experience for students of design, history, and anthropology, by creating virtual models to be manipulated by the user. Here, the learning experience becomes interactive by controlling and manipulating the object, allowing for closer analysis of the article, how it was created or what it would look like. With the use of Virtual Reality Modelling Language (VRML), 3D technology allows students to build virtual "worlds" which can be viewed locally on a computer or via the Internet. Through the use of a VRML player, the virtual 3D world can be viewed interactively, offering walkthrough capability in real time.[144] As an example for textile design students, 3D models could recreate a sample fabric or weave structure. Then, by using DesignScope's 3D weave (as described in Section three) and by interacting with the simulated model of the textile, the student would learn about the structure, colour, scale, and other compositional concerns of the design, thereby gaining a more intimate and advanced understanding of the subject matter.[145]

For history students the learning experiences might be enhanced from such activities as the construction of virtual 3D buildings. In this instance, students would have the

[144] The requirement for viewing a VRML world is that you must have a VRML player.
[145] This field of weave structure would normally be covered in the specialty of weaving.

opportunity to research object and design issues, such as why the location was chosen, what regulations governed other structures surrounding the one they were recreating, what was the intended use and what led the builders to develop the property? An example of this type of experimental learning activity is The Virtual Buildings Project, developed as a joint project of the National Research Council and Industry Canada to provide graduate students at the University of Ottawa with the opportunity and resources to develop materials using information technology that could be distributed over the Internet. John Bonnett in a history course which evolved from this initiative, "Researching the History of Your Structure" in relation to the buildings of downtown Ottawa, stated simply, learning the history of a historical building means performing two tasks:

> *Finding Secondary Sources* -- A secondary source is a book, article, website, or CD produced by a historian. Such works conform with what you expect to find in written history books, a written description of the lives of significant individuals, and of significant events that transpired in the past. Aside from description, historians also try to explain *why* an event, or sequence of events occurred. Secondary sources are generally found in libraries.
>
> *Finding Primary Sources* -- Primary sources are *not* history books. Primary sources are historical documents, and can be anything from a diary or letter to a photograph, map or will. They are useful for historians because they contain information produced by individuals who witnessed significant events in the past. They are also useful because they often reveal the state of mind of the author. If a historian wants to learn how Prime Minister William Lyon Mackenzie King felt during the middle of World War II, he or she would likely start by reading his diary. Or, if the same historian wanted to learn how Canadians felt about life and death during the 18th century, he or she would likely start by reading wills from the period. Primary sources are generally found in archives.[146]

Students who entered this course in the exploration of history also gained (possibly unbeknownst to themselves) the knowledge and the opportunity to better understand the

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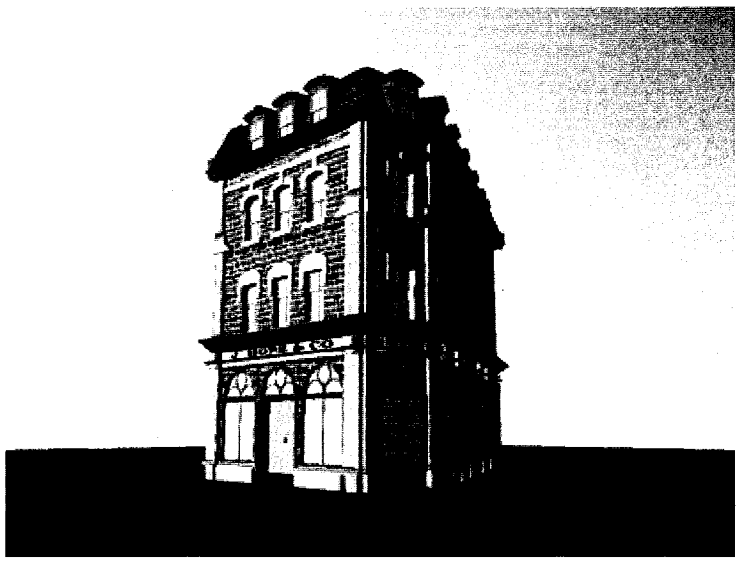
[146] *Ibid.,* Bonnett, accessed 19/01/2005

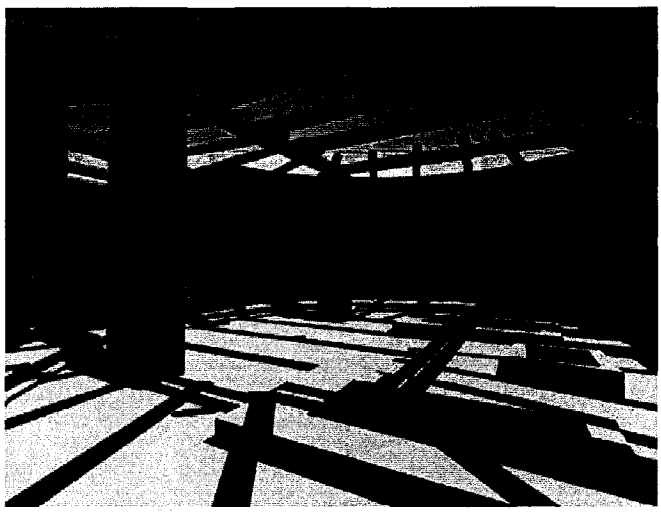
principles of foundation art and design by working with perspective, 3D shapes, basic design, and architectural design, as well as an understanding of building construction in the historical time period studied (Figure 31).



31. National Research Council CAD rendering by John Bonnett.[147]

Through the use of CAD and 3D modelling, anthropology students would benefit in similar ways from this technology through the recreation of relevant artefacts. For example by constructing the 3D models students could research stone tool artefacts, study the preparation of a platform, how to trim the edge or remove a flake and then virtually recreate the outcome. Students could recreate buildings for investigation of habitats, villages, tools, and objects like Dennis Holloway's virtual villages (Figure 32). Here, with the use of CAD technology, Holloway has recreated examples of Native American habitats.

[147] *Ibid.,* Bonnett, http://3dlearning.iit.nrc.ca/3DVirtualbuildings/ accessed 19/01/2005



32. The Aztec Great Kiva.[148]

Through the use of computers and digital technologies in the creation of virtual worlds and objects, students can create both 2D and 3D models that will enable them to better comprehend what living and working conditions were like in various time periods. They will experience through creation, exploration, and research an understanding of how people created everyday objects and how they lived. In so doing they will gain a better understanding of these times, as well as how past technologies were developed and used.

Students come from diverse backgrounds and students of textile design arrive from a variety of entry points, including museum studies, anthropology, history, craft and design. For textile students it is in the field of CAD that they develop the skills needed to operate within industrial settings. CAD studies are only part of a design program, which combine traditional colour, printing and design theory and practice. Design students appreciate the value of these computer applications when learning traditional hand colouring techniques for creating colour palettes and colourways. After a level of

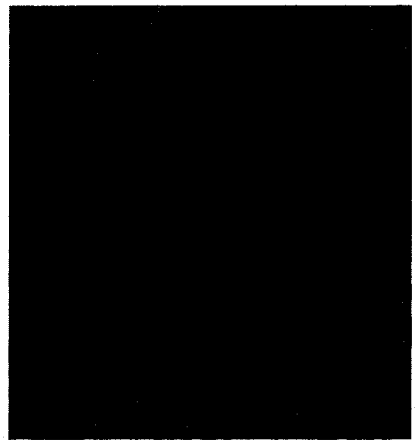
[148] Dennis Holloway, *An Architect in Northern New Mexico.* http://www.dennisrhollowayarchitect.com/html/AztecKiva.html accessed 20/01/2005.

proficiency in colour theory and practice, the student transfers that knowledge to designing on the computer. The resulting savings in time and energy allows the student more opportunities for developmental experimentation.

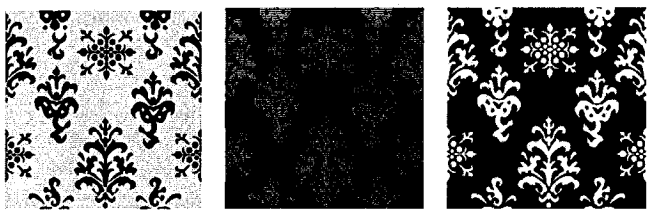
One opportunity afforded by textile CAD software is the chance for students to examine digital textile collections. Fragments of designs can be recreated for a variety of end uses, allowing students appropriate access to textile collections previously unavailable to them. The Cranbrook Collection is an example of one such powerful learning tool. As an educational classroom tool the addition of online access to the NBM's digital textile collection will enhance learning for New Brunswick educational institutions. The digital images can be accessed real-time during the delivery of lessons in crafts, textile design and museum studies. Through scanning, digital photography, or Internet retrieval they can capture an image of the textile. Then, by isolating the (repeat) unit the student can recreate the design by manipulating the scale or colour. Another example of digital technology use in textile design is in the form of textile research. Aside from gaining access to historical and anthropological archives (such as museum and provincial collections) students can seek to understand the three dimensional nature of fibres and fabrics. Through microscopic examination of "virtual" textiles, they can examine and recreate designs and colourways in their own classrooms.

With the addition of learning activities where students can reinterpret or create a new design from a fragment in the collection, students may construct combinations of colourways based on the original fragment. Then by moving one step ahead in the colour

wheel and applying the next group of colours, a new colourway is created.[149] By conducting this exercise on a computer, the student rapidly learns how colours affect a design. In the following example, a yellow background with a red motif has been recreated from a selected velvet fragment (Figures 33 and 34).



33. Design # 1945.207 from the Cranbrook Collection



34. Design # 1945.207 variation, recreated in three colourways.

Although none of these design colourways exist as woven velvet textiles, the use of CAD provides the option of creating a large number of instantly viewable variations of the design with considerable time saving. Further, this assists students in understanding how they can change the appearance of a design, while providing them with a clearer understanding of how colours work together.[150]

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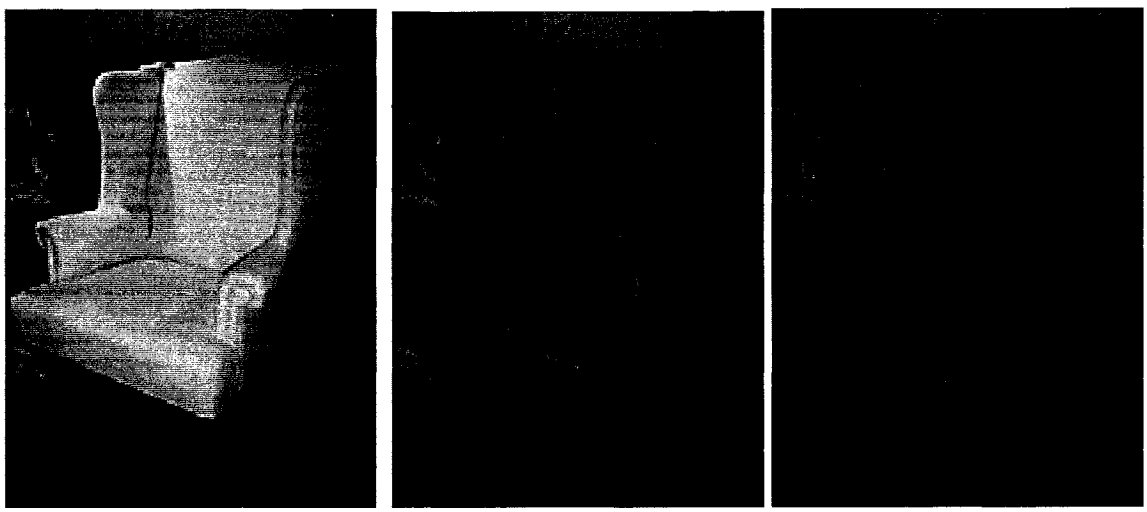
[149] Mary Paul Yates, *Textiles A Handbook for Designers* (New York: W.W. Norton & Company 1996) p.135

[150] Colour theory is a science that has been studied in depth and is not covered in this thesis. There exists an abundance of information covering this science should the reader require doing so.

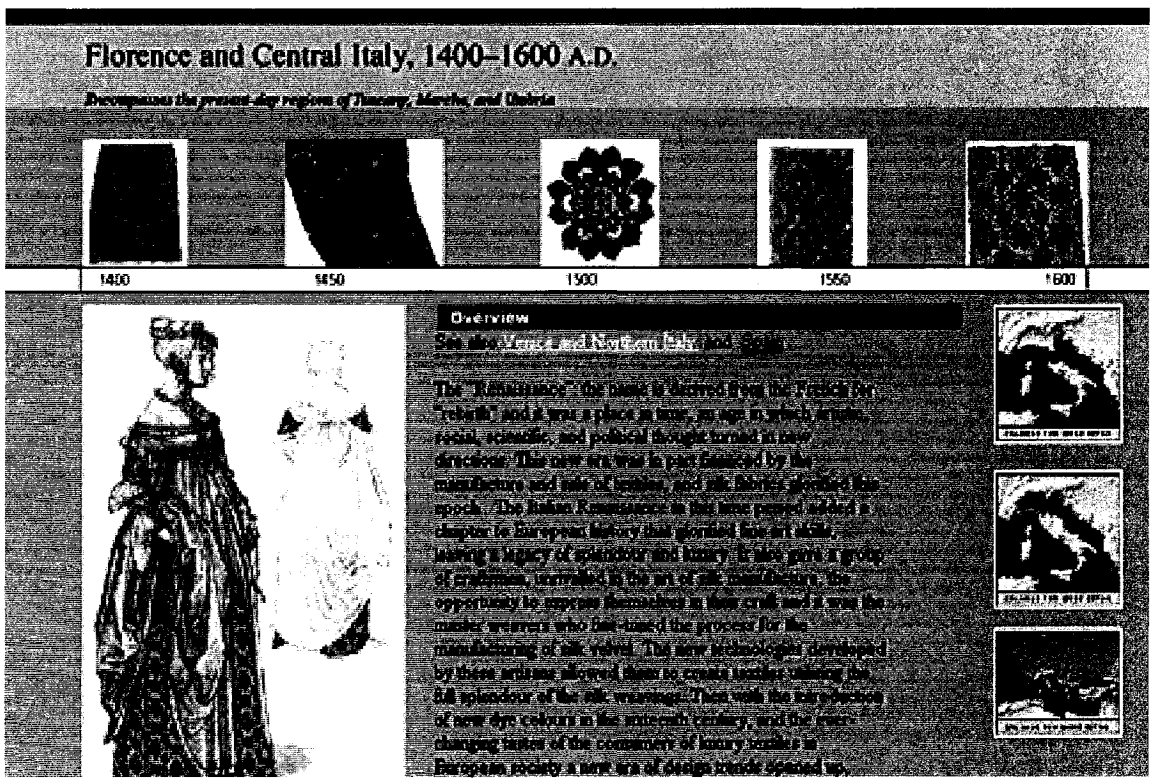
Another benefit to CAD software is the "texture mapping" component. Using applications that simulate a virtual product image, a design is superimposed on the object to simulate the final product object, such as a fashion garment or a piece of upholstered furniture (Figure 35). Texture mapping software is, in reality, a 2D image that has been mapped to trick the viewer's visual sense into believing they are looking at a 3D image. The illusion consists of grids based on traditional perspective methods, applied to a semi-opaque layer. The illusion was created by first scanning a copy of the silk velvet from the collection (c.1500), isolating the repeat unit, and then associating it with the grid that has been applied on top of the original photographic image of a chair.



35. The same digital scan of the original fabric applied to the 3D map of the white chair and rescaled showing the contrasting effect of the design.

Of benefit to students is that within a compressed timeframe the design can be captured and viewed for consideration to proceed (or not) with the recreation. By associating a variation of the design with the same grid map, the user can make further corrections or manipulate the scale. Below is an example of a possible website display I have created, to show examples of how silk velvet designs would have appeared in Renaissance times

(Figure 36). Through the creation of a virtual museum, the NBM could provide an interactive visual adventure. By adding accompanying text to the images they could tell the story of how life would have been for a resident of sixteenth century Florence where the velvet fabrics were designed, created and sold by the merchants. There could be virtual rooms where 3D animations and interactive demonstrations could show the silk throwing machine from the thirteenth century in action, another virtual room demonstrating how dye baths worked and colour theory, and complementing them further could be a design room showing a design being created and then woven on a virtual loom.



36. Sample velvet design applied by texture mapping with historical description.

This "virtual silk mill" experience could then be enhanced in the classroom where questions could be posed and learning objects[151] set in place to actively involve students in their learning by enabling them to try out models for viewing different design options, creating a constructive learning environment.

A lesson plan could be created similar to the following example:

Motif and Repeat Pattern

Learning Goals:

To create awareness of Renaissance textile design methods.

To explore the computer as one tool used by textile designers.

To discover types of woven design and the relationship of motif design.

Instructional Strategy: Indirect instruction, concept formation

Resources: PC with a CD player and Internet access.

Materials: sketch book, pencil, straight edge, eraser, World Wide Web access, digital printer, scanner, PhotoShop software, and Intranet access for student's use.

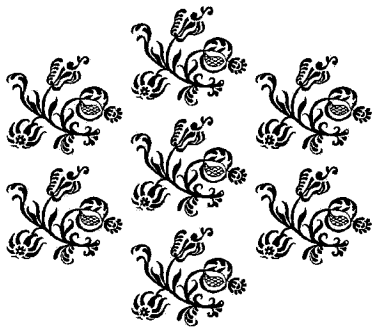
Activity:

A motif is a single or design or colour, whereas a pattern is a set of motifs organized into a repeated arrangement (Figure 37).

[151] New Media Consortium NCM. http://www.nmc.org/projects/lo/landscape.shtml accessed 01/02/2005

Motif

Repeat Pattern



37. Sample exercise designs

Examine the variety of patterns motifs on the NBM CD. Using the digital images from the NBM CD velvets motif section answer the following questions with written and visual rendition:

1. Show how it is possible to repeat a design throughout a textile in order to make a new pattern.
2. Image #3 is an example of the pomegranate motif. Use appropriate repeat pattern layout strategies to apply the motif to a repeat pattern. Using the library or the Web, research the origin of the pomegranate design.
3. Using the Internet to access the NBM's velvet collection identifies three cities in Italy where velvets such as these were made. Choose one design and describe the structure of the layout.
4. Samples 5, 6, 7, and 8 are six identical motifs created in different repeat arrangements. In your own words, explain how *three* of those repeat patterns were created.

5. Create your own motif in your sketchbook, and using one of the above layout arrangements, create a repeat pattern on a second page in your sketchbook. Your pattern must be a minimum of three rows and three columns (i.e. your motif must be repeated 9 times).

Further instructional design considerations

The museum's Web page designers could also build into their website a provision for password protected access areas where master uncompressed images would be open to students and scholars for research and study of the textiles. The construction of these web site initiatives would secure linkages with educational institutions for research and access to historical artefacts.

When a teacher transmits information to a student in the form of a lesson, it is first visualized in the "mind's eye," the image drawn from their past experience of the object or subject matter. To students the process is to recall if the object being described to them can be visualised in their "mind's eye" and can compare with what is being described. With the use of digital technology and by creating or linking to a learning object teachers can transmit their "mind's eye" information faster, directly and more accurately to the student. Teachers and students alike will benefit from the proper use of digital technology tools. These tools will assist in the delivery of educational experiences, creating access to resources that previously were limited to an elite audience.

Formal educational research agreements with the province and universities, schools, colleges allow for wider distribution of these educational resources to other institutions throughout Canada.

Section 5 Conclusion

Scholars study how cultures urbanize and interact socially, politically, economically and culturally, and educators seek new ways of sharing this knowledge to students. Technology, in particular digital technology, has played an important role in the advancement of teaching tools in the learning environment. Increasingly, students and teachers are moving beyond traditional educational resources for a comprehensive, multi-sensory learning experience, and textile education is reaping the benefits of this research. The modern computer owes its structural origins to a technological development in the textile industry, the Jacquard loom. Indeed, many current practices within design development and the textile industry can be traced to technological advances originating in the minds of the Renaissance masters, and later innovators like Joseph-Marie Jacquard's loom. Over the Renaissance period merchants, traders and bankers explored new markets to increase their wealth and status, while designers, artisans and craftspeople created innovative technological solutions through which to ply their trade. Many of the standards for design excellence and manufacturing methods are still observed today and the West has seen a resurgence in the use of historical Renaissance textile patterns. We owe much of our current understanding of textile design to the Renaissance masters.

The development of the Florentine silk industry in the Italian Renaissance and the role of Florence's silk merchants have been outlined, while stories of the merchants and families who were involved in silk manufacturing, as well as the craftspeople and workers who thrived in the maturing silk trade, are limited in depth and study. This thesis addressed the intricacies of the woven design process and the technical challenges that constrained

manufacturing and stimulated innovative solutions. The knowledge of silk weaving and dyeing, which originated in Asia, and travelled across Mid-Eastern borders into the hands of the Italian masters and craftspeople, changed how textile artists applied their craft. Merchant's agents sold to an elite market through trade fairs in neighbouring countries and the market dictated design development. By the thirteenth century, there was an established trade in silks and velvet textiles in Italy and in the cities of Genoa, Venice, Bologna, Lucca and Florence. By the late fourteenth century, as Lucca's silk industry was failing, Lucchese technology spread to cities such as Florence, Bologna, Genoa, Milan, and later, Venice. Artistic and aesthetic discoveries flourished for the luxury textile designers and master weavers, and the church led in directing the industry. Silk merchants, acting upon the directives of the powerful and influential church, dictated the types of motifs, colours and materials to be used in the construction of these luxurious fabrics. Large volume sales for the times, many made through connections with Rome and the Vatican, fattened the merchant house's bank accounts by cardinals who paid handsomely for their church vestments.

Since competition among fifteenth-century silk merchants was fierce, the purchase of raw materials, supplies and labour in France soon required new export markets. Merchants contracted agents and dealers to carry on business in an expanding marketplace, particularly in the Ottoman Empire, where the textile fabrics woven with gold on crimson velvet were a much sought-after commodity. Florence's silk velvet manufacture of the fifteenth century afforded its silk merchants the luxury of high status never seen before.

Renaissance design evolution was largely a result of market demand for new and fresh interpretations of subject matter, pattern themes, colour and style. It fed upon consumer lust for flamboyance and "larger than life" appearances, and it is from this background of grandiloquent tastes that patronage appointments began. Artists, sculptors, and weavers worked side by side on great tapestries for the halls of the Vatican and state palaces. The church, with its power and influence over commerce, its demand for the flamboyant display of godly rule, and its need for aesthetic supremacy over the common parishioner, created an incubator for the arts and for the advancement of the intellect.

As in the past, contemporary textile artists and designers look to the marketplace for direction and inspiration, and just as the Renaissance masters before them, they employ the latest technologies to assist them in their work. Now, however, in place of candle-lit workshops, designers work in well-lit studios with computers as drawing boards. Weave structures are interpreted by computer, saving hours in the process and replacing hand-rendered draw-downs on grids, and dyers use synthetic pigments and dyes for developing their colours. Merchants ply their trade over virtual networks alongside the traditional trade fairs, and, although today's marketplace is global, merchants still find the need to meet with clients and exchange information in the context of the trade fair.
Contemporary trade fairs attract exhibitors and attendees from countries around the globe just as the Renaissance fairs attracted buyers and sellers from neighbouring states. Today, merchants and designers enter a new era of trading. Likewise, the tools used in the design process are changing, as now more than ever they require advanced technical knowledge and skills in order to succeed.

Correspondingly, contemporary educators, like the Renaissance master weavers, have entered a new era of discovery. With the digital age comes a vast array of tools for transferring knowledge to students, providing them with multi-sensory learning experiences. By embracing digital technology and the appropriate use of technology in a variety of learning contexts, studies in the domains of anthropology, art, history and education advance into a future where new boundaries are crossed and new ways to learn emerge from the past. Several hundred years ago there was a technological shift in the manufacture of woven cloth with the invention of the Jacquard loom. So too, contemporary students are witnessing the improvement of learning strategies for the advancement of contemporary thinking. With digital technology, and the opening of access to archival records by museums and governments, student's resources to global reference materials are expanding at an unprecedented rate.

It is because of this global access that the archives of the NBM should make available for research purposes the Renaissance textile fragments that have come to be known as the Cranbrook Collection. The collection was imported to New Brunswick from the US over half a century ago in order to benefit local students, scholars, artists and craftspeople, but lay in storage as an under-utilized resource. The story of the fragments' journey to Saint John, New Brunswick, reaches back in time to the minds of the designers and weavers of the Italian Renaissance. For the purpose of this thesis, the Cranbrook Collection serves as an ideal context for describing the educational benefits of new technology in the creation of virtual museums, interactive lesson plans, and design research archives.

Finally, the Cranbrook Collection also provides a direct link to a vastly important time in the development of Western culture, and the legacy of this powerful historical period can now be shared by educators and learners through the virtual domain.

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Appendix

1. Copy of Leger

106. 1927.113 thru 1927.608 Collection of 500 examples of Old Fabrics mounted on 154 cards, each 52 x 72 cm. Italian, 15th to 18th centuries. Purchased from Giuseppe Salvadori, Florence, June 1927. Obtained from dealers and private collectors in various places throughout Italy and Europe since 1895. Catalogue of collection describes each piece.
(In Art Library). $3,725.
Size: 52 x 72 c.m.
Not on Original Inventory See "Textile Collection"

107. X 1926.23 Green pottery plate, square, in blue, green and gold with dancing figure in centre, by Jean Mayodon, French [illegible]. From Paris Exposition, 1925.
Size: 9-3/16" wide, 9¼" high. $250.
Am. Assn. of Mus. 4/6/26
P. 7 Orig. Inv.

108. X 1926.41 Pottery Vase, triangular, in blue, gold and deep red with dancing figures by Jean Mayodon, French contemporary Base broken and repaired.
Size: App. 10" high. $300.
P. 7 Orig. Inv.

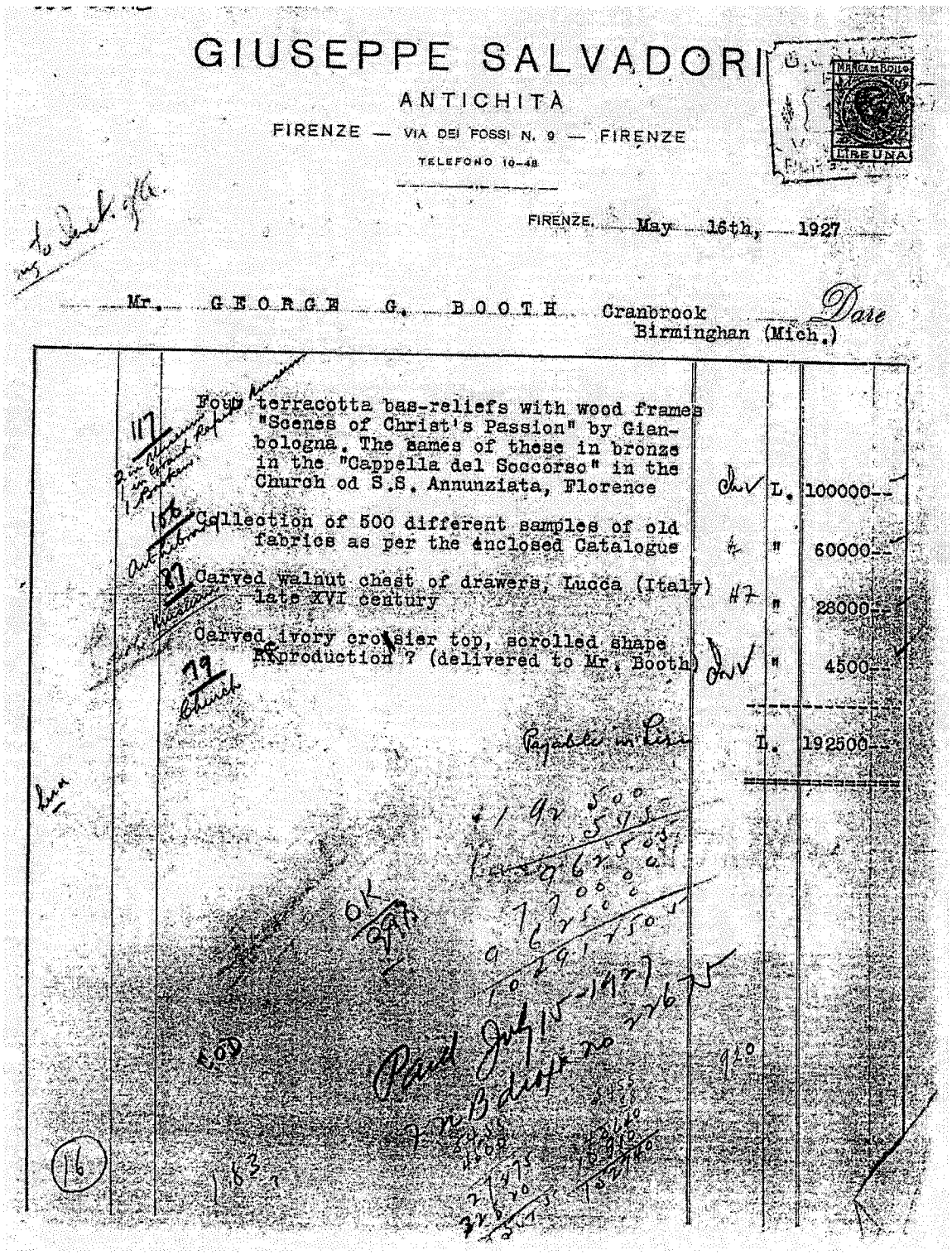
109. X 1926.24 Small pottery dish on stem in red, black, white and gold of man and stag by Jean Mayodon, French contemporary
Size: 6¾" diameter, 5" high. $250.
Am. Assn. of Mus. 4/6/26
P. 7 Orig. Inv.

110. X 1927.37 #5. Faience jar with two handles showing faint blue-green glaze, Roman Rakka, 4th century. Purchased from Khawam Bros., Cairo, Egypt. March 1927.
Size: 11¾" high, 8½" diameter. $125.
P. 7 Orig. Inv.

X 111. 1924.6 Reproduction Illumination "A Sonnet addressed by King James to His Son Prince Henry", signed M.H.R. English contemporary. From Exhibition of British Arts and Crafts, 1920-1921.
Size: 10¼" wide, 14" high. $200.
Society of Arts & Crafts 8/11/24
P. 7 Orig. Inv.
In cabinet in C.H. Dining Room – 10/3/66

GEORGE GOUGH BOOTH PAPERS (1981-01)
BOX 24, LEDGER TITLED "OLD SYSTEM 1 THRU 399"

2. Original Shipping documents May 16th. 1927



GIUSEPPE SALVADORI

ANTICHITÀ

FIRENZE — VIA DEI FOSSI N. 9 — FIRENZE

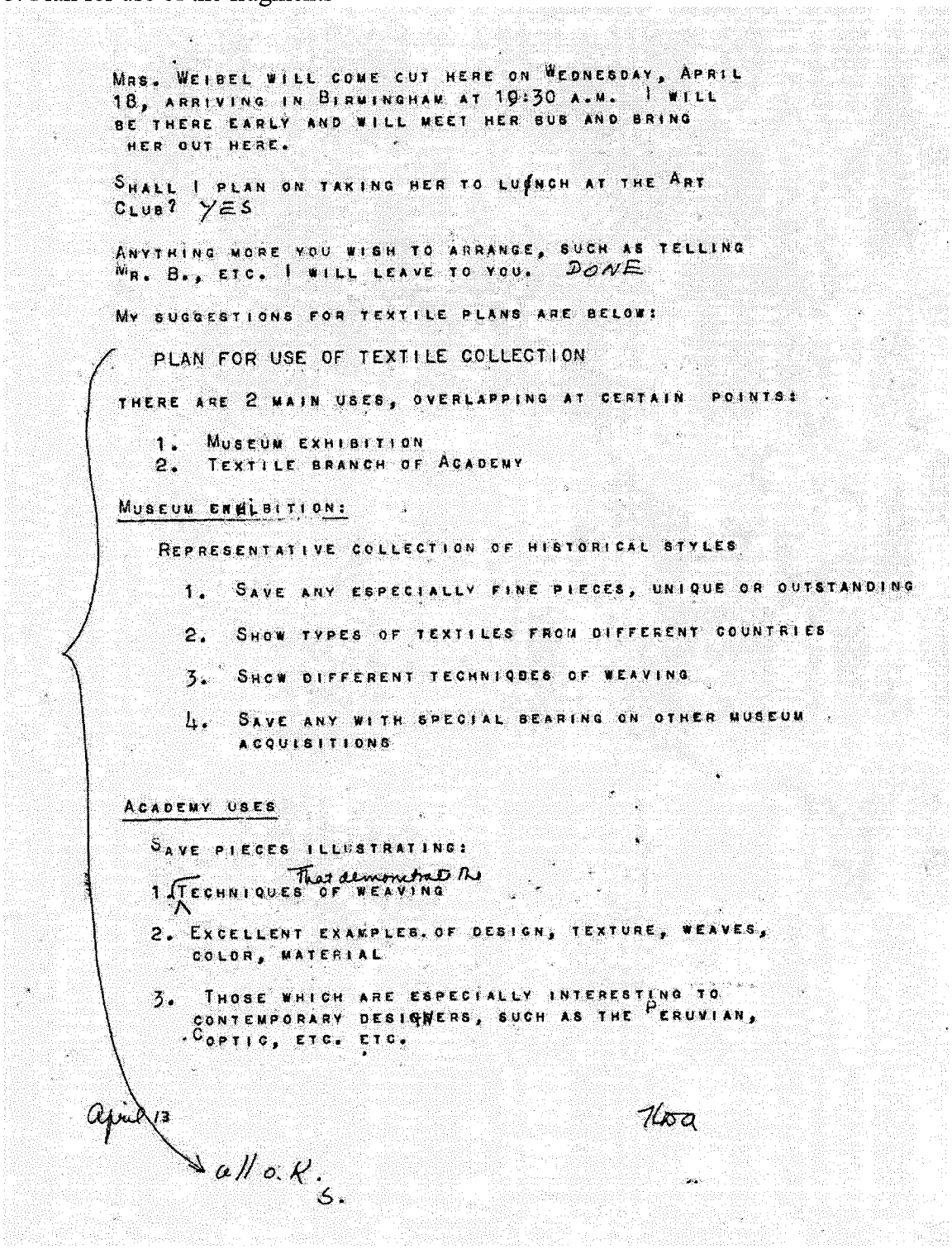
TELEFONO 10-48

FIRENZE, May 16th, 1927

Mr. GEORGE G. BOOTH Cranbrook Dare
Birminghan (Mich.)

Four terracotta bas-reliefs with wood frames "Scenes of Christ's Passion" by Gian-bologna. The names of these in bronze in the "Cappella del Soccorso" in the Church od S.S. Annunziata, Florence		L.	100000--
Collection of 500 different samples of old fabrics as per the enclosed Catalogue		"	60000--
Carved walnut chest of drawers, Lucca (Italy) late XVI century		"	28000--
Carved ivory crosier top, scrolled shape Reproduction ? (delivered to Mr. Booth)		"	4500--
	Payable in Lire	L.	192500--

3. Plan for use of the fragments



MRS. WEIBEL WILL COME OUT HERE ON WEDNESDAY, APRIL 18, ARRIVING IN BIRMINGHAM AT 10:30 A.M. I WILL BE THERE EARLY AND WILL MEET HER BUS AND BRING HER OUT HERE.

SHALL I PLAN ON TAKING HER TO LUNCH AT THE ART CLUB? YES

ANYTHING MORE YOU WISH TO ARRANGE, SUCH AS TELLING MR. B., ETC. I WILL LEAVE TO YOU. DONE

MY SUGGESTIONS FOR TEXTILE PLANS ARE BELOW:

PLAN FOR USE OF TEXTILE COLLECTION

THERE ARE 2 MAIN USES, OVERLAPPING AT CERTAIN POINTS:

1. MUSEUM EXHIBITION
2. TEXTILE BRANCH OF ACADEMY

MUSEUM EXHIBITION:

REPRESENTATIVE COLLECTION OF HISTORICAL STYLES

1. SAVE ANY ESPECIALLY FINE PIECES, UNIQUE OR OUTSTANDING
2. SHOW TYPES OF TEXTILES FROM DIFFERENT COUNTRIES
3. SHOW DIFFERENT TECHNIQUES OF WEAVING
4. SAVE ANY WITH SPECIAL BEARING ON OTHER MUSEUM ACQUISITIONS

ACADEMY USES

SAVE PIECES ILLUSTRATING:

1. TECHNIQUES That demonstrate OF WEAVING
2. EXCELLENT EXAMPLES OF DESIGN, TEXTURE, WEAVES, COLOR, MATERIAL
3. THOSE WHICH ARE ESPECIALLY INTERESTING TO CONTEMPORARY DESIGNERS, SUCH AS THE PERUVIAN, COPTIC, ETC. ETC.

April 13

all O.K.
S.

Thos

4. Letter to Booth pg.1 & 2 regarding the evaluation of the collection.

April 20, 1946.

Mr. George G. Booth
Bloomfield Hills, Michigan.

Dear Mr. Booth,

It has been a delightful experience, examining carefully the fine collection of textiles which you have built up over these many years. I understand that you feel it has grown over large and ought to be reduced. I have several suggestions, each of which could be elaborated.

The main drawback to a profitable use of your collection by students is the lack of a card catalogue with photograph, full description, measurements and previous history wherever this is available. Then the specimens should be mounted so that students can easily handle them. The care of the collection really requires a full time curator.

For reducing its size, it could well be separated along the lines of special value 1) for exhibition purposes and 2) for study. Your collection contains many fine specimens that will always be of great value to the Cranbrook Museum, such as the splendid Venetian chasuble, the larger Italian, Spanish and Peruvian textiles and the Mughal and Rajput saris, complete and fragmentary

Collections of small textile specimens are used more and more by students of history; the adepts of the craft, the weavers, seem to lack interest in the evolution of design and technique. Thus, for the needs of Cranbrook Academy a collection of modern textiles might have greater and more direct appeal. Such a collection might begin with William Morris - tying in the Merton Abbey tapestries at Christ Church - and be continued to the preser day. The students of graphic arts would surely welcome a collectic of printed fabrics that might inspire them to create really interesting textile designs.

The rest of the present study collection would make a splendid gift to a public institution where it would be accessible to many students. The material is historically interesting, beautiful and valuable to students. Much of it is paralleled in our collection, but there are a number of good pieces of types

-2-

not represented in our collection. I would like to suggest that the bulk of the collection would be immensely useful to the Museum of Art and Archaeology of the University of Michigan, which has already made a fine beginning, building up an important collection of Hellenistic, Coptic and Egypto-Islamic fabrics. I hope, However, that in any disposal of the collection you would permit me to make a limited selection of specimens towards filling a few gaps in the fairly complete collection of the Detroit Institute of Arts.

I trust that you will let me know whenever I can be of further assistance; perhaps you will one of these days let me talk over the problem with you. A visit to your Museum is always a pleasure and this time it was doubly so, with the grounds so green and Jonas' whale spouting water in every direction in the sharp wind. And quite especially delightful I have found spending the day with your new curator, Miss Adams, whose enthusiasm is well balanced by sound knowledge.

With all good wishes for you and your museum, I remain

sincerely yours

5 Request of interest to U of M.

May 16, 1945

Dear Peter:

I should like to ask your advice about a museum matter, if I may. We have a large collection of historic textiles which we are reducing in size as being too large for our particular needs here. Mr. Booth has suggested that the University of Michigan might like to have them for a study collection. He would be glad to see an exchange of some sort worked out if possible, should you have duplicates in your textile collections.

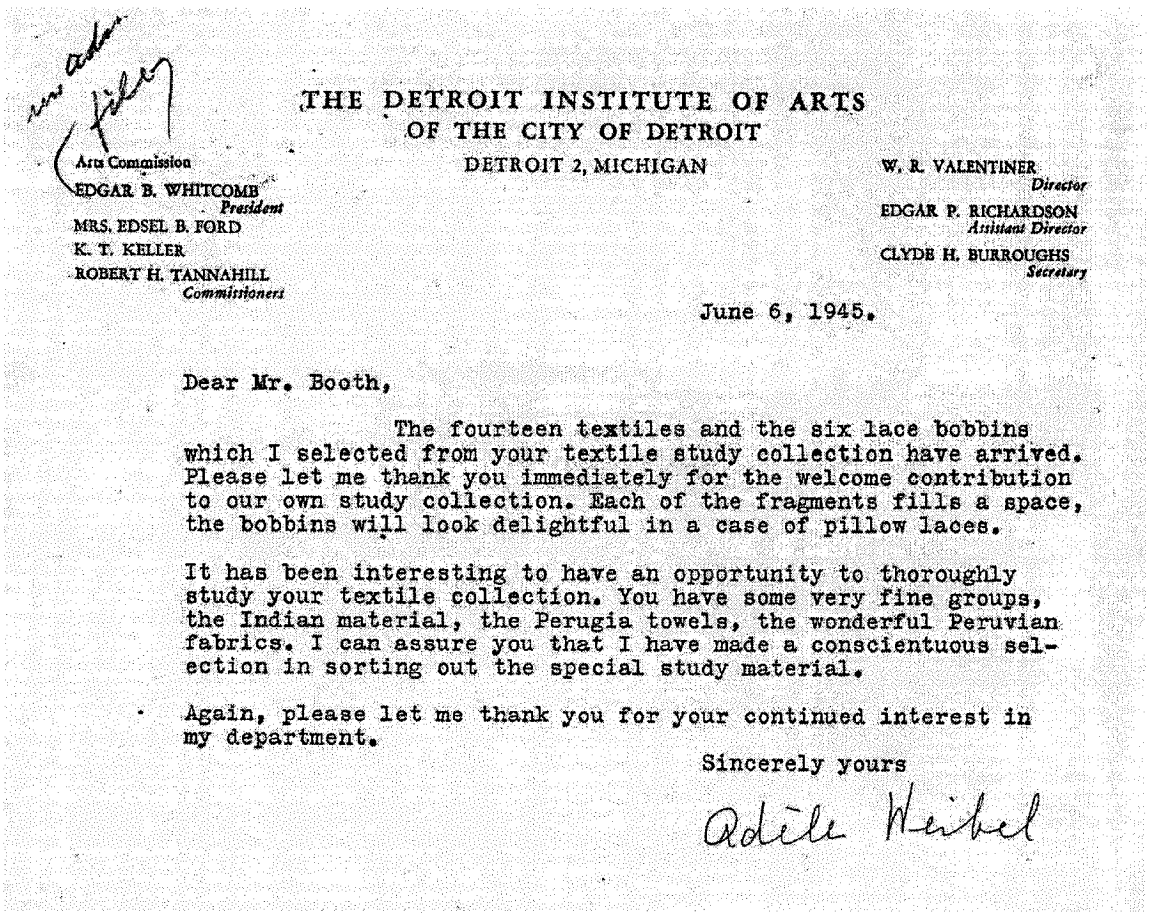
At all events, if you are interested, and I hope you are, can't you come over and see these textiles to get enought information so that a definite decision could be made?

Will you set a date that is as early as is convenient for you and let me know? I will then call Peggy and Albert and we will plan celebrations for your arrival.

Please remember me to your family. I did enjoy our visit the other day. I wish that I could have seen Kate too.

Yours,

6 Payment for evaluation of collection by DIA



THE DETROIT INSTITUTE OF ARTS
OF THE CITY OF DETROIT
DETROIT 2, MICHIGAN

Arts Commission
EDGAR B. WHITCOMB, *President*
MRS. EDSEL B. FORD
K. T. KELLER
ROBERT H. TANNAHILL, *Commissioners*

W. R. VALENTINER, *Director*
EDGAR P. RICHARDSON, *Assistant Director*
CLYDE H. BURROUGHS, *Secretary*

June 6, 1945.

Dear Mr. Booth,

The fourteen textiles and the six lace bobbins which I selected from your textile study collection have arrived. Please let me thank you immediately for the welcome contribution to our own study collection. Each of the fragments fills a space, the bobbins will look delightful in a case of pillow laces.

It has been interesting to have an opportunity to thoroughly study your textile collection. You have some very fine groups, the Indian material, the Perugia towels, the wonderful Peruvian fabrics. I can assure you that I have made a conscientuous selection in sorting out the special study material.

Again, please let me thank you for your continued interest in my department.

Sincerely yours

Adèle Heibel

7 Offer of collection to U of M

JUNE 25, 1945

MR. PETER RUTHVEN, ASSISTANT CURATOR
MUSEUM OF ART AND ARCHAEOLOGY
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

DEAR MR. RUTHVEN:

FOLLOWING YOUR EXAMINATION OF CERTAIN HISTORIC TEXTILES FROM OUR COLLECTION, I WRITE TO OFFER FORMALLY THOSE TEXTILES WHICH WE SHOULD LIKE TO PRESENT TO THE UNIVERSITY OF MICHIGAN FOR ITS STUDY COLLECTIONS.

I SHOULD BE HAPPY TO HAVE YOUR FINAL DECISION IN THIS MATTER.

SINCERELY,

HARRIET DYER ADAMS
ASSOCIATE CURATOR

8 U of M declining the offer

August 24, 1945

Miss Harriet D. Adams, Associate Curator
Museum of the Cranbrook Academy of Art
Bloomfield Hills, Michigan

Dear Miss Adams:

I regret to inform you that the University is unable to use the textile study collection which I examined in June .

Knowing Mr. Booth's desire to have the collection placed where it will be both used and, also appreciated, I will make notes of the places which I come across in my travels where they can make the best use of the textiles . If you should ever desire the information, please feel at liberty to write to me .

Sincerely,

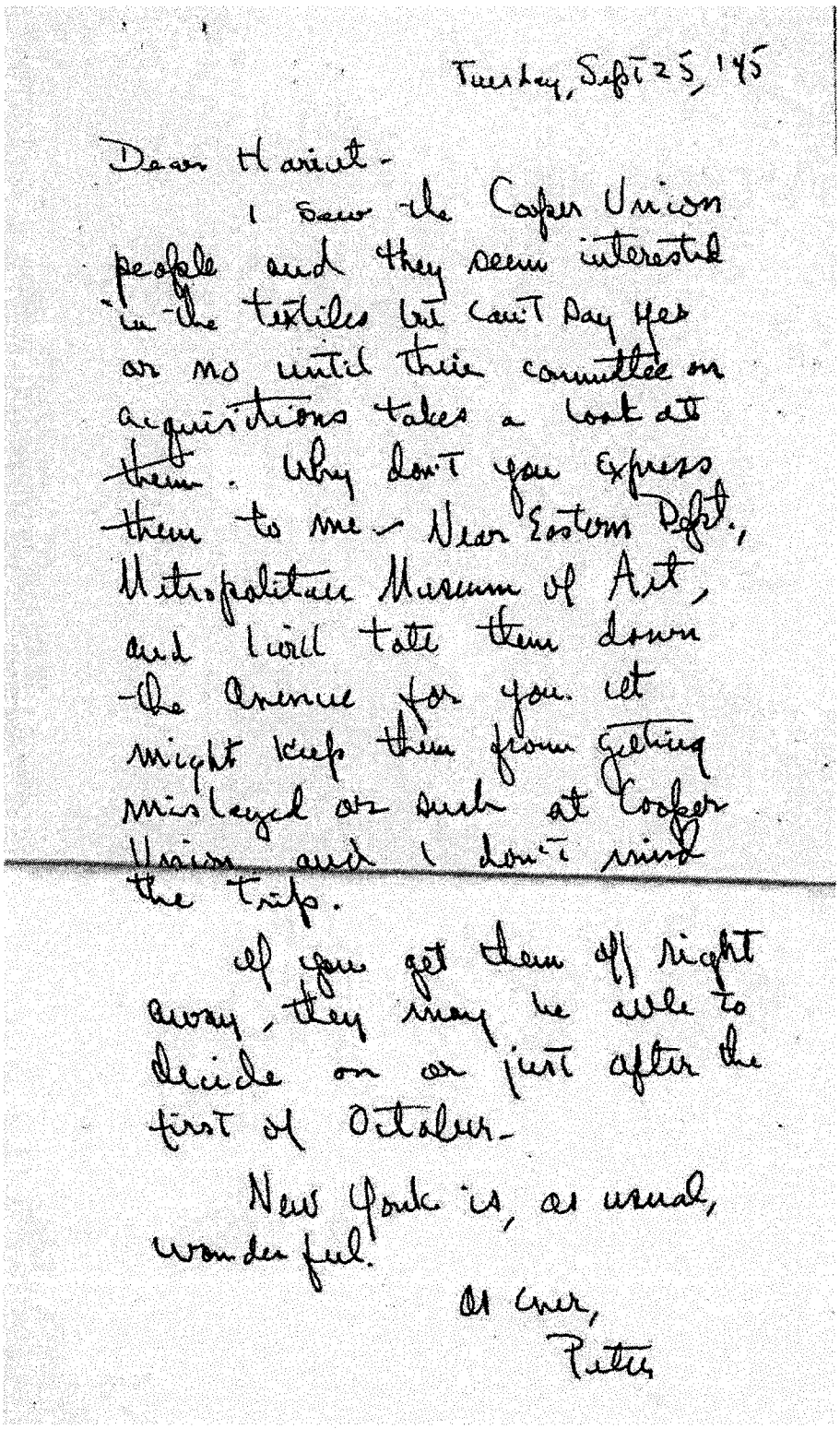
Peter Ruthven

Peter Ruthven

Such suggestion @ places
Deadline Oct. 1

Mr. Peter Ruthven
Museum of Art & Archaeology
U. of M.
Ann Arbor, Michigan

9 Hand written note concerning possible Copper Union interest



Tuesday, Sept 25, '45

Dear Harriet -

I saw the Cooper Union people and they seem interested in the textiles but can't say yes or no until their committee on acquisitions takes a look at them. Why don't you express them to me - Near Eastern Dept., Metropolitan Museum of Art, and I will take them down the avenue for you. It might keep them from getting misfiled or such at Cooper Union and I don't mind the trip.

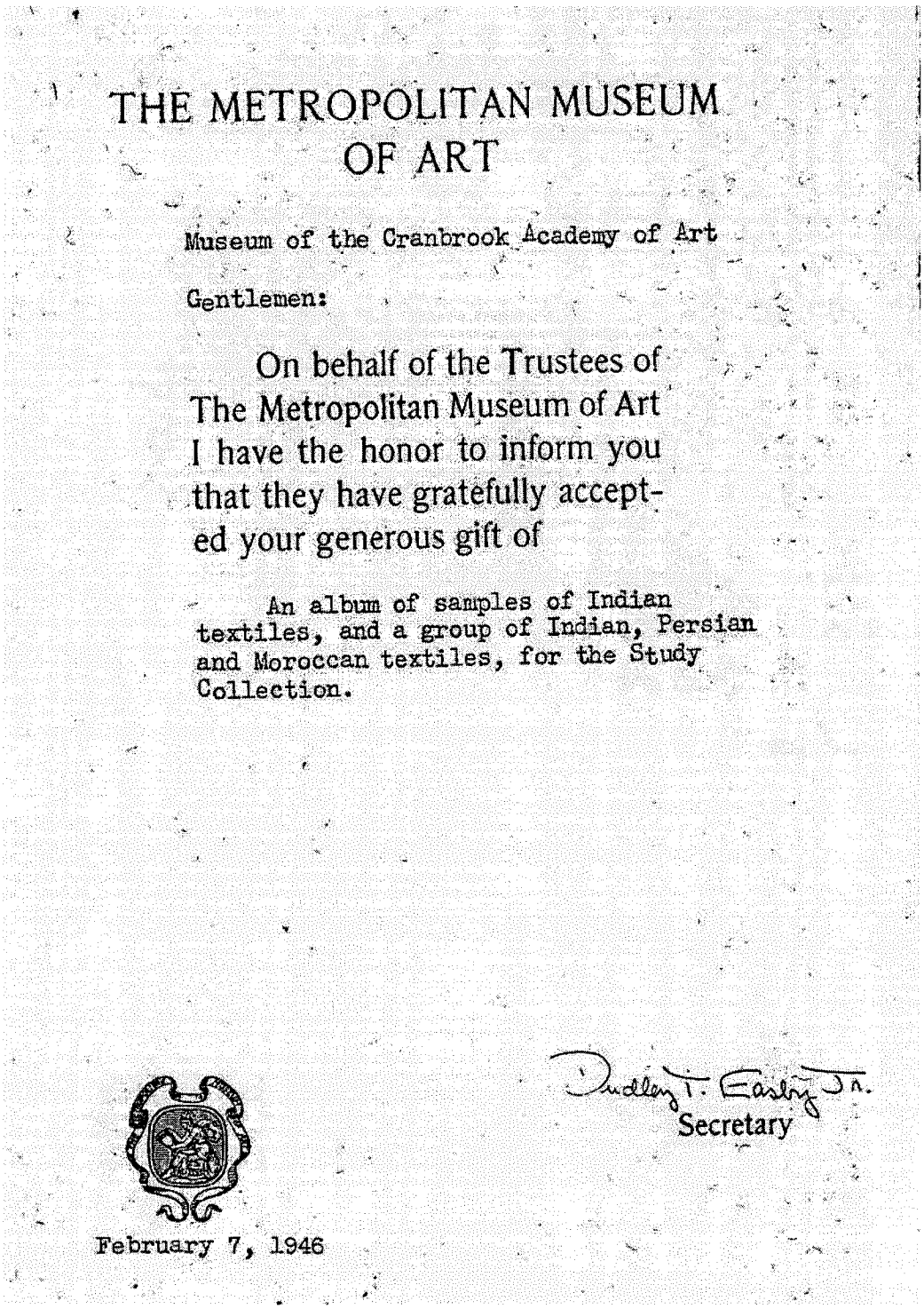
If you get them off right away, they may be able to decide on or just after the first of October -

New York is, as usual, wonderful.

All Love,

Peter

10 Letter of thanks from Metropolitan Museum of Art



THE METROPOLITAN MUSEUM
OF ART

Museum of the Cranbrook Academy of Art

Gentlemen:

On behalf of the Trustees of
The Metropolitan Museum of Art
I have the honor to inform you
that they have gratefully accept-
ed your generous gift of

An album of samples of Indian textiles, and a group of Indian, Persian and Moroccan textiles, for the Study Collection.

Dudley T. Easby Jr.
Secretary

February 7, 1946

11 details of gift to NBM from CUASA

The Cooper Union for the Advancement of Science and Art

COOPER SQUARE, NEW YORK 3, N.Y. ALGONQUIN 4-6300

ART SCHOOL
SCHOOL OF ENGINEERING
EVENING FORUM SERIES
MUSEUM FOR THE ARTS OF DECORATION
THE LIBRARY

MUSEUM FOR THE ARTS OF DECORATION
Calvin S. Hathaway, Curator

13 May, 1947

Miss Harriet Dyer Adams, Curator
Cranbrook Academy of Art
Bloomfield Hills, Michigan

Dear Miss Adams:

At the May meeting of the Advisory Council of the Museum your generous gift of textiles was presented, and twenty-eight pieces were accepted for the Museum collections. We are most grateful to you for your kindness. As you may realize we should have been most happy to have selected a larger number of pieces, had it not been that they were so closely similar to our already rich collection of material of the periods represented.

Following the instructions contained in your letter of 1st April, 1947 we have forwarded the balance of your textiles to a museum which is badly in need of such material: The New Brunswick Museum, Saint John, New Brunswick, Canada. Mrs. Clarence Webster, President of the museum, and Mr. Avery Shaw, its Curator, saw the textiles on their recent visit to Cooper Union and were extremely pleased with the prospect of obtaining them for the New Brunswick Museum.

With thanks to you for your generosity, I am,

Sincerely yours,

Calvin S. Hathaway

Curator

CSH-H

12 Harriet Adams request to the NBM

The New Brunswick Museum
Saint John, New Brunswick
Canada

March 20, 1951

Miss Eva Ingersoll Gatling,
Curator,
Cranbrook Academy of Art,
Bloomfield Hills,
Michigan, U. S. A.

Dear Miss Ingersoll:

This acknowledges your letter of March 16th. The textiles to which you refer were given us by Mr. Calvin Hathaway of Cooper Union Museum in 1947. Pressure of work has prevented us from cataloguing them, and we cannot give you a detailed description. We have approximately 300 pieces, most of which are European from the 15th Century.

Might I suggest that you write Mr. Hathaway, since he culled the collection before turning the remainder over to us.

Yours truly,

Avery Shaw

AS:BS

Avery Shaw,
Curator, Art Department.

13 Letter requesting information about missing parts of the collection

March 23, 1951

Miss Marta Larssen
417 Waverly Avenue
Syracuse, New York

Dear Miss Larssen:

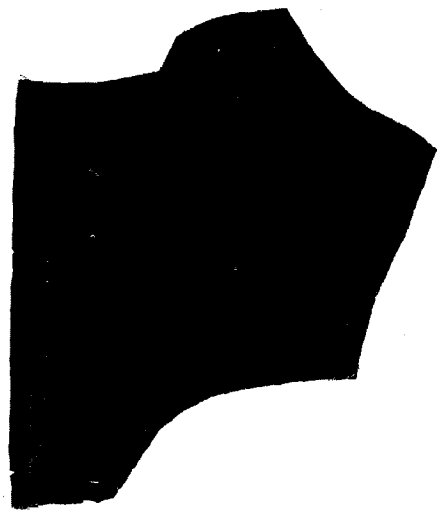
We are endeavoring to trace some textiles which Mrs. Weibel remembers in our collection and which we are not able to locate, so I am writing to ask you if you remember anything about these pieces. Mrs. Weibel came out asking to see our Perugia towels. We had a group of seven fragments which we got out for her. She was quite distressed as she had remembered a considerably larger collection, some of which she was quite sure she had seen mounted on our mounts. She told us that this museum had purchased the entire Cavaliere Rocchi collection and that she and Mr. Christ-Janer had both felt very strongly that this collection should never be dispersed. She did not know the exact number of pieces but thought that it might run as many as thirty. We have searched all of the museum records and all of the little black books that Rhea Moore knows about and do not find any mention of any Perugia towels, other than the seven fragments which we have. We do find record of a large group of textiles which are simply listed as 500 fragments, and we also find record of a gift of about 300 fragments still not listed, so we are very anxious to find out whether or not any of the Perugia towels were disposed of in some manner.

We will be very grateful for any information which you can give us.

Sincerely yours,

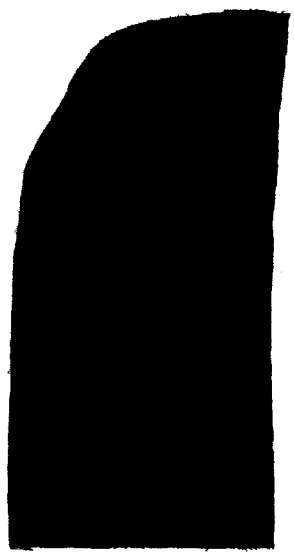
EG:fg

14 Collection catalogue fragments



1927-113

1927 - 126



1927 - 116

Glossary Weaving Terms

Brocade: Multicoloured jacquard woven fabric with floral or figured pattern emphasized by contrasting colours. The background may be either satin or twill weave.

Loom: is the frame that holds the warp threads aligned and under tension so that weaving can take place.

Selvedge: The narrow reinforced edge of the fabric. It runs lengthwise and is usually made of stronger yarns in a tighter weave. The selvedges stabilized the fabric during weaving so that the cloth maintains its rectangular shape.

Tie-up: shows the shafts that must be raised and/or lowered by each treadle to make each shed required by the weave structure.

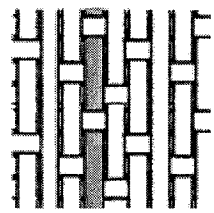
Tying on: the warp usually refers to the tying of small groups of warp threads to the front apron rod.

Warp: the set of threads running lengthwise or parallel to the selvedge.

Warp sett: is the number of warp ends per inch—usually abbreviated as epi. The weft sett is the number of weft picks per inch—usually abbreviated as ppi.

Warp yarns:

- pass from the back to the front of the loom
- run down the length of the fabric (in garments from head to toe)
- run parallel to the selvedge
- form the strongest direction of the fabric with the least amount of give
- form the lengthwise grain
- referred to as the straight grain.

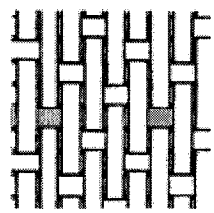


Weave structure: is the order in which warp and weft threads go over and under each other, i.e., the interlacement. If they interlace alternately, the weave structure is plain weave. "Tromp" is an old way of saying "step" on a treadle.

Weft: the set of threads that run from selvedge to selvedge, perpendicular to the warp threads.

Weft yarns:

- go across the fabric width
- run from selvedge to selvedge
- are usually woven at right angles to the warp to fill the cloth
- the crosswise grain which has more stretch (usually used around the body).



Vitae

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Publications:

Taylor. Stephen A., *The Wonderful World of Digital Fibre Printing* Needlework New Brunswick - The How and Why (http://needleworknb.tripod.com/id27.html. 2005)

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