FROM ECONOMY TO EXCLUSIVITY: A HISTORY OF THE DEVORÉ TEXTILE 1880 TO 1940.

A Thesis submitted for the degree of Doctor of Philosophy

By

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Abstract

This thesis creates a contextual historical analysis of the development of chemical and devoré manufactured textiles, relating methods of construction and intended use to existing textile design and social histories.

The initial investigation of devoré practice, whether used in association with woven, knitted and stitched textiles, includes a comprehensive examination of the historical textile patent record from 1840 to 1940, which formed an extensive part of the historiography. The aim of the research was to establish a credible narrative of woven devoré, through its design and its manufacture.

The methodology is interdisciplinary. In the course of my research and material evaluation I have considered evidence that is normally considered to be chemical and fibre analysis, design and art history review, dress textile and interior textile analysis, social and economic history and object analysis.

This study in particular focuses on the peculiar dichotomy of woven devoré: that is its growth as a manufacturing method of affordable textiles for the mass market contrasted with its most common deployment, as an ornate decorative textile. This study also challenges the conventional view that the aforementioned decorative woven devoré textiles were developed in response to periods of economic depression.

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I dedicate this work to the memory of my mother, Sister F. L. Robertson. MBE.

Authors Declaration.

Whilst every endeavour has been made to properly credit literature, ideas and quotations from other sources referred to in this thesis, the author accepts no responsibility for any omissions and/ or errors found in the text.

GLOSSARY OF TERMS

A

a1) **acetone.**
A colourless liquid which is an excellent solvent, is prepared by heating calcium acetate... Acetone is an important chemical compound in the manufacture of cellulose acetate rayon'. Bendure Z and Pfeiffer G. (1946). p.444

a2) **Artificial Silk Dyeing.**
Artificial Silk, 1928, p.14. 'The difficulties which were encountered in producing a marketable product, more especially one which showed a satisfactory and uniform affinity for dyestuffs, were very great, and for a long period prevented the commercial exploitation of this material.

And also Foltzer J. (1928). p.192; 'Delpech has published in the review "Le caoutchouc et la gutta percha" of 15th June, 1911, the result of some experiments on acetate spinning, in which he states: "According to the diameter of the capillary tubes employed, the silk obtained is more or less supple. If the diameter of the filaments is arranged to be from .05 to .06mm., the acetate silk is strong, supple and silky; its appearance approaches that of good natural silk; it is not so lustrous as the artificial silk made by either the Chardonnet process or the cuprammonium process-this is not a defect, however, but rather an advantage. Its great disadvantage is its weakness, for according to Delpech, it is much weaker than Chardonnet silk, and moreover, when wet it loses one third of its strength- a defect eliminated by the time of this publication.' - 'Unlike other artificial silks, acetate silk scarcely swells under the influence of water.' Foltzer, J. (1928) p.193.

B

b1) **Body of the cloth.**
A term used by Stevenson and Wakefield to denote the remaining textile or predominant/ remaining structure.

b2) **Blotch Pattern.**
Blotch 'any relatively large area of uniform colour in a printed design. The printed background to the design is commonly referred to as the blotch.' Anstey Weston (1997).

C

c1) **Caustic soda: Na OH. Sodium Hydroxide.**
A strong alkaline solution in water. Also refer to Pot Ash

c2) **Cellulose acetate**
Classified as a derivative cellulose fibre, as the chemical composition of acetate is not cellulose, but a chemical variation of cellulose known as an ester. For this reason the behaviour of cellulose acetate differs somewhat from other cellulosic fibres. Nasmith, F. (1926). p.61; also states that cellulose in its 'simplest chemical expression, has the formula C6H10O5 or C6H7O2(OH)3, - that is, it possesses three hydroxyl groups (OH). By the introduction of one, two or three acetyl groups-(CH_3CO)-in the acetating reaction, various acetyl derivatives of cellulose are formed. The acetate silk of the present day usually consists of a cellulose containing from two to three groups. The greater the proportion of these groups introduced the less easily is the silk wetted and generally also less easily is it dyed. This is the reason why the earlier forms of this silk (usually fully acetylated) were so difficult to wet and dye. Acetate silk possesses an analogy to nitro or Chardonnet silk in that, with both, esters of cellulose are first produced which necessitate the employment of organic solvents for solution, the esters not being soluble in aqueous media. With viscose and cuprammonium silks the cellulose derivatives are soluble in water.'

Koslowski, H.J. (1998). With regard to **cellulose acetate** fibre states; 'In the production of acetate, high-grade cellulose is converted into cellulose acetate (acetyl and dissolved in acetone. The viscous spinning solution is pressed through spinnerets, failing through 3-6m high spinning ducts, where the volatile solvent acetone is evaporated (and recovered). The dissolved cellulose acetate is transformed into solid, filament yarns (dry spinning) with a silk-like lustre. They are wound at the bottom of the spinning machine, then twisted, and wound on to bobbins ready for processing or made ready for processing on the spinning machine by means of an air interlacing process (intermingling) without the necessity of a further twisting operation. Chemical after treatment and yarn cleaning- as with the viscose and ammonium copper oxide processes is unnecessary after spinning.'

c3) Cellulose Acetate Manufacturing- British Celanese

Placing the said cotton material into a bath of acetic acid and acetic anhydride and a catalyst of zinc chloride or sulphuric acid, a whereupon the cotton linters remained in the solution for several hours during which the temperature was slowly raised, a process known as acetylation **b**, a technique that the editors of 'Man-Made Fibres, their Manufacture and Application declare the brothers Dreyfus are said to have perfected.
Furthermore this thick fluid resembling treacle 'but smelling pungently of vinegar' was allowed to ripen, and the cellulose acetate element subsequently separated from the mixture by the addition of water (precipitation). **c** With the acid carried off the cellulose acetate solid could be ground up. For spinning into yarn this 'acetate flake' was brought into solution by dissolving in acetone, filtered and then pumped through a spinning candle from which it emerged from the fine holes of the jet in the form of filaments which were then twisted together into a single yarn and wound onto a bobbin. **d**

a. **Catalyst.** 'A substance which when added to a reaction mixture changes the rate of attainment of equilibrium in the system formally without itself undergoing a permanent chemical change.' 'In theory the catalyst can be recovered chemically unchanged at the end of the reaction, although it may be changed physically.' Sharp, DWA. (1990).

b. **Acetylation.** 'A process for introducing acetyl groups into an organic compound containing –OH, -NH_2 or –SH groups. It is carried out by heating the compound with ethanoic anhydride or ethanoic chloride usually in the presence of an inert solvent such as benzene or ethanoic acid. In many cases, zinc chloride or pyridine is used to hasten the reaction.' Sharp, DWA. (1990).

c. **Precipitation.**

d. **Dry spinning.** The process explained within the text is known as dry-spinning. Refer to point 2. In the British Celanese publication Man-Made Fibres- Their Manufacture and Application. 2nd Edition page 22 'In the making of cellulose acetate yarn, however, the so-called dry spinning system is used. The fluid threads are converted into yarn, not by immersion in a hardening solution, but by evaporating the solvent, which is in the spinning solution. This method allows a very high speed of spinning and involves the least handling of the thread.'

However Foltzer, (1928), p.192; states there are two methods of manufacture connected with the spinning of cellulose acetate dry-spinning as in the case of Chardonnet silk and wet-spinning as in the process of Despeissis and Lehner. With wet spinning the thread passes through a precipitation bath. In dry-spinning the thread is formed before it leaves the capillary tube, and a precipitation bath is not required. Foltzer states that 'in most case dry spinning has been abandoned, the attempts to spin acetate being practically confined to the wet process.'

c4) Cellulose Acetate History of development

'Acetate silk was made in America in 1901, and research work carried on for 14 years manly by the Du Pont Co. The names of Little, Mork and Walker are particularly associated with this early work (U.S. Pats No 712,200 and 792,149). In Germany two important groups, Bayer & Co. and Knoll & Co., achieved interesting results. Eichengrun was associated with the former concern and Knoevenagel with the latter. Nasmith, F. (1926). p.43.

'Better success was achieved by a further new product, produced from cellulose acetate. The workers in this field comprised the Americans, Mork, Little, and Walker, also Leonhard Lederer, the Fürst Guido Donnersmarcksche Kunstseiden-und Acetatwerke, the Farbenfabriken vorm. Frederich Bayer & Co., of Elberfeld, Chemische Fabrik Knoll & Co., of Ludigshafen, Henri Dreyfus of Basle and others. Although acetate silk has only just achieved economic success, after experiments extending over the last thirty years, no final opinion can even now (in 1925) be expressed on this product.' Hottenroth. (1928). p.14.

'Cellulose Acetate process.- The pioneers of this process, in addition to Schutzenberger and Naudin (1865-70) already referred to, included Franchimont (1878-82), Girard, Liebermann, Hoermann, Lederer, Ewingst Koenigs and Cross and Bevan , the later being the first to attempt the industrial production and utilisation of these esters (British Patent, 1894). Their patents were taken over by the Donnersmark concern, which spent a large sum developing the process at Stettin works, selling the product under the name of "Cellestron." Nasmith, F. (1926). p.43.

c5) Cellulose acetate: Dreyfus Brothers:

When used as a painted coating for aeroplane wings, **cellulose acetate** caused the fabric to tighten and become impervious to air. 'In 1916 the Government were considering the erection of a factory to manufacture 'dope', or non-inflammable lacquer, for coating aeroplane wings and bodies, and an independent committee of chemical experts had unanimously recommended the adoption of a cellulose-acetate process put forward by Dr. Henry Dreyfus, who, with his brother Camille, had specialised since 1905 in the chemistry of cellulose esters.' Jackson, C. H. Ward (1941).

'1916 – 'The British government invites the Dreyfus brothers to Britain to produce their new airplane paint along with the intermediate product acetic acid which was being imported from Canada at the time due to the First World War. The British Government patented the process developed by Henri Dreyfus which lowered the costs of acetic acid anhydride production.' www.celanese.com CelaneseAg- History. /index/about ¡index/history-1999-1980/history-1918-1863.htm. 20.11.2002.

'Only recently have these difficulties been mastered to such an extent that the process has proceeded beyond the experimental stage to the erection of fairly large works. British Celanese, Ltd., Spondon, and the allied enterprise, the American Cellulose and Chemical Co., Cumberland, U.S.A., operate according to the process of Henri Dreyfus, the managing Director of the former company.' Hottenroth. (1928). p.14.

It could be said that Courtaulds had paved the way of the artificial silk product because of their focused development of viscose silk. Early difficulties with this product were resolved by the time of acetate silk development. The war years may also have affected the general response to artificial silk textiles, Europeans in particular had been reduced to limited availability of all textiles, fashion or furnishing in weight.

British Cellulose and Chemical manufacturing Company produced the first commercial cellulose acetate yarn in 1921. 'The material revolutionized the industry, but was far too ahead of the weaving and dyeing technology. The company had to develop its own technology that would replace the outdated versions.' Celanese Chemicals History. www.celanesechemicals.us /index-c/$_{the}$_company-c/history-c.htm 20.11.2002.

With thanks to Cathy Stilwell of Celanese Acetate. Cathy. Shimanski@CelaneseAcetate.com

c6) Cellulose acetate treatments/ fabric styles

Delustering.

The action of boiling water or steam can destroy the lustre of a cellulose acetate fabric. Prolonged treatment can leave the fibres with a woolly appearance. Lipscomb. (1933) p.218.

British Celanese. B.P. 310,845. p.223.

Lustre pattern effects can be achieved by weaving together 2 types of acetate yarns. One that can be easily delustred with boiling water or soap solutions, the other having a higher level of resistance, and then subjecting the fabric to a delustring process.

c7) Solvents for Cellulose acetate

The description of other solvents for cellulose acetate removal was found within Amcelle's/ British Celanese GB Patent 263,355 'Improvements in or relating to the Printing of Fabrics and

Articles Made of or Containing Cellulose Esters or Ethers.' Application dated March 12, 1926. Complete Accepted Dec. 30 1926.

c8) **Esters**: 'Organic compounds formed by the union of an acid and an alcohol with elimination of water. They are volatile liquids or low melting solids and are usually insoluble in water but soluble in alcohol or ether.' Sharp, DWA. (1990).

c9) **Cellulose ethers**: 'Formed by alkyl- and aryl halides on cellulose in alkali solution. Used as plastic materials. Methyl cellulose is water soluble and used as an emulsifying, sizing and priming material. Sharp, DWA. (1990)..

c10) **The drying of cellulose acetate** should according to Lipscomb, Cellulose acetate its manufacture and applications, Ernest Benn Ltd, 1933, 'should be as rapid as possible, in order to avoid loss of lustre..'

c11) **Covering**, this is thought to be a reference to the way in which a supplementary set of fibres can appear on a woven textile, for instance, pile fibres, as in a velvet textile or a velour, or a satin weave.

c12) **Cut velvet**. A pattern of velvet woven on a sheer fabric, like georgette or chiffon, leaving the sheer material visible in areas. Similar to Burn-out and Faconne Velvet. www.narrow-fabrics-manufacturers.com/glossary-of-products-f.ht.

D

d1) **Dextrin**: 'Intermediate products formed during the hydrolysis of starch to sugars.' Strongly dextrorotatory. Sharpe, 1990. In this recipe it is used as a thickening agent, however other agents such as 'starch or casein' can also be used.

F

f1)

a) Façonné: 'Fibre: Silk or rayon. Weave: Figured weave or "burnt-out" finish. Characteristics: Façonné in French, means fancy weave. Has small designs all over the fabric. fairly light in weight, and could be slightly creped. Background is much more sheer than the designs, therefore the design seems to stand out. Very effective when worn over a different colour. Drapes, handles, and wears well. Uses: Dresses, blouses, scarves, after 5, dressy afternoon and bridal wear'.
www.ravistailor.com/glossary.

b)Façonné: 'A fabric with small scattered motifs usually jacquard but sometimes burn out. The French word for 'figured'. It is used in relation to textiles to describe Jacquard fabrics with a pattern of small scattered figures'.
www.narrow-fabrics-manufacturers.com/glossary-of-products-f.ht

c) Façonné velvet: 'Patterned velvet made by burnt-out print process. The design is of velvet with plain background. (same as above)

I

I1) **Infusorial earth** can 'be replaced by other suitable powdered materials such as blotting paper, powdered cellulose, barium sulphate or any other solid absorbent material in powdered form which has no chemical effect on the solvent used; for example if instead of lactic acid, acetone or another neutral solvent is used, powdered calcium or barium carbonate can be used.' Camille Dreyfus US patent 1,588,951. Line 45-54.

I2) **Inorganic esters**
(Cellulose) **propionate**: 'propanoic acid, propioninc acid, $C_3H_6O_2$, CH_3CH_2COOH. Colourless liquid with an odour resembling that of ethanoic acid; m.p. 24 °C, b.p. 141 °C. Occurs in the

products of the distillation of wood. Prepared by the oxidisation of propanol, propanal or by the reduction of propenoic acid. Used in production of esters and polymers.' Sharp, DWA. (1990).

L

l1) **Lactic acid**: the acids are colourless syrupy liquids which readily absorb moisture, and are formed by the fermentation of sugars', and used as a chemical intermediate in textile finishing. In this recipe the lactic acid or other solvents of cellulose acetate, 'like acetic acid, acetone or higher boiling point solvents or combination of solvents of acetate of cellulose can be used.'

M

m1) **Mercerisation:** 'process of treating cotton and linen yarns and fabrics with a solution of caustic alkali, generally caustic soda, which is sodium hydroxide. The fibres are swollen, and the strength and dye affinity are increased. The textile is generally held under tension to increase the lustre.' Anstey Weston (1997). Stevenson and Wakefield state the 'animal threads may be of any origin and the vegetable threads that may be mercerised are line, cotton, ramie or jute threads.'

m2) **Mordanting**. Another definition for mordant is 1. Any corroding substance used in etching. 2. (Dyeing &Calico Printing) Serving to fix colours. 3. Biting; caustic; keen; severe.
Mor"dant (?), v. t. [imp. & p. p. Mordanted; p. pr. & vb. n. Mordanting.] To subject to the action of, or imbue with, a mordant; as, to mordant goods for dyeing. Webster 1913.
Consequently, the use of the term mordant to mean devoré manufacturing should be considered at this point. It has been included within the possible terms for woven devoré at least. Patents prior to this date will be re-evaluated for any possible inference of this term being used to describe the burn out process.

N

n1) **Ninon:** a lightweight plain weave, made of silk or manufactured fibres, with an open mesh-like appearance. Made of a high twist filament yarn, it has a crisp hand. heavier than chiffon, its use includes evening wear and curtains.

O

o1) **Organic derivatives of Cellulose:** Examples of organic substitution derivatives of cellulose are cellulose esters and cellulose ethers. Among the cellulose esters that may be used are 'cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate. examples of cellulose esters are methyl cellulose, ethyl cellulose and benzyl cellulose.' Process of Treating Fabrics. US Patent 1,818,505. Application filed December 16, 1927. Patented August 11, 1931. Page 2, Line 22 –29.

o2) **Oxalic acid:** When heated with sulphuric acid is decomposed to CO, CO_2 and H_2O. Oxalic acid is used for metal cleaning, because of its bleaching action it is widely employed for textile finishing and cleaning. Sharp, D.W.A. (1990).

Oxalic acid: also called ethanedioic acid. Poisonous crystalline organic acid. Used as a laundry bleach.

P

p1) **Phenol:** (carbolic acid) 'is a white crystalline solid,... It is used in making synthetic resins, one of which gives a crease resistant finish to fabrics.' Bendure & Pfeiffer. (1946). p. 444.

p2) **Plush:** A warp pile cloth cut in the horizontal direction by the blades in the loom whilst being woven. de' Marinis. p.189, point 11 plush. 'It has certainly been in use since the seventeenth century. Beginning with the turn of the last century, plush was manufactured as an imitation of fur, and it has become fashionable again only recently, and is manufactured with special mechanized looms.'

p3) **Pot ash:** Pot"ash` (?), n. [Pot + ash.] (Chem.) (a) The hydroxide of potassium hydrate, a hard white brittle substance, KOH, having strong caustic and alkaline properties; -- hence called also caustic potash. (b) The impure potassium carbonate obtained by leaching wood ashes, either as a strong solution (lye), or as a white crystalline (pearlash). **Potash** (Page: 1120) Websters 1913 Dictionary.

S

s1) **Saponification practices**: acetate alkaline saponifies the organic derivative. converts the cellulose to a cellulose derivative and then removes locally the converted cellulose. Saponification: 'The act process, or result of soap making; conversion into soap; specifically (Chem.), the decomposition of fats and other ethereal salts by alkalis; as, the saponification of ethyl acetate. ←"ethereal salt"=ester→' with reference to Webster's Dictionary of 1913 http://humanities.uchicago.edu/cgi-bin/WEBSTER.sh?WORD=saponify. [31 May, 2002].

s2) **Solvents (for cellulose acetate, etc.): "like dissolves like".** 'Not all solvents will dissolve all solutes. An important consideration is the polarities of the solvent and solute. The rule to remember is that "like dissolves like".' Collier & Tortora. (2001).p.57.

s2) **Soured**. Caustic soda is neutralised in weak acid bath hydrochloric or acetic acid.

T

t1) **Textile engineer**: A forerunner of the textile designer. Controlling both the manufacture and patterning or design of the textile, and whose background may be in finishing, printing or engineering or connected with textile manufacturing. The modern use of this term reflects the emergence of the designer craft maker whose work can be destined for mass manufacture or more technological and science output.

t2) **Transparent Velvet:** Lightweight, soft, draping velvet using silk, rayon, acetate or nylon for the pile effect; back is of rayon, silk or nylon. Linton & Pizzuto. (1961). p.88.

V

v1) **Vintage**: The term applied to contemporary textiles whose patterning, patina, fabric styling or fabric structure has been fashioned to appear from a past era, possibly distressed to appear worn with age. The design and imagery applied by printing, weaving, embroidery or appliqué may be an amalgamation of styles from various art and design periods.

v2) **Volatilize:** 'render volatile; to cause to exhale or evaporate; to cause to pass off on vapor.' Websters Dictionary 1913.

Introduction

Introduction.

Woven and knitted textiles are rarely thought of as being plain or unadorned. The very nature of their creation, the use of varied weights, textures, colours and the patterning of yarns, inevitably suggests a sense of surface design. The further embellishment of constructed fabrics, whether for ritual or decorative purposes, often involves enhancing the surface of the original textile through the use of printing or dyeing, stitch or beading.

The use of decorative textiles to exclusively communicate a sense of personal or religious identity is in decline. The design of the modern decorative textile is superficial and relatively short lived. Decorative fabric production has reached a point where dress and interior fabrics are as a rule mass-produced, textile manufacturing is standardised, and the inspiration for design and patterning is dependent upon a synthesis of many visual sources.

In response to this design and manufacturing shift the modern decorative textile industry has become highly skilled at delivering new and innovative products to an extensive group of consumers. The phenomenal range of techniques and processes now employed in the manufacture of dress and interior textiles is reflective of the textiles market's constant need to surprise and excite the design conscious consumer. With the fashion and interior retailers strict adherence to seasonal fibre and design trends the modern decorative textile is designed to compete against a breadth of designs, colours, patterns, and labelling and graphics, often to disappear when the collection is refocused towards the next agreed look.

A consequence of this inclusive, technique-led fabric designing (apart from achieving fast turn over in the market place) has been consumer's evident detachment and limited knowledge of fabrics, how they are constructed, coloured or decorated in direct contrast to previous generations understanding of fabric discovered through the making of clothing and textiles for the home. Furthermore, the production of sophisticated textiles for rapid turnover high street stores is seemingly taken for granted by the consumer.

In recent years the embellishment of woven and knitted textiles has tended to rely upon pattern and colour trends of the past as a source of design inspiration. The current 2005 appetite for past design and fabric styling, although not exclusive to this period in textile

design development, reflects a new fascination for all things vintage. Moreover, the consumer's attraction to vintage styled textiles indicates the desire to attain personalized or customized belongings and surroundings.

The growth in real vintage clothing and interior fabric collecting, through modern vintage stores including on-line vintage sites, has created a new interest in the researching of past textile processes and methods of decoration. These historical craft based processes of fabric decorating are being mixed with contemporary fabrics and patterning likes. The textile designer maker has, as a consequence of the interest shown in these past textiles processes, an opportunity to become both historical researcher and innovative practitioner.

This thesis has taken for its subject the field of textile finishing, more specifically it concerns itself with the devoré process. Generally classed as one among many textile-finishing techniques, the devoré style of textile and its process of manufacture differs from other "special finishes" in its reliance upon structural enhancement by destruction rather than decoration through added embellishment.[1] Traditionally, it is considered to be a textiles chemical finishing process because it employs 'treatments with alkalies, acids, bleaches, starch resins and the like.'[2] DS Lyle in Modern Textiles considered "surface applied designs" to be a more suited description of procedures that can be used to create 'readily recognized' textiles with 'special aesthetic appeal'.[3]

The devoré procedure of burning away single or multiple fibres from a constructed fabric has been developed and refined as a form of textile manufacturing and decoration for over a hundred years. Varying types of chemically etched fabric have emerged as the woven, knitted and stitched textile industries, have created specialized and innovative forms of the technique. Textiles manufacturers, by applying the devoré process to suitably constructed fabrics, have afforded the consumer finely stitched chemical laces and chain stitched embroidered textiles, delicately etched knitted cloth and figured plain woven and pile woven fabrics often created from innovative or previously unworkable natural, manufactured or synthetic fibres.

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[1] Lyle, D.S. (1976) Modern Textiles. New York: John Wiley and Sons Inc. p. 281
[2] Wingate, I. B. (1964). 4th Edition. Textile Fabrics and their Selection. NJ: Prentice Hall. p.170
[3] Lyle. (1964)

The appeal of the devoré technique to designers and manufacturers can be measured by its repeated adaptation and employment. From the later part of the nineteenth century the devoré method of fabric procedure has been employed by some of the textile industries leading designers and engineers. While initially intended for use with yarns and threads that were previously unworkable, the devoré process, over its period of development, was adapted to create and decorate a broad range of traditional and innovatively manufactured fashion and furnishing fabrics.

One might assume therefore, that the origin and evolution of devoré should be established and widely understood, with the relationship between the various forms of chemically manufactured textiles such as woven and chemically etched lace and embroideries widely acknowledged, yet this is not the case. Both lace and embroidery have at times been highly fashionable and well documented, yet clearly it appears the manufacturing origin of woven devoré is little known and, until recently, received limited consideration or review. It is the express remit of this dissertation to address this historical deficit.

Given the resurgence in popularity of the woven devoré process with textile practitioners, the couturier and high street designers the continuing absence of any examination of past woven devoré development fails to acknowledge textile artists in America who have re-emerged at the forefront of its development, and Britain's textile students and designers who are widening its use within fashion and the interior product.[4] Interestingly the apparent divergent use of the process by these two groups reflects the nature of textile education in their respective countries. A subject which, sadly, falls outside the remit of this study.

The reason devoré textiles lacked appeal as a subject for serious historical research until now may have been because its history lies in chemical manufacturing which may have deterred textile historians. Moreover, where cross over between textile technology and the realm of the designer has been apparent within a textiles subject in the recent past, it was expected of art and design researchers to remain within their field of specialism. This issue was raised by Susannah Handley in her 1997 Doctoral thesis Cloth, Clothes, Chemistry: synthetics, technology and design in the 20th century. Handley

[4] The distinction between textile artist and designer is that the textile artist uses the devoré process to create one off conceptual pieces with a craft bias. The designer uses the devoré process in order to create textiles for multiple production, either by the designer or on a manufacturing/ industrial level.

acknowledged the 'symptomatic boundary drawing' that prevents non-technologists from writing and researching within a technical subject area.[5] Throughout this study I have brought to the research my own interests and experience as a practising textile designer rather than treating the subject purely from the view of the textile historian. Accordingly, this has impacted upon the interdisciplinary nature of the research methodology, ultimately resulting in the science of devoré manufacturing being used as a writing framework for the structure of this thesis. Consequently the intention of this research has been to place the various devoré processes into a wider social, economic, manufacturing and design context. Furthermore, the focusing of the examination on woven devoré textile design and manufacture within this thesis was not intended to be wholly science based in its evaluation, but rather targeted towards a designer maker's perspective of the chemical processes that are utilized during woven devoré manufacture.

A lack of clarity regarding manufacturing origin may also be responsible for the textile industry and the textile historian's neglect of woven devoré history. The simplicity of the textiles final appearance often belied the complexity and diversity of the fabrics manufacturing. Moreover, the similarity of woven devoré textiles to woven textiles patterned during fabric construction clearly influenced the lack of recognition these textiles have faced. It may be that the design and patterning of the woven devoré textile has been perceived by historians as being imitative of established woven fabrics, and therefore, considered to be lacking in originality of pattern design or manufacturing. It is an express intention of this study to establish a discussion within the academic community and with archivists and curators on the subject of woven devoré textiles and their past development and applications.

Undoubtedly devoré manufacturing was developed and adapted by manufacturers already involved in some form of textile production. Until the early 1920's regional textile industries within Europe were remained focused on local industry and specific methods of textiles manufacturing. The employment of the devoré process by these manufacturers was adapted to suit their traditional manufacturing procedures and commercial interests. Only with the development of artificial silks did the textile

[5] Handley, S. (1997) Ph. D. thesis Cloth, Clothes, Chemistry: synthetics, technology and design in the 20th century, RCA.

manufacturing industry become more integrated and the woven devoré textile more standardized.

The complexity of devoré history is ultimately linked to the chemical variegation of the fibres and fabrics selected for treatment; designers using this process had clearly to be trained in the fibre sciences. Moreover it is evident that the manufacturing of devoré textiles was traditionally in the hands of the textile engineer, whether a finisher, printer, or chemist.[6] It has been an express intention of this research to reveal how the design of the woven devoré textile was influenced first by the textile engineer and then by popular design trends evident during the processes development.

Recognising the various woven fabrics that were created or ornamented using this technique, along with the application of these textile products and the nature of their patterning and design, forms an important aspect of the study. The significance of contemporary woven devoré fabrics to the detection of past devoré practice was recognised in the early stages of the research, as much terminology associated with devoré process is rather oblique, and an initial aim of this research has been to establish a feasible history of the woven devoré textile using a breadth of research material on the terms synonymous with devoré.

The decision to use the term 'devoré' to represent the process of chemical fibre removal outlined within this thesis rather than 'burn out', or any other historical term that was found to have been in use during 1880 and 1940, was in response to the breadth of terms discovered and the inconsistency with which terminology was applied to the devoré process. Moreover the devoré term has become widely accepted by the modern consumer, designer and many textile writers, curators and archivists over the last twenty years.[7] The origin of the devoré term can be traced to the late 1960's where 'devorant' was applied to Terylene and cotton devoré treated lingerie. This French word dévorant, meaning burning, devouring, consuming, has over the subsequent decades, been

[6] Textile engineer. A forerunner of the textile designer, but whose background was in the manufacturing of textiles. Controlling both the manufacture and patterning or design of the textile, and whose background may have been in finishing, printing or engineering or connected with textile manufacturing. The contemporary use of this term relates more to the textile designer becoming more involved in the shaping and engineering of a previously constructed textile not necessarily of their making. See also Glossary of Terms.

[7] A term used predominantly by manufacturers to describe the process of fibre removal, and still predominantly used in America by textile artists and surface designers.

gradually replaced by dévoré and then devoré, the past participle of the verb, which literally means devoured, eaten away. The rejection of the burn out term, a rather unassuming phrase predominantly used by manufacturers in the later part of the twentieth century, by many artists and designers is possibly an indication of the increasing commercial branding of textiles by consumer conscious retailers. However, the creation of a memorable generic name that immediately intimates an association with French fashion and therefore design sophistication has ensured today's consumer can now identify this particular figured textile amongst the vast array of patterned textiles. Furthermore, the devoré term has entered into the language of textile students, textile designers and consumers and is now widely applied to any textile, whether woven or knitted, that has undergone this specific chemical fibre removal treatment and therefore the term has as a consequence become universally associated with the process of chemical fibre removal rather than any one specific textile. As the intention of this research was the historical evaluation primarily of woven devoré development, but also knitted and stitched chemically treated textiles, the employment of devoré as the preferred and therefore defining term for this research was considered to be both appropriate for a contemporary audience, and in regard to the processes application suitably all-encompassing.

For the most part woven devoré textile history has been fashioned from a modern point of view rather than based on any historical evaluation. Sweeping statements regarding its origins and employment during the twentieth century are made with no real foundation. Specifically it has been velvet devoré that has received the most coverage over the last twenty years. Mimi Spencer for Vogue magazine declared devoré or burn out velvet to be the year's favourite fabric in 1993, it was she said a process that 'originated in France centuries ago, enjoys periodic renaissances, tending to surface at times of economic upheaval.'[8] Jasper Conran considered the increased employment of devoré in 1993 to be because "it's a craft-based process, perfect for the current movement away from that which feels mass produced." Helen Storey in the same article explained its place within her autumn collection was because "It has that great worn, antique quality – not so much a recycled look as 'from the museum' – a sense of history, a preciousness."[9] This view of velvet devoré has changed little over the

[8] Spencer, M. (1993). Velvet, eat your heart out. Vogue. June 1993. p.75.
[9] Ibid. Spencer, M. (1993).

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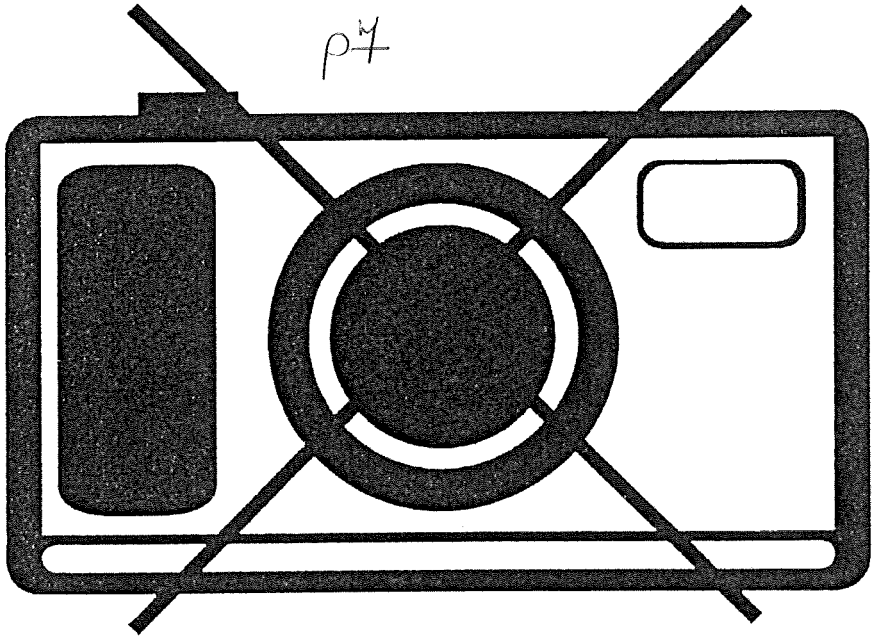

previous ten years despite its widespread availability on the high street and in galleries and museum shops, contrary to Mimi Spencer's prediction, see Fig. 1.

Tracing woven devoré development has proven challenging. There have been limited past references regarding the nature and breadth of the process, and until recently the devoré textile seemed irrelevant to textile history accounts. The devoré technique clearly was not an invention of the late twentieth century. This was a process that was widely known within the textile manufacturing industry in 1930, but after this point had somehow become marginalized.

In regard to the mapping of the research, in the preliminary stages it became evident that chemical lace and embroidery and knit and woven devoré were linked by a common chemical history. As chemically manufactured lace and other forms of chemical embroidery were well represented in regard to their documented history, with Santina Levey, Christina Risley, Patricia Wardle, and Pat Earnshaw and others offering a significant contribution to the establishment of a historical record for this style of fabric and its techniques of manufacturing.[10] In contrast there appeared to be a limited account of woven devoré development, which in 1997 at the start of this research seemed incongruous, given that woven devoré textiles were extremely popular having become a familiar textile product to the high street consumer.

The apparent distribution of the process as regards its geographical manufacturing locations was initially ambiguous, as woven devoré could have originated in the United States, Germany, France, Spain, the UK, and Italy, with some suggestion of India having engendered some form of the technique. Cursory and infrequent references to techniques or the varying forms of textiles created by means of the process evident within general textile design and textile chemistry dictionaries and encyclopaedia initially assisted in the dating of the technique. However, they neither fully acknowledged or adequately contextualised the devoré process and therefore, offered limited information to a devoré historiography.

The research framework offered by the chemical textile historical patent record helped establish a solid basis from which to explore the origin of the devoré process while

[10] Gwynne, J. (1997); Levey, S. M. (1983); Reigate, E. (1986); Risley, C. & Wardle, P. (1961); Simeon, M. (1979).

correlating other more recognised aspects of the chemical textile manufacturing field. In this connection the work of J. T. Marsh, An Introduction to Textile Finishing (1947,1966), with its references to chemical lace processes and extensive evaluation of cellulose acetate treatments, proved a useful model for my investigation of the historical textile patent records.[11] Primary patent categories were most important in ascertaining woven devoré textile development, including wool carbonising and chemical fibre extraction methods, extract fabric uses, thread manufacturing, woven fabric manufacturing, velvet and pile fabric manufacturing and ornamentation, other plain woven fabric decoration including Jacquard manufacturing, chemical lace and embroidery designing and associated production methods, knitted manufacturing and knitwear designing, as well as lingerie. Furthermore, the researching of what were initially considered to be more tangential subjects such as the chemical development of regenerated cellulose fibres, cellulose acetate and nylon, rubber products, significantly influenced the approach of future woven devoré research.

The density and complexity of the material that was subsequently uncovered during the study created an objective approach to other literature based material. The inconsistency with which woven devoré designing and manufacturing was categorised within the historical textile record also required careful re-evaluation of how past classifications of woven manufacturing and decorative practice were reached. The challenging nature of the data necessitated a straightforward approach to the requisite analysis of documented material. The development of a woven devoré chronology based on patented devoré techniques allowed the undertaking of a literature survey that accurately reflected the interdisciplinary nature of the woven devoré process. This included a review of textile chemistry, woven textile manufacturing, fibre technology, textile colouring and printing, textile designing, textile history, fashion and interior history, social and economic history.

A consequence of the comprehensive researching of predominantly European and American literature based material inevitably created a western-centric perspective of the woven devoré process and its relationship to other chemical textile treatments. The possibility of woven devoré development having originating in Asia was not discounted during the initial researching of the process. However, the positioning of this investigation toward the historical development of the woven devoré textile in Europe

[11] Marsh, J.T. (1947). An Introduction to Textile Finishing. London: Chapman and Hall Ltd.

and North America between 1880 and 1940 was in response to the formation of a plausible timeline for woven devoré invention and the subsequent detection of past examples of woven devoré textiles within Europe and American archives.

A preliminary survey of European and American textile archives culminated in the first visit being to The Museum at F. I. T. in New York in 1999. This opportunity to view woven devoré pieces from the late 1920's early 1930's not only shaped the manner of contact made to other textile archives, but also provided a guide as to the nature of early twentieth century woven devoré textiles, in particular the woven devoré textiles probable level of preservation, fibre usage and fabric structure, patterning and method of cataloguing. However, locating of past examples of woven devoré within specialist textile collections was variable, with no one archive having the same rationale of collecting. It was also apparent that the individual purchasing and collecting preferences of the curator determined whether woven devoré pieces were included within textile archives.

The varied composition of archives highlighted the difficulty in establishing whether chemically manufactured or decorated textiles had over their period of development been considered worthy of collection. This issue combined with the variation in classification of pieces, for instance woven devoré textiles manufacturer prior to the Second World War were likely to have been broadly catalogued as patterned velvet, or velvet lamé, brocade, or cut velvet, meant a rethinking of the nature of mass manufactured, ready to wear and novelty textiles preservation.[12] Furthermore, the sparse collections of woven devoré textiles manufactured of modern materials such as viscose, and cellulose acetate raises questions about museums' current policy on the conservation of mass manufactured fibre dress and interior textiles of the twentieth century.

While the devoré pieces held within textile archives were on the whole of high quality or especially decorative in nature, the sphere of activity outlined within the devoré patent record was clearly directed towards the creation of a range of textiles of varying economic levels. Locating surviving pieces of what could be described as 'middle

[12] With reference to American ready-to-wear clothing trade and Fairchild's Bulletin. (1925). American Men's Clothing for England. Fairchild's Bulletin. January 19, 1925. 'Ready to Wear' was the term applied to off the peg clothing in the 1920's and should not be confused with Prêt a Porter of the 1960's.

market' suitable for use within ready to wear garments required more unusual methods of researching. Investigating the employment of woven devoré textiles in the ready-to-wear market was only possible by looking for less complete examples, be they in sample or dress form. This thesis has therefore, made on-line textile vintage clothing web sites a source for historical textiles I have rarely seen included within any other contemporary textile reviews or discussions. The development of internet vintage clothing retail in America and Canada has steadily increased during the period of this study. The market for on-line vintage clothing in America has always been considerably healthier than in Europe, possibly as a result of textiles shortages experienced during and after the Second World War. Moreover, the level of knowledge presented by dealers is particularly sophisticated, the range of dress seen on these sites ranges from printed Fortuny to 1970's polyester flared trousers.

This interest in collecting is also reflected in the number of guides and books written on the subject of vintage dress, textile and accessories appreciation, now currently available in America and increasingly in the UK where the popularity of vintage clothing from the early twentieth century is reflected in high street stores ranging from Jigsaw to Top Shop. A technological factor as to why this vintage shopping and retail has occurred is the widespread availability of inexpensive digital cameras coupled with high speed internet's exponential growth allowing for a viable market place, and consequently a broader spectrum of historical dress and textiles has become available, with decorative pieces previously stored within the attic or wardrobe now considered valuable. This is a phenomenon that has emerged during the period of this research and has greatly influenced the consideration of past research methodologies. Moreover the immediacy with which an image can convey how a fabric has been created and the nature of its design and construction has also positively affected the way in which I can present theories on the nature of the devoré textile to my contemporaries.

The connecting of surviving examples of woven devoré from various archives and on line sources, whatever their fibre content or manufacturing origin, became an important aspect of the study. The formation of a chronological historical source that facilitates the matching of patented processes to woven devoré pieces and woven devoré designs to each other has not to my knowledge been attempted before now. Furthermore, the organizing of the visual record of woven devoré textiles greatly influenced the structure of the thesis.

The systematic analysis of woven devoré and the related processes of carbonising, fibre extraction, thread making, and chemical lace and embroidery, evident within this thesis is a reflection of the complexity of the subject material. Moreover, a precise chronological approach in the subject classification also allowed for a coherent and methodical examination of the economic, technological and social influences on the development of the woven devoré textile from its origination in the 1880's until 1939. The rationale in selecting this specific period of woven devoré design and manufacture was in order to show the woven devoré journey from the science of simple thread and fabric making to sophisticated fashion and fabric patterning, while also emphasising natural and manufactured (viscose and cellulose acetate) fibre usage in woven devoré textiles, including natural fibre combinations, single manufactured fibre use and the combining of natural and manufactured fibres.

The shift from natural fibre to manufactured fibre devoré reflected the industrialisation of textile manufacturing in the later part of the nineteenth century. The advance of mass production in textile manufacturing stimulated the development of all chemically manufactured textiles. Chemical lace, embroidery and woven devoré seemingly developed during the same time period. With the origin of the woven devoré textile found to be linked to the wool carbonising and fibre extraction industries of the mid nineteenth century. What clearly began as a process of staple fibre yarn and fabric manufacturing in the 1880's evolved into a technique of fabric patterning by fibre removal and destruction. Therefore,, for the woven devoré textile to be seen in the overall context of chemical textile development the linking of the woven devoré technique with the lace, embroidery and knitted devoré textile was fundamental to the study.

The emphasis of **Chapter One** is the formation of a new definition of devoré practice and a clear classification of the varying devoré processes, including thread, lace, embroidery, knitted and woven devoré processes, with particular reference to aspects of chemical usage and associated terminology of manufacturing. An examination of the relationship that existed between chemical carbonising and fibre reclamation, thread manufacture by carbonising, chemical laces and embroidery manufacturing, woven devoré, and knitted devoré during the period of research forms the basis of the subsequent research into woven devoré textile design and manufacture.

The study of fabric cleaning, construction and finishing patents was also key to this chapter, accordingly the historical patent record provided evidence of a chronological manufacturing development from textile cleaning and extraction processes to thread and then fabric making. Although chemical carbonising has been widely written of by wool industry analysts, its association with the woven devoré treatment has to this point lacked any significant examination.[13] It is hoped that this will encourage a broader context and will secure a greater understanding of carbonising application. The geographical spread of chemical carbonising and devoré practice through Europe and within the United States was a contributing factor to the secrecy surrounding woven devoré manufacturing development. The future designing of woven devoré fabrics was shaped by the location of manufacturers, the method of the processes employment and the types of fabric used in association with the technique. Therefore, the classification of fibre and fabric woven structures suitable for use with either carbonising based devoré or applied carbonisation, was considered to be fundamental to the understanding of early development of woven devoré and why the process was widely adapted within the textile industry.

With a clear definition of devoré manufacturing terminology and chemical and physical techniques of devoré established a more detailed investigation of woven devoré practice and the social and economic influences involved in the processes transition from thread and yarn manufacturing to fabric manufacturing and fabric decoration was required. This evolution of process forms the basis of **Chapter Two**, with the emphasis of the research focusing on the key period of woven devoré development, specifically the late 1880's and early 1900's. A key objective of this chapter is to establish the variation in woven fabric structures and determine the origins of the woven devoré technique. The economic conditions of the woollen industries of Europe and America are accordingly evaluated in conjunction with the development of the early wool woven devoré processes and their manufacturers.

The textile industry of the late nineteenth century was on the threshold of significant manufacturing change. Hand machine methods of production were being replaced by more fully automated manufacturing. The development of woven devoré manufacture seemingly coincided with the reduction in hand finishing practices, moreover, the

[13] Bendure, Z. & Pfeiffer, G. (1946); Dannerth, F. (1908); Georgievics, G. von (1902/ 1920); Groves, C. E. & Thorp, W. (1889/1895/1900); Harmouth, L. (1920); Jenkins, D. ed. (2003); Nisbet, H. (1912).

styling of woven devoré fabrics was especially reflective of mainstream fabric trends. New methods of patterning both plain and pile woven fabric were to emerge during this period, with engineers in America and France pioneering decorative chemical etching techniques. Decorative fabric manufacturers at the very end of the century began to employ standard printing machinery and equivalent patterns in the manufacture of pile devoré textiles.

The increasing diversity of structural and patterning designs of woven devoré fabrics evident during the early part of the twentieth century was due in part to the development of new artificial silk fibres, in particular regenerated cellulose fibres such as viscose. The aim of **Chapter Three** is to establish the varying devoré processes used prior to and in conjunction with this new fibres development, marking the departure from totally natural fibre based woven devoré textiles to manufactured fibres.

The significance of regenerated cellulose fibre devoré is reflected in the modern high street where viscose devoré reigns supreme and where its usage as a vulnerable element within pile and two-element weave textiles predominates. A review of the development of artificial silk usage in devoré textiles was therefore, considered fundamental to the general history of the woven devoré textile but also modern woven devoré manufacturing. The reassessment of regenerated cellulose fabric development with emphasis given to the use of devoré treatments takes the examination of woven devoré up to the First World War. The switch from American manufacturing to European led devoré innovation during this period is particularly noteworthy. The economic influences of European trade and industries on woven devoré are also considered at this point. With Europe in manufacturing decline prior to the First World War, the impact on textile manufacturing and material availability underpins the chapter's review of decorative woven textile designing.

The evolution of derivatives of cellulose, for instance cellulose acetate filament, after the First World War significantly influenced the making and patterning of woven devoré textiles during the early twentieth century. The role of the chemist as woven devoré designer was to become routine during the 1920's, with the advance of the woven devoré textile during this decade seemingly unparalleled. An introduction to woven fabric and devoré fabrics of the period is followed by a review of silk and wool fibre devoré, cotton fibre and regenerated cellulose devoré, allowing for an evaluation

of innovative cellulose acetate devoré processes in context of the general textile manufacturing environment, and which forms the basis of **Chapter Four**. The investigation of devoré fabric design and manufacture is followed by an analysis of surviving woven devoré textiles of the 1920's and early 1930's. On line vintage textile and fashion web sites provided a wealth of information regarding middle market and ready to wear clothing of the period, consequently woven devoré dresses are examined in relation to ready to wear advertising and patented woven devoré processes. [14] Woven Devoré textiles held within museum and textile collections are also reviewed, with personal relationships created with Liberty of London archive, American archives such as The Museum at the Fashion Institute of Technology, New York and the Museum of Art, Rhode Island School of Design, proving to be of particular importance to the detection of woven devoré textiles from this period.

To complete this historical study of the early development of woven devoré textiles the impact of the world wide economic depression and the ensuing innovation in textile manufacturing was considered an appropriate conclusion to this research. With the peak of woven devoré designing occurring during the mid to late 1920's, the resulting adjustment in devoré manufacturing practice of the mid 1930's was remarkable for its reorganization in the face of massive economic down turn. The focus of **Chapter Five** is the examination of woven devoré in the decade leading up to the Second World War, from 1930 to 1939. The analysis within this section reflects the devoré patents of the early 1930's followed by manufactured fibre usage and then the processes redeployment in the making of rubber and elastic textiles. The review of past woven devoré manufacturing practice by B. S. Hillman published in America in 1937 high lights the point at which woven devoré invention was to be redirected towards fabric engineering, for instance in the designing of corsetry and portable radar, rather than patterning and fabric decoration.

The innovation in design and manufacturing that accompanied the development of woven devoré textile designing has for the first time been afforded in depth research and analysis. The historical position of the study has allowed for a new interpretation of decorative woven textiles. The linking of science and fashion has been a primary

[14] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. 'Ready to Wear' was the term applied to off the peg clothing in the 1920's and should not be confused with the concepts of Prêt a Porter of the 1960's.

objective of this study. The geographical spread of the process across the Europe and America has added an international dimension to the researching and critical analysis of the devoré technique.

Methodology and resources.

At the start of this study I was surprised by the lack of academic and design research in this field. A literature review of published secondary sources failed to reveal much evidence of the woven devoré textile or its historical development. Texts covering fashion and interior textile history also failed to acknowledge the design and manufacturing significance of the woven devoré textile.

The interdisciplinary nature of the woven devoré textile manufacturing and its historical development is reflected in the approach to research and the resources that enabled the investigation. In retrospect I found the material drawn from an extensive historical patent review to have provided the clearest indication of the design and manufacturing development of the devoré process and the woven devoré textile. The primary evidence that textile patent abridgements offered proved to be essential to the creation of a devoré manufacturing chronology. My researching of chemical textile processes within the patent archive initially drew upon abridgments classified under the following subject areas:

- Ornamenting fabrics; finishing and dressing
- Fabrics; pile, woven
- Fabrics; testing and inspecting
- Printing fabrics
- Carbonising
- Lace
- Sewing

These broad subject areas reflect the spread and diversity of the material connected to the woven devoré textiles origin and development. The sub-categories (abridgement classifications) that were subsequently considered germane to this research in terms of linking devoré practices across the textile disciplines were as follows:

- Fabric dressing, bleaching and related processes
- Fabric making
- Pile woven textile manufacturing, pile fabric decoration
- Sheering, sizing and washing
- Carbonized fabrics
- Carbonising fibres, rags, and fabrics
- Carbonising and drawing wool
- Obtaining wool fibres from mixed rags
- Yarn and thread making
- Embroidery
- Embroidery with ground fabric (work) destroyed
- Carbonizable embroidery
- Open work fabrics
- Nitrated lace
- Hamburgs and Swiss embroideries and other classes of trimmings

The historical record of devoré manufacturing and fabric decorating extended throughout these textile disciplines. However, carbonising and wool and fibre reclamation specifications were fundamental to the understanding of all forms of devoré practice, therefore, the examination of late nineteenth century patents held within the USPTO registry and British Patent Office was extensive. Moreover, the investigation of patent specification connected to wool carbonising and fabric extraction continued throughout the period of the study. The registration of carbonising processes by English, European, and American manufacturers during the later half of the nineteenth century was seemingly continuous and without any major interruption. This lengthy survey of textile patents was considered a vital part of this study's development. The comprehensive examination of processes and manufacturing practices revealed the origin woven devoré and the nature of its development and application.

To facilitate the investigation of patent abridgements and specifications an extensive literature review of published secondary sources was commenced. In regards to patent research of devoré textiles, most invaluable to interpreting historical devoré patent records was Irene Emery's The Structure of Fabrics, (1994) which helped define the

parameters of the structural requirements of the woven devoré textile.[15] In the identification of woven fabrics, A. F. Barker's reductionist approach to textiles and their manufacture during the early years of the twentieth century is particularly noteworthy, while E. Miller's Textiles, Properties And Behaviour logical analysis of velvet and pile fabric manufacturing processes informed my thinking on potential woven devoré fabric styling.[16] In the analysis of devoré fabrics and their connection to Jacquard fabrics and Jacquard patterning, T. F. Bell's late nineteenth century work on Jacquard Weaving and Designing, contextualised devoré manufacturers recurrent reference to Jacquard styled textiles and the popularity in interpreting this specific class of woven fabric.[17]

As the importance of American manufacturers became increasingly evident to the study a series of American textile and chemical texts were called upon during the examination of American patent specifications. Principally, G. E. Linton and J. J. Pizzuto's Applied Fabrics, provided a precise classification of woven textiles, facilitating my interpretation of fabric references within patent specification claims. To support my detailed research of fibre extraction practices M. S. Woolman and E. B. McGowan's Textiles, presented an over view of fibre separation techniques and a chemical study of textile fibres that challenged my assumptions regarding the automatic selection of chemical processes by textile manufacturers.[18] David Jenkins work on The Western Wool Textile Industry in the Nineteenth Century, although part of a recent publication was a useful source of reference when placing carbonising and wool extraction practices into a wider manufacturing context. Jenkins careful examination of wool textiles prior to the development of the first wool devoré textiles in 1880's reflected my own discoveries and views on the woollen industry's experimental attitude to new fibres and novelties in the mid to late nineteenth century.[19]

With regard to past theories of fibre chemistry and devoré chemical practise Dr G von Georgievics' work on The Chemical Technology of Textile Fibres (1902,1920) was

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[15] Emery, I. (1994). The Primary Structures of Fabrics. London: Thames and Hudson. (Washington D.C. The Textiles Museum).
[16] Barker. A.F. M.Sc. (1910). Textiles. London: Constable and Company; Miller, E. (1968/ 1973/ 1992). Textiles, Properties and Behaviour. London: B.T. Batsford. Ltd, p. 96. Similar supportive texts include: Dooley, W. H. (1910/ 1924); Mitchell, C. A. & Prideaux, R. M. (1910); Dannerth, F. (1908); Georgievics, G. von (1902/ 1920); Groves, C. E. & Thorp, W. (1889/1895/1900); Nisbet, H. (1912).
[17] Bell, T. F. (1895). Jacquard Weaving and Designing. London & New York: Longmans, Green and Co.
[18] Linton, G. E & Pizzuto, J. J. (1961) Applied Textiles- raw materials to finished fabrics. NY: Duell Sloan and Pearce.
[19] Jenkins, D. ed. (2003). The Cambridge History of Western Textiles. Cambridge: Cambridge University Press.

instrumental in my creating a new definition for early devoré manufacturing and chemical carbonising practices, while A. G. Lipscomb's Cellulose Acetate, its Manufacture and Applications (1933), was possibly the first study found to describe cellulose acetate fibre devoré in the ornamentation of woven textiles; moreover, the analysis of cellulose acetate fabrics of the 1920's within this text encouraged my close researching of cellulose acetate devoré patents.[20] When evaluating devoré processes that utilised cellulose ester fibres, H. L Needles Handbook of Textile fibers, Dyes and Finishes, part chronological review of acetate and triacetate fibre development, was key to my understanding of the physical and chemical properties of cellulose acetate and its potential end use.[21] The commercially innovative cellulose acetate processes patented in the late 1920's and early 1930's clearly warranted some evaluation against later published material.

Other important key texts that position this study within the field of fibre chemistry and more specifically textile finishing that particularly influenced my comprehension of past textile finishing practice and therefore, helped define the framework of this study included A. J. Hall's, Textile Finishing (1952), and B. S. Hillman's review of pile textile finishing, including Soda Prints on Pile Fabrics, although published in 1937 as part of Rayon Textile Monthly.[22] Hillman's practical advice to printers of rayon pile textiles is the only reference found prior to the Second World War to have promoted the pile woven devoré process to a broad section of the community of textile manufacturers. Furthermore, the reference to current terminology that Hillman declared as being used commercially assisted the analysis and formation of a new classification for woven devoré terminology.

Throughout the research I have consistently referred to published works describing twentieth century consumer practices. The association between dress and interior trends of the wealthier classes and the subsequent effect on textile design offered to the middle classes has been key to understanding the various stages and styling of the devoré textile. Mary Schoeser and C. Rufey's English and American Textiles from 1790 to the present, and Schoeser and Dejardin's French Textiles from 1760 to the present, helped

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[20] Georgievics, Dr G. von (1902) Translated from the German by C. Salter. The Chemical Technology of Textile Fibres: Their origin, structure, preparation, washing, bleaching, dyeing, printing and dressing. London: Scott Greenwood & Co.; Lipscomb, A. G. (1933). Cellulose Acetate, its Manufacture and Applications. London: Ernest Benn Ltd.

[21] H. L. (1981). Handbook of Textile Fibers, Dyes and Finishes. NY/ London: Garland STPM Press.

[22] The review of chemical carbonising and fibre extraction development and patents was supported by Hall, A. J. (1952). A Handbook of Textile Finishing. London: National Trade Press.

form certain hypotheses in regard to trends in woven devoré textiles designing during the late nineteenth and early twentieth centuries.[23]

The style of fabric retail during the early twentieth century also reflected the social divide and purchasing power of the relevant consumer groups. In America a series of guides and educational publications were popular titles during the mid 1920's. The instructive merchandise manuals created by the Research Bureau for Retail Training, written by F. J. Ringo and others, on Draperies, Linen and Bedding, Muslin Underwear and Petticoats, and published by A.W. Shaw of Chicago were considered key historical texts within this study as they meticulously provided the consumer with the know how in recognising, cleaning, exhibiting and protecting an assortment of utilitarian and decorative fashion and furnishing woven textiles.

As the retail of interior, dress and lingerie goods to the middle classes was principally performed by working class salespeople a level of clarification as to how fabrics were used within the home interior was warranted. The Shaw guides provided an insight as to how middle class women budgeted for, and purchased fabrics similar to woven devoré textiles for the home or for use within dress. In the early 1930's E. Ostick's Textiles for the Salesman, assumed the same role as these earlier texts, while highlighting current practices of fibre and fabric finishing within the textile manufacturing industries.[24] Bendure and Pfeiffer's authoritative guide to America's Fabrics published in 1946, gave a more contemporary viewpoint on the appearance of fabrics and their varying structural and decorative patterning, which was accompanied by a photographic range of sample images particularly useful in referencing the use of 'rayon' within textiles of the period.[25]

While the emphasis of my research methodology has primarily been directed towards the design development of fabrics, in particular their construction, patterning and purpose, the importance of correlating the devoré textile to a more generalised textiles history was subsequently realized through an extensive periodical review. Accordingly women's magazines such as Vogue, London and New York editions, Vogue Fashion

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[23] Schoeser, M. & Rufey, C. (1989). English and American Textiles from 1790 to the present. London. Thames and Hudson. Schoeser, M. & Dejardin, K. (1991). French Textiles. From 1760 to the Present. London: L. King.

[24] Ringo, F. J. (1925). Draperies. Chicago/ New York/London: A.W. Shaw Company. (Ltd); Ringo, F. J. (1925) Linen and Bedding. New York: A. W. Shaw and Co.; Ringo, F. J. (1925). Muslin Underwear and Petticoats. Chicago/ New York: A. W. Shaw and Co.; Ostick E. (1931) 2nd edition. Textiles for Salesmen. London: Sir Isaac Pitman and Sons.

[25] Bendure, Z & Pfeiffer, G. (1946). America's Fabrics. New York: The Macmillan Company.

Bi-Monthly, Weldon's Ladies' Journal, Ladies Home Journal, Le Beau Monde, Les Parisiennes, American Album of Fur Novelties, were until the 1930's particularly text driven with extensive reports and reviews required to fill pages, in marked contrast to contemporary fashion magazines that depend on visual merchandising techniques to highlight fabric usage within dress. Writers of this period paid particular attention to the seasonal Parisian dress and fabric trends, recognising the close alliance between French textiles manufactures and the couture industries, while extensively reviewing the seasonal shifts in fabric usage by the Parisian designers for their style conscious readership. The importance placed on achieving a sense of Parisian design by American magazines influenced the dress trends of women at all economic levels during the early twentieth century.

The significance of these fashion and lifestyle magazines to the development of my research was only matched by contemporaneous journals and bulletins that highlighted the relationships between the varying fields of the textile industry, and which summarized manufacturing rationale, global trade reports, issues of textile and fashion retail, direct retailing to the consumer, and the trends in modern fashion and interior products. Accordingly F. Nasmith's The Artificial Silk Handbook (1926) published as part of The Silk Journal, along with The Draper, Textile Industries and Journal of Fabrics (and its later incarnation Textile Industries) and Fairchild's Bulletin with its focus on American and European export and importation of textiles goods, tariffs, fibre design trends within fashion, production rates and materials costs, were of great importance to my investigation of woven devoré manufacturing, marketing and retail.

A key text that provided this study with a critical review of French textile manufacturers and the design and fibre trends of 1925 was Sir Frank Warner and A. F. Kendrick summary of the International Exhibition of Modern Decorative and Industrial Arts in Paris. Warner's appraisal of pattern, metallic fibre usage, cut velvets and silks of the French textile companies, as seen from a silk manufacturer's perspective, inadvertently provided this study with a clearer understanding of the way in which novelty textiles for fashion and the interior were developed promoted and received by other manufacturers in the textile trade.[26] Equally significant to the investigation of woven devoré textile

[26] England. Departments of State and Official Bodies. Department of Overseas Trade. (1927). Reports on the present position and tendencies of the Industrial Arts as indicated at the International Exhibition of Modern Decorative and Industrial Arts. by Warner, Sir Frank and A.F. Kendrick,

applied to the interior was Jack Lenor Larsen's Fabrics for Interiors: A Guide for Architects, Designers and Consumers (1975) and Furnishing Fabrics: An international sourcebook (1989). As a designer and contract retailer of woven devoré textiles from the early 1970's, his perspective on the decorative value of devoré textile has been essential in defining the attraction this fabric had for twentieth century interior designers and consumers alike.[27] However, the employment of sheer woven devoré textiles within the contemporary interior was seemingly in direct contrast to its application in the early twentieth century. The fundamental change in woven devoré fabric appearance and employment in the early 1970's challenged my understanding of how a decorative fabric could be totally altered in order to suit fashionable design trends.

Electronic archives were also instrumental to my understanding of woven devoré and its styling development during the period of study. Accessing the digital archive of decorative textiles at The Antonio Ratti Textile Centre at the Metropolitan Museum of Art in New York early on in the researching period provided a unique visual source from which to actually determine the possible styling of woven devoré textiles by observing pattern, colour, and fabric structures employed at varying time periods.

The knowledge of textile structures and design trends gained as a result of this investigation enabled a more comprehensive understanding of the historical patent record, which in the instance of US patents was conducted solely on-line via the **USPTO** website.[28] This on-line service provides images of scanned historical specifications dating from 1790 to the present.[29] The on-line service **esp@cenet**, also consolidates various on-line patent databases, however, the European archives tend to begin at 1920, therefore, in order to obtain European specifications registered prior to this cut off date detailed manual searching of patent abstracts held within the British Libraries Patent reading rooms was necessary. Accordingly, a selection of the US and European devoré patents registered prior to 1920 were intermittently accompanied by drawings of the inventors proposed textile. While usually relatively simple in their style,

[27] Larsen, J. L. & Weeks, J. (1976). Fabrics for Interiors: A guide for Architects, Designers and Consumers. New York/ London: Van Nostrand Reinhold Co.; Larsen, J. L. (1989). Furnishing Fabrics: an international sourcebook. London: Thames and Hudson.

[28] United States Patent and Trademark Office, and Agency of the United States Department of Commerce; www.uspto.gov.

[29] It should be noted that a fire destroyed some of the early American patent records however this does not appeared have affected the registration of devoré patents.

for the purposes of illustrating the chemical processing involved in devoré textile manufacturing, these images have been invaluable to the study.

In conjunction with these electronic research sources more traditional archives such as The British Library, The British Library Newspapers national archive at Colindale, West London, The National Art Library at the V&A, The PRO at Kew, Richmond (where sample books of textiles submitted with patent specifications are currently held) and the Study Room at MODA at the University of Middlesex, [30] The Science, Industry and Business Library, New York, and The Thomas J. Watson Library at the Metropolitan Museum of Art, New York, were regularly accessed throughout the period of researching. As the history of the devoré textile and in particular that of the woven devoré process matured, access to American sources of fabric manufacturing history became increasingly relevant.

From the outset, locating past examples of pre-1970's woven devoré fabrics, whether used in dress or interior products, has proved challenging. In accessing surviving devoré textile pieces, many of which were previously unclassified, Lou Taylor's The Study of Dress History was particularly resonant in its opening discussion of the experience of the contemporary dress and textile historian.[31] Her categorisation of the way in which the dress historian journeys through a garments structure/ content in order to fully comprehend its basis for creation had particular significance to the approach of this research. Therefore, with so few known pieces of woven devoré known at the outset of the research it was imperative to communicate with a range of textile, dress and design specialists. After some consideration, those archives containing a greater range of exclusive textiles, meaning hand manufactured fabrics, or pieces made by renowned manufacturers, including those perhaps more focused towards the decorative arts rather than retail, were reconsidered as possible repositories for the woven devoré textile. On the whole larger archive collections and their past collectors appear to have regarded the woven devoré textile as ephemeral, manufactured in imitation of other quality machine or hand manufactured textiles, to be worn and discarded as soon as dress trends changed. Whereas woven devoré fabric use within the interior seemingly appears to

[30] Public Records Office. Kew. London. Moda: Museum of Domestic Design and Architecture 1870 – 1960. Cat Hill. Barnet. Herts.
[31] Taylor, L. (1992). The Study of Dress History. Manchester and New York. Manchester University Press.

have been considered nominal prior to the 1970's, while Larsen's interior woven devoré fabrics were most notable after this period.

Historically, the woven devoré textile was intentionally manufactured to emulate the design of Jacquard woven fabrics, in some instances it would appear the process was actually performed on Jacquard woven textiles. Consequently distinguishing a devoré textile from a traditionally woven textile, for instance a cut velvet fabric from a devoré velvet fabric, is often only possible by looking closely at the weave configuration. Therefore, if a woven fabric appeared to have been manufactured by devoré it is questionable whether a curator would have been considered it worthy of preservation, unless it was considered a high quality piece. Dress and textile archives that were more inclusive, for instance those which incorporated machine made goods or short-lived trend based merchandise, or more importantly were located near to the textile manufacturing regions of the devoré manufacturers, with reference to those named within patents, were considered more likely to have examples of surviving woven devoré fabric.

Appointments with Joanne Carter Ingersol at The Museum at the Fashion Institute of Technology New York, Anna Buruma at the Liberty archive, London, a contact made as a result of attending a CHODA conference in 2003 where Anna Buruma outlined the breadth of the Liberty archive, and Jenny Lister Assistant Curator Dress and Decorative Art at The Museum of London, held some of the finest examples of surviving woven devoré textiles, although seemingly unaware of this at the time. While more long distant communication with Marie Hélène Guelton at the Musée Historique des Tissus, Lyon, France, and Madelyn Shaw at The Museum of Art, Rhode Island School of Design, (an ongoing relationship that has recently resulted in Bianchini Férier as being confirmed as a manufacturer of woven devoré textiles) has proven to be especially productive in the locating of highly decorative and beautifully manufactured woven devoré pieces.

While the devoré samples held within the aforementioned mentioned archives were on the whole of high quality or especially decorative in nature, the sphere of activity outlined within the devoré patent record was clearly directed towards the creation of a range of textiles of varying economic levels. Locating surviving pieces of what could be classed as 'middle market' suitable for use within ready made garments required alternative methods of researching. The collecting of day wear or ready to wear has

until recently been limited to private collectors who either inherited or who accumulated pieces through a desire to preserve garments to which they were personally connected.[32]

The unusual step of approaching on line archives and vintage textile websites in American and Canada has directed the study towards an as yet unexploited area of textile and dress preservation. The quality of the predominantly dress based textiles varies from site to site, however, vinatgetextiles.com is possibly the finest of the American vintage sites up and running at this present time, closely followed by prototypevintag.com which is based in Canada. The opportunity to analyse both dress textiles manufactured in America or Canada and imported European textiles of varying quality and market levels is enhanced by the visual display these fabrics are given. The possibility of being able to visually compare couture cut velvet textiles and home or industrially manufactured versions is unique to this source.

The research journey then has been a complex one. The variety of sources, sites, and institutions examined reflects the interdisciplinary nature of the research. The examination of woven devoré design and manufacture has required a committed approach to process that has proven to be as integrated within the textiles manufacturing industry as any other decorative textile process.

[32] Ready to wear or ready made refers to the American ready-to-wear clothing trade and Fairchild's Bulletin. (1925). American Men's Clothing for England. Fairchild's Bulletin. January 19, 1925. The 'ready made' term used within this thesis denotes manufactured clothing of the 1920's and 1930's and should not be confused with Prêt a Porter of the 1960's.

Chapter 1

Devoré: A new definition

Chapter 1

Devoré: a new definition.

The lack of formal study of devoré history, particularly in regard to woven and knitted textiles and their breadth of use as fashion and furnishing fabrics, is attributable to the devoré technique's complicated and fractured development. The employment of this chemical fibre destruction process in one field of textile manufacturing was frequently modified by textile engineers in another textile manufacturing area, with the result that by the early twentieth century all known fibres and fabric structures had been treated using some form of devoré processing, often simultaneously, by a broad section of the textile manufacturing industry.

The many methods developed to create a devoré textile, though in reality based upon a single manufacturing concept, were specialised enough to appear distinct. Previous attempts to document aspects of the devoré production were therefore often focused towards a specific field of textile manufacture or individual class of fibre rather than the creative process itself. In reviewing the forms of the process it is essential to first define what constitutes devoré manufacturing practice. In particular what set this process apart from other late nineteenth and twentieth century finishing techniques?

Devoré manufacture can be distinguished from other finishing techniques by is its unique procedures of fibre destruction. Its employment is based on an elementary understanding of the chemical composition of fibres, and in turn, their 'differential solubility' or vulnerability to heat and applied destructive reagents. Essentially devoré (or burn out manufacture) is primarily reliant upon the careful arrangement of a vulnerable fibre and a resistant fibre, for instance two that differ chemically from each other, within a suitably structured textile. This textile structure, of which there are numerous combinations, has to survive the removal of part or whole areas of fibre by an application of, or immersion in, a destructive chemical reagent or solvent.

Furthermore, a detailed examination of the historical patent record for textiles design and manufacturing, chemical textile finishing and other related chemical processes, including methods of single fibre destruction, woven and knitted manufacturing, decorative devoré patents, and chemical lace or chemical embroidery procedures and their associated machinery, shows the seemingly diverse procedures of devoré or burn

out manufacture are actually based upon this single concept of fibre removal however, each uses one of three different procedures, these being:

- Chemical disintegration as used in carbonisation where a textile is saturated in a chemical bath and then heated to ensure fibre removal.

- The dissolving of a fibre using a suitable solvent.

- Carbonisation effected by applied means (such as printing) in conjunction with heating.

Supplementary processes adapted to work with these procedures and developed during the period under research include:

- Pre-treatment of fibres to either accelerate or resist carbonisation.

- Printed resists to selectively protect or encourage fibre degradation.

- Printed solvents to weaken fibre structure and the saponification of fibres to either encourage or allow fibre destruction, all of which can be used in localised fibre removal.

The importance of the carbonising process to the development of devoré became increasingly clear during the period of research. As a technique devoré traces its origins to textile industries involved in the processing and cleaning of wool, where cellulose debris trapped in wool fibre was removed by saturating the wool stock in a chemical bath and then heating to ensure chemical disintegration of the contaminating matter, as substantiated by the textile patents of Renals/ Steiger1881, Suter 1883, Chaux 1883, and Scheppers 1887, (see appendix 1). Prior to the development of devoré techniques in the late nineteenth century manufacturers making use of carbonising within the fibre extraction industries also relied upon this process to recycle fibres from waste fabrics. Similarly, piece carbonising of textile goods was also practiced by woollen manufacturers who for economic reasons preferred to remove cellulose contaminants from previously constructed cloth, with the fabric carbonized in exactly the same way as wool stock before its spinning into yarn.

From a historical viewpoint, the development from wool stock cleaning by carbonising to the creation of yarns and textiles by carbonising appears to have been a logical evolution, especially when the patent history of wool extraction processes are also brought into this review of the devoré process. Although the carbonising devoré process was eventually directed towards the patterning and decoration of constructed textiles, it was initially employed in the destruction of supplementary fibres purposely added to the constructed textile, for instance a fabric backing used as a temporary scaffold in the embroidering of lace; a supporting scaffold yarn for staple fibres; or a temporary yarn included within a constructed textile at the yarn manufacturing or textile construction. When no longer required the temporary support was in each case removed by carbonising. Moreover, by using such a process the textile engineer could remove anywhere between 5% and 50% of a fabric's original structure, or all of the supplementary yarn, with the result that the scaffold or supporting yarn was repeatedly employed in association with innovative fibres that were at the outset of their development difficult to weave because of delicacy or elasticity.

In contrast to the carbonising devoré process the printing of a chemical to encourage fibre disintegration appears to have been for the most part developed by woven textile manufacturers, velvet finishers and associated printed textile industries. As a process it was particularly favoured by velvet manufacturers because it was compatible with existing practises of printing and finishing, in much the same way that devoré fabric creation by carbonising seemingly suited those involved in the wool extraction industry.

As a form of fibre destruction it could be accomplished by varying means of application; spraying, roller printing, stencil plates and later on screen printing. The process was also frequently used in combination with heating techniques that were already employed by velvet and other woven fabric finishers, moreover, fibre destruction could be localised to specific areas of a textile which allowed for even the most delicate of patterned effects. For this reason it became a style of devoré manufacturing popular with small-scale manufactures and the designer crafts maker, such was its simplicity and reliability of production. Furthermore, the rapidity with which the applied carbonising method can be completed, combined with the capacity for devoré patterning to be altered almost instantaneously to suit design trends in patterning, whether on woven, knitted or stitched textiles, has resulted in contemporary textile manufacturers recurrently employing this method of devoré fabric production.

With regard to the dissolving of fibres, the historical patent record shows the effect was achieved by both chemical saturation and printed processes. Moreover, with the advent of the new manufactured fibres such as cellulose derivatives during the mid to late 1920's the breadth of the devoré process increased and a new phase of devoré manufacture commenced. Consequently a range of associated techniques were patented, some of which involved localised removal of fibres by printing a solvent, resists and protective chemical treatments using carbonising style fibre removal, with the recovery of the reduced fibre from the, destructive substrate also outlined in a series of devoré patent specifications.

As the various textile disciplines adapted these devoré processes of fibre destruction to suit their specialised approach to textile production, specific textile manufacturing regions came to be noted for particular methods of chemical devoré processing, resulting in chemically manufactured or decorated textiles often marketed to the consumer as having originated from and therefore linked to a certain region or country of manufacture, even though this may have been erroneous. For instance chemical lace manufacture, although developed simultaneously in both Saxony and Switzerland in the early 1880's in general became known as 'Swiss Chemical Lace' or 'La Suisse', regardless of its actual country of origin.[33] Conversely printed forms of fibre carbonising were primarily associated with velvet devoré manufacture, regardless of the subsequent development of other constructed textile processes such as plain woven and knitted devoré, seemingly as a result of velvet manufacturers based in France, Germany and the United States proving to be highly proficient at adapting and revitalizing this style specific of devoré manufacturing.

In the tracking of these devoré manufacturers through the historical textile patent record it became apparent from the wealth of evidence detailing the practices of the wool and fibre reclamation industries of the nineteenth century, that firstly devoré practice evolved specifically from the fibre cleaning and reclamation industries of Europe and America, and secondly the absence of any account within the general historical textile record as to the impact of wool carbonising and fibre reclamation practices of the mid to late nineteenth century on the development of the devoré process further demonstrated the need for re-evaluation of the practices of wool carbonising and fibre reclamation industries of the later half of the nineteenth century. The American patent record in

[33] Levey, S. M. (1983). Lace: a History. London: V&A publications. p.116.

particular provided extensive material regarding carbonising, wool fibre and early devoré practices registered by both American and European manufacturers. The British Patent record corroborated the American textile records while predictably having more of a European emphasis, with British and French (specifically Parisian) manufacturers preferring to register their specific technologies at the British patent office.

Carbonising and fibre reclamation.

Despite the numerous terms and procedures the devoré process has engendered the manufacturing origin of the devoré process is unmistakably linked to wool fibre cleaning and extraction industries of the mid to late nineteenth century, (see appendix 1). Both European and American practitioners of these fibre cleaning and extraction processes regularly patented new methods of chemical fibre treatments. The closest relation devoré can claim as regards its style of manufacturing practice is wool carbonising, an aggressive treatment that was developed to remove contaminating debris from wool stock or wool woven textiles. The related but later practice of chemical wool fibre extraction similarly exploited the differing chemical composition of cotton fibre and wool fibre. By treating a woven textile of mixed fibres with a chemical that for instance destroyed only the cotton (cellulose) the extracted wool fibre (protein) was suitably recycled for use in other textile products. To the woollen textile industry the rationale of the carbonising process was economically inspired, in that the chemical eradication of contaminating cellulose matter caught within untreated wool stock unless removed prior to carding, spinning and dyeing of the wool would create discolouration within the yarn and the textile manufactured using such materials. Dr Georg Von Georgievics in The Chemical Technology of Textile Fibres (1902), warned of light-coloured spots or "nops" becoming apparent in any subsequently dyed material.[34]

The process of eradicating vegetable impurities such as burrs, straw fragments or other vegetable fragments from wool by chemical means, which has been considerably well documented by many textiles commentators over the past hundred years, is universally acknowledged as carbonising, or "burring out".[35] The procedure involves treating wool fibre stock with an acid to make the impurities friable, customarily a dilute solution of

[34] von Georgievics, Dr G. (1902) Translated from the German by C. Salter. The Chemical Technology of Textile Fibres: Their origin, structure, preparation, washing, bleaching, dyeing, printing and dressing. London: Scott Greenwood & Co. p.87

[35] Linton, G.E. (1973). 4th Edition. The Modern Textile and Apparel Dictionary. Plainfield, NJ: Textile Book Service. p. 71.

sulphuric acid, however, as A. J. Hall noted in 1952 'sometimes an acid salt such as aluminium chloride is employed.'[36] Carbonising was regarded as an option to damaging mechanical methods of burr removal that commonly involved aggressive disentanglement of the wool, or labour intensive and costly hand picking methods. The advantage of wool carbonising, as explained by Georgievics was that the 'vegetable matters in the wool are eliminated by the aid of acid and heat, which converts the cellulose into hydrocellulose, the latter being easily removed by mechanical means.'[37]

Essentially once the impurities were reduced to ash, the remains could be shaken or brushed from the wool.[38] To achieve this cellulose disintegration Von Georgievics (1902) describes the use of a 'moderately heated drying chamber' or a 'carbonizing stove.' The wool fibre once processed by carbonising was not materially changed either chemically or physically, although any lengthy exposure between the wool and the acid would eventually lead to some physical damage, consequently a neutralising agent for the wool stock was generally applied.[39] The issue of fibre damage of the principal material, as potentially experienced in wool carbonising, also raised similar concerns for the manufacturing of the devoré textile. Consequently the employment of the carbonising treatment in the early devoré processes replicated these recognized carbonising procedures, with the wool devoré textile treated similar to wool stock.

A method of fibre cleaning almost identical to the carbonising of wool stock, also examined by Von Georgievics, was the carbonising of wool fabric subsequent to a textiles weaving. According to Bendure and Pfeiffer, America's Fabrics (1946), carbonising after weaving was 'virtually the same' as the carbonising wool in the raw.[40] The carbonising of woven fabric was best performed after scouring but prior to dyeing, to avoid spotting in the wool, as previously noted. The fabric once thoroughly saturated in a large acid vat was delivered to a carbonising oven, passing through several chambers the first of which dried the fabric, while the last few charred the cellulose debris. Bendure and Pfeiffer noted that 'The fabric, leaving the oven, is passed to a dry "fulling well."'[41] An alternative to this wet carbonising process described by Von

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[36] Hall, A. J. (1952). A Handbook of Textile Finishing. London: National trade Press.
[37] Georgievics. (1902). p.87
[38] Ibid.
[39] Hall, A. J. (1952). A Handbook of Textile Finishing. London: National trade Press. p.20.
[40] Bendure Z and Pfeiffer G. (1946). America's Fabrics. New York: The Macmillan Company.
[41] Bendure Z and Pfeiffer G. (1946). Ibid. Also called a "riffler," as the as the cloth is literally "riffled" or shaken to remove the charred particles. The cloth is beaten back and forth, and twisted and wrung to dispose of the carbon.'

Georgievics and Bendure and Pfeiffer was the dry carbonising technique, outlined by Farnfield and Alvey in their publication Textile Terms and Definition (1954). This procedure of carbonising advocated hydrochloric acid gas (dry process), rather than the sulphuric acid solution (wet process) followed by heating. The dry carbonising process achieved the exact same carbonising effect as the wet.[42] The importance of establishing the exact procedures of these carbonising processes was especially vital to the evaluation of early devoré patents. Woven devoré processes in particular used wet and dry carbonising procedures concurrently. Moreover, procedures of carbonising wool once constructed in fabric forms pointed the research towards manufacturers based in the fibre reclamation industry.

The waste fibre industry's routine involvement and employment of carbonising as a means by which to extract wool fibres from wool and cotton union fabrics from a range of cloth of varying quality was evident from the mid nineteenth century onwards. Such was the industries lengthy involvement in reclaiming wool and other fibres such as silk that guides such as E. Ostick's Textiles for the Salesman (1931) felt it necessary to advise readers of the general processing and consequent use of extract fabrics. Wool extract fabric, so Ostick warned, has had the cotton element extracted by sulphuric acid or other suitable chemical treatment.[43] Georgievics recommended carbonising piece goods with sulphuric acid or magnesium chloride, (A. Frank, 1877) and wrote of these two carbonising chemicals as being in current at the time of publication in 1902, though aluminium chloride (R. Joly, 1874) was also noted as suitable for carbonisation at this time, but was used less because of its higher price.

The supply of fabrics that contained reclaimed wool was, during the mid to latter part of the nineteenth century, wide ranging. However, the extraction of wool fibre usually from a mixed wool cotton fabric did not necessarily imply it was of poor quality, a varying range of grades of extract wools (and other extract fibres) were required by the dress and furnishing textiles industry. Prof. Dr. HK Roulette, in his authoritative work The Encyclopaedia of Textile Finishing writes of wool being obtained by the carbonisation process from piece goods, rags and shoddy.[44] Such was the routine employment of a carbonising treatment within the extract fibre industry it eventually

[42] Farnfield, C.A. & Alvey, P. J. (1954). Textile Terms and Definitions. Manchester: The Textile Institute.
[43] Ostick, E. (1931) 2nd edition. Textiles for Salesmen. London: Sir Isaac Pitman and Sons. p. 46.
[44] Rouette. H. K. (2001). The Encyclopedia of Textile Finishing. Berlin; London: Springer. p.218

gave rise to fabric goods with names such as carbonized noils, extract wool and extract fibre.[45]

The carbonising of piece goods, while notionally appearing to be a simple procedure, wasn't without risk. In 1902 Georgievics advised 'Carbonising is applied only to loose wool or piece goods; and even the latter alternative is attended with numerous drawbacks, owing to the formation of acid spots, soda spots, and other spots arising from impurities in the goods, these defects for the most part only becoming visible after the material has been dyed.'[46] Therefore uniform saturation was required with no irregularity in the drying as this would lead to spotting in dyeing or acid stains. In addition the chloride (aluminium, or magnesium) processes required high temperatures for the decomposition of the reagents, with the consequence that the wool always appeared a tinged yellow shade after the treatment. After carbonisation the chemical reagent had to be removed from the wool fabric. Magnesium and aluminium chloride residue was eliminated by vigorous washing, however, wool treated with sulphuric acid required the excess neutralising with 'soda'.[47] A treatment that was also required in devoré textile manufacturing. The use of carbonising in extract fibre reclamation was an important connection to devoré textile manufacturing and decoration, therefore the connection between carbonising, fibre reclamation by carbonising and devoré textile manufacture and patterning by carbonising is further examined in greater detail in Chapter 2: The origin of woven devoré.

However, it is important to note at this point that the initial theory at the beginning of the research that carbonisation of wool stock, wool fabric, extract fibre carbonisation and early devoré carbonisation were linked by a similarity of practice and as such developed in association with each other appeared to be credible given the apparent congruent chemical utilization. Moreover, from an examination of the carbonising patent record 1850 to 1900, the manner in which these chemicals were applied and carbonisation was achieved revealed a correlation in their methods of manufacture. For instance, sulphuric acid as a carbonising chemical that was used to eradicate cellulose impurities without risk being caused to protein fibres such as wools and silks was long established by the time E Ostick's published his guide in 1931. Early advocates of

[45] Rouette. H. K. (2001). Ibid.
[46] Georgievics, G. von. Trans. by Salter, C. (1902). The Chemical Technology of Textile Fibres. London: Scott, Greenwood and Co. p.20.
[47] 'soda', in this instance thought to refer to soda alum, aluminium sulphate.

sulphuric acid for vegetable fibre destruction were J. B. Rüttre of Paris, James Norton of Surrey, and Pierre Thomas, a chemical engineer also based in Paris, who registered processes for the removal of vegetable fibres from mixed fabrics of wool and cotton by means of a sulphuric acid bath and heating to encourage vegetable fibre destruction in 1855.[48] Soon after J. G. Perzél in his wool reclamation patent of 1863 declared sulphuric acid was already well known for its ability to dissolve or decompose cotton.[49]

As textile inventors developed more ingenious ways of exploiting the carbonising process in the reclamation of wools, and other protein fibres such as silks from a variety of woven and non-woven sources, the transition from fibre reclamation to actual fabric manufacture was seemingly inevitable. It is evident within the wool carbonising patents that by 1874 a variety of carbonising agents were employed to destroy vegetable matter without causing harm to pre-dyed wool, while aluminium chloride was considered to have been as effective an acid in this situation but with no effect on mineral or mineral products.[50] Although sulphuric acid was the popular choice of destroying agent for many practitioners of carbonising, less widespread but similarly employed were the aforementioned aluminium chloride, magnesium chloride and hydrochloric acid, with reference to Farnfield and Alvey (1954).

Of the key devoré processes patented that cite protein fibre destruction, Wissel, Girard and Brunier's 1896 'Ornamentation of Velvet' supported oxalic (ethanedioic acid) and sulphuric acid for cotton removal and potash or caustic soda for protein fibre (wool and silk) destruction.[51] Whereas Frederick Sutter of St Gall, Switzerland advised a temporary silk ground used in cotton embroidery could be dissolved in a solution of chloride of lime, a bleaching agent for instance calcium hypochlorite.[52] Alternatively, Woolman and McGowan in A Handbook for the Student and Consumer (1938) attested

[48] J. B. Rüttre, Paris, France. (Application filed 6th January 1855, sealed 3rd August 1855). Improvement sin the treatment of rags and other goods, formed partly of wool and partly of vegetable fibres, in order to separate the vegetable fibres from them and obtain the wool in its pure state. BP 37.
[49] J. G. Perzel, NY. (Dated September 8, 1863). Improved process of recovering wool from mixed fabrics. US Patent 39,828; 'forming dextrine and sugar, etc.' though it was noted that wool could not resist a continued action of the acid and particularly not a raising of the temperature.
[50] F. R. Joly, Paris, France. (Application filed August 17, 1874, accepted October 13, 1874). Improvements in processes of destroying vegetable matters in wool and woolen fabrics. US Patent 155,802.
[51] Auguste Wissel, Louis Girard and Joseph Brunier, of Neuville-Sur-Saône, France. (Application filed November 18, 1895, accepted March 24, 1896). Ornamentation of Velvet. US patent 556,794.
[52] Fredrick Sutter, St Gall Switzerland. (Application filed November 29, 1882 accepted June 26 1883). Process of Producing Open-Work Fabrics. US patent 280,094.

concentrated hydrochloric acid had a slow destructive action. They noted how it was selected for the separation of silk from cotton by eradication of the former.

While similarity of chemical treatments alone does not fully establish the link between carbonisation, wool fibre extraction and early forms of devoré, the identical methods of chemical application, treatment and finishing of such goods evident within patent specifications points to the devoré process being connected to textile processes linked by their common employment of carbonising. Engineers William A Dickie and Frank Brentnall Hill assignors to the Celanese Corporation of America, working in Derby for British Celanese, outlined the practice of carbonising that had by the time of their writing in 1931 engendered carbonising bath devoré processes and applied carbonisation devoré with the manufacture a significant number of devoré textiles. Writing at some length within their 1931 US Patent Treatment of Artificial Materials, Dickie and Hill acknowledged:

> 'The method of carbonisation has found many useful applications in the textile art. Thus, for example, it provides a method of removing cotton from admixture with wool or wool from admixture with silk in shoddy or waste materials. Further it provides a valuable means of obtaining pattern effects. A pile fabric, for example, may be treated so as to remove selected portions of the pile while leaving the backing material and the remainder of the pile unaffected. Again embroidery may be worked upon a suitable backing material, which may subsequently be removed by a process of carbonisation, which does not affect the embroidery itself. By treating fabrics woven from mixed yarns with a carbonizing agent capable of removing one constituent of the mixture without affecting the other, gauzes may be obtained. Moreover the production of these effects is not confined to the treatment of mixed materials; the effects may be produced upon materials, the fibres of which are all of the same chemical nature by the application of suitable resists to selected portions thereof.'[53]

To summarise, the family of textile carbonisation processes as recognised by Dickie and Hill included carbonising, extraction/ reclamation process and woven and stitched devoré practices. The necessary re-evaluation of textile and chemical textile texts after the discovery of this patent revealed the majority of devoré practices had been developed and were in operation by 1931. Somewhat surprisingly, new or adapted devoré processes developed after this point were in direct response to the creation of synthetic or man-made fibres, such as nylon and polyester.

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[53] William Alexander Dickie and Frank Brentnall Hill. Spondon, nr Derby. Assignors to Celanese Corporation of America. (Application filed May 7th 1931, accepted November 13, 1934). Treatment of Artificial Materials. US Patent 1,980,191.

With devoré textile manufacture clearly attributable to carbonising procedures and protein fibre extraction practices, as the historical patent record for devoré shows, evidence of the manufacturing connections should have been apparent in the many textile reference books and journals published during the chemically etched fabrics' hundred and thirty years development. While key texts such as J. T. Marsh's An Introduction to Textile Finishing (1947,1966)[54] goes some way toward identifying the principle procedures of fibre destruction actively employed within the textiles industry at the differing times of its publication (1947 and 1966), the evaluation Marsh provides of devoré processes/ burn out techniques was presented as part of a review of specific fibre types and their associated procedures of textile finishing rather than as a distinct devoré category. Moreover, A. G. Lipscomb's analysis of cellulose acetate devoré in Cellulose Acetate: Its Manufacture and Applications, classified the cellulose acetate devoré technique under the heading 'Ornamental effects', possibly indicating the cellulose acetate devoré process was regarded as a novelty form of devoré manufacturing, and as such was omitted from any subsequent examination of textile decoration techniques. [55]

B.S. Hillmanin his late 1930's review of velvet finishing practices for Rayon Textile Monthly preferred the heading 'Soda Prints on Pile Fabrics' to describe the practice of pile fabric devoré, with alternative terms used in association with this style of devoré printing also listed by Hillman as being 'Damasse, Jacqueline, Cut Out Printing, etc.' The apparent array of names the process engendered and the fractured nature of devoré textiles history for just the woven form, highlights the devoré process's general lack of unified and coherent categorization.[56] The consequence for the devoré textile and its associated fibre destruction techniques not only appears to have been a disregard among the textile community as to the historical development of devoré manufacture, but also the relationship between the process and the various structural, compositional and ornamental design of fabrics it either imitated or created has received limited consideration or review, with some practices apparently totally forgotten until now.[57] To fully appreciate the spread of the devoré process, its adaptation from carbonising based processes to printed caustic pastes accelerated by heating, and the nature of the

[54] Marsh, J.T. (1947). An Introduction to Textile Finishing. London: Chapman and Hall Ltd.
[55] Lipscomb, A. G. (1933). Cellulose Acetate, its Manufacture and Applications. London: Ernest Benn Ltd.
[56] Hillman, B. S. (1937). Soda Prints on Pile fabrics, Rayon Textile Monthly. Feb 1937. p.54 (94).
[57] In reference to Cornely Chain stitching devoré as reviewed within this chapter as part of Stitched devoré: chemical lace and embroideries.

fabrics created by the varying processes, a review of the chemical practices raised within wool cleaning, general fibre reclamation and early devoré patents was undertaken. Historically it would appear the chemical make up of the fibre selected for destruction by the manufacturer dictated the selection of its chemical treatment, with the remaining fibre's reactivity or resistance to the chosen devoré chemical clearly taken into account by the textile manufacturer. For instance when attempting to destroy cellulose fibres such as cotton, linen, or regenerated cellulose such as viscose from a mixed cellulose protein fibre fabric, a suitable acid or acid salt was used at a strength that would cause little harm to a protein partner fibre. A table of fibre and chemical practice showing the varying combinations is shown in appendix 2.[58]

Furthermore, the preservation of the primary fibre during carbonising or applied carbonisation required specific knowledge of both fibre reactivity and resistance to acids and alkalies, an understanding that manufacturers would have been gained within the textiles wool cleaning and fibre extraction industries. From the examination of the carbonising and devoré textile patent record the earliest cotton devoré procedures were based upon the destructive effect of sulphuric acid on cellulose matter and the natural resistance that protein fibres have to this and other acids, at the strength required to complete carbonisation. While concentrated sulphuric acid was used to rapidly degenerate cellulose, even dilute sulphuric acid was destructive, if dried and concentrated in the fibre, as with the carbonising process. However, devoré manufacturers quickly adapted the sulphuric acid carbonising process to create a printed version, with Otto Timme in 1901 describing the printing of a pile destroying medium that contained 'sulfuric acid'.[59] Contemporary devoré manufacturers continue to opt for sulphuric acid processes with Rouette in 2001 stating cotton in a cotton polyester mixed fabric was found to dissolve in cold 70% sulphuric acid with no effect on the polyester.[60]

Contemporary to Timme, Wissel, Girard and Brunier outlined in their groundbreaking 1895 Ornamentation of Velvet printed devoré patent the use of a mixed paste of oxalic and sulphuric acid with 30g oxalic acid per 100g binder combined with 40g of sulphuric

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[58] Woolman, M. S. & McGowan, E. B. (1938). Textiles, A Handbook for the Student and Consumer. New York: The Macmillan Co. p.382. 'Action of Acids'. In most cases mineral acids attack cellulose fibre and frequently harm such fibres even when in dilute concentrations.
[59] Otto Timme, New York, N.Y. (Application filed December 4th 1901, accepted July 29 1902). Method of Producing Figured Pile Fabrics. US Patent 705,977.
[60] Rouette. (2001). See Vol. 1. Burn out fabrics.

acid per 100g binder.[61] The use of oxalic acid either on its own or in conjunction with sulphuric acid paste was consistently advocated within many early devoré patents, because as a non-volatile acid it was known to spoil cellulose fibre if allowed to dry without any neutralisation or subsequent washing.[62] This simple reaction formed the basis of the oxalic acid devoré process.[63] The devoré manufacturer consistently exploited the vulnerability of cellulose fibres to this reagent when in paste form because subsequent to it's application and drying within the fibre chemical disintegration readily occurred if the print was exposed to a source of heat. When the preferred method of application in devoré patents was by printing or spraying the chemical often required the stability of an inert binder to act as the chemical carrier to even out the delivery of the chemical, as with discharge printing.

The employment of hydrochloric acid and hydrochloric acid gas (carbonising dry process) in the destruction of cellulose fibres in devoré manufacturing clearly evolved from a joint patent issued in 1853, by a bleacher, together with a waste and fent dealer (all from Manchester) who patented a cotton carbonising technique that removed cotton from wool fabric by first saturating the fabric in hydrochloric acid followed by heating, causing the cotton to submit 'to the action of the vapor or gas evolved from such acid.'[64] Subsequently Maertens, in 1884 detailed his use of using hydrochloric acid or hydrochloric acid-gas, and spraying (drop distribution) or carbonising the complete woven textile in his landmark devoré patent Art of Making Textile Fabrics, the significance of which is discussed in detail in Chapter Two.[65]

Fulton in his 1905 Paisley fabric devoré patent preferred the printing of 'aluminic chloride' in a semi fluid paste followed by dry heat to 'liberate the acid' and aid in the destruction of cotton threads.[66] Rouette in the aforementioned Encyclopedia of Textile Finishing when tabulating contemporary fibres and chemicals that are actively used in the manufacture of modern devoré textiles, (see appendix 2) also makes reference to woven fabric when manufactured of silk and cotton or silk and viscose be treated with

[61] Wissel, Girard, & Brunier. (1895/1896). US patent 556,794. See Glossary of Terms.
[62] Rouette: saccharic acid, and Sharp: ethanedioic acid.
[63] Woolman, M.S., & McGowan, E. B. (1938). p.383.
[64] William Aldred, Richard Fenton, William Crone, Lancashire. (Application dated 12th August 1853, sealed 27th January 1854). Certain improvements in separating or recovering the wool from cotton and woollen or other similar mixed fabrics whereby the wool is rendered capable of being again employed.
[65] Emile Maertens, Oswego Falls, New York. (Application filed November 13, 1884, accepted May 18, 1886). Art of Making Textile Fabrics. US Patent 341,927.
[66] Charles William Fulton, Paisley Scotland. (Application filed August 7, 1905 accepted March 3, 1908). Production of Patterns, Designs, or other similar markings in Fabrics. US Patent 273,215.

'aluminium sulphate or chloride to carbonize and dissolve out the later component (by saturation, mild drying, heating, final brushing out).'[67] This comparison between past and present devoré practice highlights the contemporary devoré manufacturer's continuing reliance upon methods of fibre destruction that were developed at the end of the nineteenth century and early years of the twentieth century.

The popularity of viscose as a fibre for devoré with contemporary designers is in stark contrast to the fibre's infrequent use in devoré early history. In 1913, Henry Giesler a velvet manufacturer based in Brussels patented a devoré process where cellulose threads and pre-treated or acidulated artificial silk fibres (such as viscose treated with sulphuric acid or hydrochloric acid)[68] were combined within a woven textile intended for devoré treatment. Patterning was created on the mixed fibre fabric by printing with a paste of 'soda', ammonia or caustic soda, which neutralised areas of the acidulation. Those pre-treated fibres that had not been neutralised were then carbonized at high temperature and removed by brushing.[69]

In regard to the specific destruction of regenerated cellulose fibres such as viscose, devoré manufacturers found these fibres were more susceptible to the action of acids than cotton or other cellulosic fibres. Consequently in light of their increased vulnerability to the effects of mineral acids, regenerated cellulose fibres eventually replaced cotton fibres within fabrics developed for the devoré process, (although it should be also noted that viscose is also vulnerable to damage from bases).[70] This meant that the amount and therefore the strength of the chemical required in regenerated cellulose fibre destruction was considerably reduced affecting not only the economic cost of such as process but also reducing environmental pollution, although this latter issue was not necessarily of importance to the early twentieth century manufacturer as discussed in Chapter Five: B. S. Hillman and the finishing of pile fabrics, and evidenced in appendix 5.

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[67] Rouette. (2001)Vol. 1, p. 201,202. Burn out printing, Burn out styles. Note Rouette states 'Sodium dihydrogen phosphate is regarded as a 'universal burn out agent' for fabrics that contain polyester as a resistant fibre.'

[68] Or alternatively with aluminium chloride, magnesium chloride.

[69] Henry Giesler, Brussels, Belgium, assignor to Heberlein & Co. A. G. of Watwill, Switzerland. (Application dated 2nd May 1914, accepted 25th November, 1915 and in Belgium 17th November 1913). Improvements in or relating to Processes for the Decoration of Woven fabrics. BP 10,867.

[70] Collier B. J., &Tortora P. G. (2001) 6th edition. Understanding Textiles. New Jersey: Prentice Hall. p.150.

The presumption that devoré was solely used in conjunction with fabrics manufactured of two dissimilar fibre types required reconsideration as the research of fibre destruction techniques progressed. The assumption was that manufacturers favoured dual fibre devoré with the inclusion of a resistant fibre within a fabric structure supporting the removal of the targeted fibre. Without a chemically dissimilar fibre being mixed with a resistant fibre holes would appear within a woven textile if devoré printed, while full destruction of the textile would occur if treated by the carbonising process. However, devoré designers recognising the potential of the destructive effect caused by devoré on single fibre fabrics (both cellulose and protein fibre fabrics) developed processes that allowed for perforated or controlled areas of open work on a range of woven fabrics with the intention of making the most of the market for economically manufactured simulation handcrafted fabrics for instance in the style of Broderie Anglais.[71]

In 1901, Carlos Casanovas Y Amat, (Barcelona) patented a technique that should be classed as a single fibre devoré process for the embellishment of woven textiles.[72] In principle it follows the concept of localised fibre destruction through the printing or stencilling of a fibre destroying agent. The creation of delicate open work patterning on a uniformly woven textile constructed of linen or cambric was accordingly achieved by 'stamping' an acid or acid salt, and on an animal fibre such as silk or wool an alkali or alkaline salt known to perforate the textile once heated 'in order to further the carbonisation or destruction of the fiber.'[73] It should be noted versions of this technique were included within recent (predominantly in 1970's) textile dictionaries and glossaries, with the processes usage said to include the creation of buttonhole details and other finishing effects. E. Miller, writing in 1973, noted 'These methods can be used to produce puckered effects or to simulate open-work or embroidery by printing either chemicals which cause the fabric to pucker in the printed parts, or chemicals which dissolve or destroy selected parts of the fabric leaving deliberate holes.'[74] While Casanovas Y Amat's procedure may at first appear to have weakened or damaged the

[71]Broderie Anglais. A French term used to describe a form of English embroidery. Original pieces have simple eyelets and ovals described as 'cut work embroidery'. See Caulfield, S. F. A. and Saward B. C. (1882). The Dictionary of Needlework. London: L. Upcott Gill. p.48, 49. 'An open embroidery upon white linen or cambric,..... True Broderie Anglais patterns are outlines of various sized holes, arranged so as to make floral or geometrical devices.. The art in the work consists in cutting and making all the holes that should be the same size to match,...'.

[72] Carlos Casanovas Y Amat, Barcelona, Spain. (Application filed August 15, 1901, accepted April 21, 1903). Process of Producing Perforated or Open-Work Patterns in Fabrics. US patent 725,823.

[73] Carlos Casanovas Y Amat. (1901/1903). US patent 725, 823. Page one. Line Number 41-45. This process was accelerated by heat through steaming or by applying 'hot surfaces'.

[74] Miller, E. (1973). Textiles, properties and behaviour in clothing use. London: B.T. Batsford. With reference to chemical printing, p.154.

integrity of the textile, the accompanying patent illustration of a pattern composition reveals the balance of fibre destruction to untreated fabric was primarily aimed at localised destruction, with ***a*** being the woven fabric and ***b*** representing the placement of the open work patterning, see Fig 2.

The destruction of animal fibres (protein), such as wool and silk from a mixed fibre devoré textile requires chemicals that do not affect the fabrics remaining dominant fibre, which in the majority of late nineteenth and early twentieth century fabrics was cotton or other vegetable fibre. Wool and silk fibres are especially vulnerable to damage when exposed to strong base solutions, even dilute alkali products produces some effect.[75] Wissel, Girard and Brunier noted their preference for the printing of a basic alkali for silk and wool pile removal (potash or caustic soda) from a fabric of mixed cellulose and protein fibres, with Rouette advising the same in 2001, 'Sodium hydroxide solution is used to burn out the wool/silk components in mixtures with polyester or polyamide; protein fibres are broken down hydrolytically under conditions of high pH which results in their complete removal.'[76]

Conversely dilute acids rarely harm protein fibres, although silk has less resistance to acids and more resistance to alkalies than wool. The resilience of these fibres ensures their use as partner fibres in vegetable cellulose fibre processes. The cotton fibres are relatively unaffected by the process because of the limited time to required to destroy silk fibres. However, strong mineral acids eventually destroy wool fibre, hence the rigid control required in wool carbonising and the use of scouring treatments, (fibre neutralising).[77]

Of the protein fibres used in contemporary devoré textiles silk remains a popular partner fibre, despite the increased combining of manufactured fibres in devoré fabrics. This is in part because of the fibres reliability and strength but also because of its handle and lustre, consequently its mixing with viscose in velvets and satins is universal and for the last ten years such devoré fabrics have been consistently employed within contemporary high street fashion collections, see Figs. 3 and 4. Despite the modern styling of silk

[75] Base: 'On the simplest view a base is a substance which in aqueous solution reacts with an acid to form a salt and water only. Sharp, D. W. A. ed. (1990). 2nd Edition. The Penguin Dictionary of Chemistry. London: Penguin Books.
[76] Rouette. (2001) Burn Out Printing (devoré printing). v.1, p 201. Sodium Hydroxide, Caustic Soda NaOH. 'Gives a strongly alkaline solution in water.' Sharp. D. W. A. (1990)
[77] Collier B. J. &Tortora P. G. (2001). p56,57.

viscose devoré textiles the origin of the viscose devoré processes had for the most part been patented by the early 1930's. In addition to using viscose and other regenerated cellulose fibres the woven devoré patents of the late 1920's and early 1930's also made use of the new derivatives of cellulose, first as a resistant fibre and then as one that could be locally destroyed. Derivatives of cellulose, such as cellulose acetate and triacetate are fully resistant to acids and bases, although acetate can be converted back to cellulose with strong bases, a reaction that was exploited by Camille Dreyfus in 1927.[78]

A series of devoré processes were developed for use in association with acetate filament. Acetate fibre because of its manufacturing process was known to dissolve in acetone, while triacetate swelled, weakened, or dissolved.[79] A printed solvent for the patterning of cellulose acetate velvet was first suggested by Camille Dreyfus in 1924 (for Celanese), while René Clavel proposed the partial destruction of cellulose acetate while simultaneously adding a metallic powder to the fabric. Ellis, Olpin and Walker, working for The Celanese Corporation of America, also proposed a "weakening agent" (a solvent for cellulose acetate) be applied to the back of a pile fabric by stencilling or spraying to loosen the connection of acetate rayon pile fibre to its backing of silk, wool, cotton or artificial filament (though not a cellulose derivative). A series of patents that promoted the decorative etching of cellulose derivatives fabrics also refer to the practice of saponification, in this instance the localised conversion of the derivative of cellulose fibre to a cellulose fibre (as in cotton or regenerated cellulose fibre such as viscose,) which exploits the effects of a strong base on acetate, with the removal of the converted cellulose carried out in line with previously employed carbonising practices or 'hot acid treatment', see Glossary of Terms.[80]

Towards the end of the 1930's devoré processes of fibre removal were supplanted by the development of alginate fibres, which J. T. Marsh noted 'dissolve in warm dilute alkali.'[81] Alginate fibres were first employed with acid resisting wool, however, in 1941 A. Johnson and J. B. Speakman in association with the Alginate Industries Limited,

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[78] Camille Dreyfus. N. Y. (Application filed December 16, 1927, accepted May 12, 1931). Ornamental Fabric containing Derivatives of Cellulose and Method of Producing the Same. US patent 1,804,529. p.1, line 27-28.

[79] See Glossary of Terms.

[80] Henry Dreyfus. London. England. (GB August 2, 1929; Application filed USA July 23, 1930, accepted May 21, 1935). Treatment of Fabrics. US 2,002,083.

[81] Marsh. (1966). p.334. Seaweed. Alginate fibres are a product of neutralizing reaction between alginic and caustic soda. Non-flammable, and sheer in appearance when combined with other fibres.

subsequently utilized temporary soluble alginic fibres in association with high quality cellulosic fibres in the manufacture of woven, knitted or lace fabrics.[82] Their composite yarn was formed by winding alkali soluble alginate yarn with a cotton staple yarn, whereupon it was woven into a fabric then washed in an alkaline bath dissolving the alginate yarn. Fibres of alginic acid and metal alginates like calcium alginate were found to be soluble in an aqueous solution of soap, or sodium carbonate or could be converted to alginic acid by treating with an acid at a strength that did not harm wool fibres.[83] The employment of alginate yarns for yarn manufacturing proved to be short lived, however, at the time of their employment in the early 1940's they were perfectly suited to the manufacturing of fabrics that required a temporary support yarn.

The evolution of devoré chemistry examined herein further emphasises the shift from natural fibre devoré to manufactured fibre elimination. The change from cotton, linen, silk, and wool devoré development to regenerated cellulose and derivatives of cellulose devoré occurred when manufactured fibres became increasingly economically viable toward the end of the 1920's. These new manufactured fibres offered textile chemists an opportunity to establish new textile manufacturing and patterning processes including new devoré techniques. The established simpler natural fibre devoré although continuously used to destroy provisional or resistant yarns throughout the twentieth century, had by the mid 1920's been comprehensively tested and developed to the point where the devoré of natural fibres was sufficiently explored, including associated devoré processes previously highlighted, such as the pre-treatment of fibres to either accelerate or resist carbonisation and printing resists to selectively protect or encourage fibre degradation. Evaluating devoré by its class of fibre destruction proved key to this research, in that protein fibres and alkaline treatments could be traced separately from cellulose devoré and acid or acid salt employment.

The natural fibre and manufactured fibre devoré processes, while diverse in their chemical requirements, were comparable in their approach to devoré manufacturing. The earliest natural fibre devoré process facilitated the manufacture of short and long

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[82] 'The finest yarns of linen, cotton and viscose were too fine to be manufactured using a power loom, accordingly the soluble alginate yarn allowed for the manufacture of fine cellulosic textile fabric.
[83] Arthur Johnson & John Bamber Speakman, Leeds, England, assignors to Alginate Industries Limited, Maidenhead, England. (Application in Great Britain 1941, In the USA January 1948, accepted April, 1952). Cellulosic Textile Fabric. US patent 2592,145.

staple wool thread and fabrics using a temporary support thread and carbonising. A parallel experience was shown to have occurred during the development of manufactured fibre devoré, with both natural and manufactured fibre devoré then progressing to fabric manufacture and finally localised structural patterning. The rate of development of manufactured fibre devoré also corresponded to that of the earlier and simplistic natural fibre devoré, with a twenty year development and process modification period seeming to have occurred in both instances.

This review of devoré chemical practice establishes a new classification for devoré by identifying the basic principles of natural and manufactured fibre destruction as practiced by devoré manufacturers during the late nineteenth and early twentieth centuries. The principle categories of devoré under this system are:

- Thread and fabric manufacture (woven) by carbonisation.

- Stitched devoré: chemical lace and embroideries.

The following evaluation of these two categories will show that while the employment of these devoré processes created very different textile products, chemical thread manufacturing and chemical lace and embroidery production evolved simultaneously, reflecting the shift from fabric cleaning and extraction processes to the creation of textiles that were either previously unworkable, as in the case of staple fibre thread manufacturing, or rapidly produced textiles such as chemical lace and embroideries.

Thread and fabric manufacture by carbonisation

The origin of temporary or supporting yarn removal in association with composite yarn manufacturing can be traced to the early 1880's. A series of innovative yarns or textiles were successfully manufactured using a technique that employed a combination of carbonising and temporary support yarn or thread. Developed to enable the manufacture of delicate threads or constructed textiles, by stabilising threads and helping withstand construction stresses, the process was consistently adapted to work in association with the latest technological advances in fibre design or textile machinery. The earliest examples of fibre manufacture using this combined carbonising and support thread process generated both the short staple wool fibre (Chaux 1883), and the long staple

wool fibre (Scheppers' and Scheppers' 1887). Although both processes were clearly derived from wool carbonising techniques of the 1850's and 1860's, as the support thread was totally removed by carbonising, their patenting marked the shift from extract fibre fabric manufacturing to the innovative creation of an economically practicable yarn from a hitherto unworkable fibre or textile product.

The next significant use of the support thread and carbonising technique was during the artificial silk fibre revolution of the early twentieth century. The fragility and elasticity of the early artificial silk fibres necessitated a support thread be protectively spun around the artificial thread to protect and stabilise its movement during fabric construction. Wilkinson's 1912 invention also detailed the patterning of a regenerated cellulose fabric manufactured in this manner, with only localised removal of the support thread.[84] The manufacture of a "spun yarn" of cellulose acetate (or other derivative of cellulose yarn) as patented by Dreyfus, Dort and Platt in 1928, further advanced the support thread carbonising process.[85] In this instance the cellulose acetate fibres supporting thread was fully destroyed prior to the fibres employment within a constructed textile.

The same yarn type was also used in the manufacture of delicate acetate ribbons by Mendel (1932), with the inventor taking advantage of an insoluble yarn and soluble cellulose acetate yarn as its theory of fibre removal,[86] while similarly the Société pour la Fabrication de la Soie Artificielle "Rhodiaseta", suggested degrading cellulose acetate from a yarn composed of cotton, natural silk and cellulose acetate (1935).[87]

The 1930's supported an industrious period of fibre experimentation, with alginate, rubber and elastic threads and fabrics the key products for textile research. C. T. Pastor, who should be noted for his previous involvement in woven fabric burn out processes, registered techniques of rubber thread and rubber thread textiles manufacture in

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[84] Joe Wilkinson, The Bradford Dyers' Association, Limited. (Application dated 21st October, 1910, accepted 20th April, 1911; US patent application filed March 23, 1911, accepted March 26, 1912). Improvements in the Manufacture of Textile Fabrics. GB Patent 10,186; US patent 1,021,712

[85] Camille Dreyfus and Robert G Dort of New York and Herbert Platt, of Cumberland Maryland assignors to Celanese Corporation of America, A corporation of Delaware. (Application filed May 3, 1928, accepted December 1, 1931). Treatment of Textile Materials containing Carbonizable Fibres and Product thereof. US patent 1,834,339;

[86] W. Mendel. Assignor to Neidich Viscose Corporation of Burlington. N. J. Textile Fabric. (Application filed May 3, 1930, accepted May 1924, 1932). US patent 1,860,314.

[87] Société pour la Fabrication de la Soie Artificielle "Rhodiaseta", Paris. (Application dated May 30, 1934, accepted November 1935). Process for obtaining Effects or Designs on Yarns, Threads, or fabrics composed of or containing Cellulose esters or Ethers. GB Patent 439,124.

Germany in 1933.[88] The technique called for a temporary guide yarn to be given a full latex coating after which the support yarn was dissolved from within its new casing by carbonising. Moreover, by selectively removing and retaining areas of the viscose guide thread the fibre could be made fully or semi-elastic. The resulting latex fibre was subsequently employed within a woven or knitted textile and used for bandages, belts and other accessories that were improved by the textiles ability to stretch. Accordingly in 1939, C. Dreyfus used a similar principle of guide fibre for the manufacture of tyres, water hose, gasoline pump hose, water bags and containers, while Schwartz and Chavannes (France, 1937)[89] substituted Pastor's cotton thread with wool which required a caustic soda solution treatment.

The advance of alginate support fibres during the late 1930's and early 1940's clearly slowed the development of the combined support yarn and carbonising process. Johnson and Speakman (GB 1941), as previously cited, deemed their dissolvable alginic fibres would put an end to harsh chemical carbonising methods of fibre or fabric manufacturing.[90] For instance the creation of mohair fabric by carbonising a cotton thread with sulphuric acid was cited as a procedure that was limited by the suitability of fibre removing chemicals that could be applied to the cotton mohair mix. By employing 'alginic' fibres the damage previously caused to the mohair fibre was prevented. Alginate fibres also enabled the manufacture of woven or lace fabric with yarns that were previously unworkable, for instance fancy yarns that required 'additional binder threads' whose purpose was to prevent the slipping of knops or yarns during weaving, while the inclusion of tufts of fibres, or gold, metal or wood objects seemingly isolated within woven fabrics, were first gripped between the soluble alginic yarns, which upon dissolving gave no clue as to how such decorated fabrics were manufactured.[91]

The design history of the temporary support thread clearly merits further investigation, however, its gradual development during the late nineteenth and early twentieth century reflected the advancement in new fibres and the trends in fabric patterning and

[88] C. T. Pastor. Krefeld, Germany. (Application filed May 24, 1934 (in Germany May 26, 1933) accepted October 12, 1937). Process to make Rubber Textiles and Rubber Thread Textiles. US patent 2,095,529.
[89] F. F. Schwartz, M. A. Chavannes, Paris, France, assignors to American Ecla Corporation Dover, Del., (Application filed August 5, 1937 accepted October 10, 1939). Elastic Fabric and its Process of Manufacture. US patent 2,175,733.
[90] A. Johnson, J. B. Speakman, assignors to Alginate Industries Ltd. Maidenhead, Berks, England. (Divided application filed July 7, 1942 (GB 1941), accepted February 3, 1948). Textile Fabric. US patent 2,435,543.
[91] The alginic fibres were removed during scouring.

structures. Its general application within stitched, woven, and knitted textiles further emphasized the dissemination of carbonising and devoré techniques within the textile industry. During the 1940's the usage of the temporary support yarn was reduced, however, after the Second World War the use of the support yarn within thread and fabric manufacturing was re-established, often to be employed in association with new fibres. Alginate yarns were declared costly by Bertram Pusey Ridge (1948, ICI) in light of the substantial amount of alginic yarn or filament dissolved away, accordingly his Terylene support yarn enabled the manufacture of close packed fabric from twistless alkali resistant yarn, while A. L. Dorgin (1949) developed a twisted nylon and raw silk thread in the manufacture of a woven or knitted textile. The fabric once constructed was boiled off, shrinking the silk while imparting a crinkled effect to the nylon.[92] The 100% nylon fabric had a permanently set creped effect.

Stitched devoré: chemical lace and embroideries

The development of temporary yarn and carbonising procedures during the mid nineteenth century later stimulated the creation of textile carbonising processes that could be used in the manufacture of larger and more sophisticated textile products. The foundation of chemical lace manufacture or *Aetzstickerei*, in Germany and Switzerland in early 1880's, and the continuing development of the chemical lace product in the succeeding years has been substantially documented by lace and embroidery historians, although an evaluation of its connection to temporary yarn carbonising is lacking in the historical textile record. The establishment of reproduction lace on the embroidery machine, or 'flat needle laces' (also known as Edelweiss Lace, a form of machine embroidery on a net ground with open work details)[93] has according to Santina M. Levey, Lace A History, (1983), been attributed to both Robert Neubauer of Plauen (Saxony, 1881) who discovered a method of creating 'open-work effects by taking out a silk ground', and Jacob Sutter of St Gall (Switzerland, 1883) who established the beginning of the 'Swiss chemical lace' industry.[94]

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[92] The silk was then removed by a hot caustic solution, and the remaining textile neutralised in an acid bath.

[93] Jenkins, D. ed. (2003). The Cambridge History of Western Textiles. Vol. 2. See Levey, S. M. Ch. 23. Machine-Made lace: The Industrial Revolution and After. p.858.

[94] Ibid. and Levey, S. M. (1983). Lace. A history. London: V&A publications. Machine Lace, p116.

In contrast Anne Wanner states E. A. Steiger-Züst, Schweizerische Landesausstellung Bern 1914, die StickereiIndustrie (1915)[95] considered Charles Wetter-Ruesch to have been the inventor of the chemical lace corrosion technique, and the British and American historical patent record verifies embroidery fabric designers were assigned to Charles Wetter and the Wetter Brothers in 1880 and 1881 respectively.[96] Moreover, the embroidery inventor J. Steiger (Herisau, Switzerland) should also be recognised as his 1881 patent specification clearly describes the production of Guipure embroidery, and embroidery on loose or open fabrics, such as net, and the dissolving of animal fibres by a chemical solution.[97]

The nature of chemical lace manufacture employed in these two traditional lace and embroidery centres involved processes of machine embroidery, including the Schiffli machinery (automated around 1900 by a Jacquard system), and carbonising. From the outset cotton lace was the preferred merchandise, with the cotton thread patterns rapidly stitched onto a backing fabric, usually silk, but also wool, in imitation of needle laces (however, towards the end of the decade wool lace stitched onto cotton fabric was patented in Britain by F. H. Bowman).[98] Once the stitching had been applied to a fabric (or latterly a paper surface) the ground was redundant and subsequently removed by carbonising. The open work styling of these embroidered lace fabrics resulted in their being named guipures or Swiss embroidered lace guipures, with the fashionable Duchesse, Brussels Rosaline and Irish Crochet also influencing chemical lace design.[99]

The early style of these chemical lace textiles was often simplistic in terms of their apparent structure This is evident within chemical embroidery patent registrations of the 1880's. For instance, Steiger's 1881 patent shows three lace designs with only 'figure one' created by means of a removable silk ground, while 'figure two' and 'figure three' illustrating two samples of embroidered net created by means of a dissolvable paper, see Fig. 5. Frederick Suter, assignor to the Wetter Bros. (St Gall), who in his 1882 patent also laid claim to the process of cotton embroidery made on a removable silk ground,

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[95] Wanner, A. (2004). Textile History. The sample Collection of Machine Embroidery of Eastern Switzerland in the St Gallen Textile Museum. [online] Available from http://www.annatextiles.ch/publications/samplecoll/samp_1.htm. [Accessed 24th July, 2004]. p.1.
[96] US patent 238,626 and US patent 257,258 respectively.
[97] Jacob Steiger. (Application filed 26th September, 1881, accepted 24th March 1882). Improvements in the production of embroidery. GB Patent 4143.
[98] F. H. Bowman, Halifax, Yorkshire. (Application 13th November 1888, accepted 20th July 1889). Improvements in the Manufacture of Lace and other Reticulated Fabrics from Wool and other similar Animal Fibres. BP 16,420.
[99] Earnshaw, P. (1993). Embroidered Machine Nets. Guildford: Gorse p.186.

illustrated the basic design of these chemical lace fabrics.[100] Accordingly, of the three examples shown within Suter's patent the stitches or bars are all that hold the continuous lace structure together, see Fig. 6, with Suter describing this new and cheap invention as a means of creating 'open-work fabric.'[101]

The development in design complexity of the Swiss embroideries was later reflected in David Wuillemin's invention of 1885, whereby an embroidered lace design with areas of detailed fine line and patterning was constructed on a dissolvable paper or fabric backing, see Fig. 7.[102] The gradual increase in the range of patterning directly reflected the varieties of traditional fabric the process was used to imitate. Textile lace historian S. M. Levey, declared the Swiss chemical lace manufacturers to have used the technique 'to reproduce every type of needle lace and related products such as crochet', with imitation Venetian raised points said to be most successful, and Irish crochet-lace or Sol-lace from Paraguay also produced by the chemical method.[103] Moreover, Wanner describes the manufacture of complicated shapes, such as collars being 'separated into individual pieces which subsequently were produced in large numbers on the embroidery machines. Later, before they underwent the dissolving process, they were joined together by sewing machines into their final form.'[104]

While the first chemical laces of the early 1880's were manufactured on the hand machines, with reference to both Suter and Wuillemin's patent illustrations, see Figs. 6 and 7, the introduction of the Schiffli embroidery machine some five years later was clearly key to the further development of the chemical embroidery lace process as it could produce reproduction mesh ground or guipure laces by stitching onto a net or temporary fabric ground.[105]Although it should be noted that while the embroidery machine was in used in both Plauen and St Gall for chemical lace, it was not solely dedicated to the production of such laces. Furthermore, the delicate constitution of the Schiffli embroidery machine meant it was often costly to maintain, and once the employment of chemically pre-treated woven fabric grounds began to be used soon after

[100] The choice of chemical for silk fibre removal was declared by Suter as 'chloride of lime.' It is also thought that a Wetter Bros. may relate to E. A. Steiger-Züst's C. Wetter-Ruesch.
[101]Frederick Suter, of Suhr. Assignor to the Wetter Brothers, of St. Gall, Switzerland. (Application filed November 29, 1882 accepted June 26 1883). Process of Producing open-work fabrics. US patent 280,094.
[102] David Wuillemin, Fribourg, Switzerland. (Application filed May 24, 1884 accepted April 14, 1885). Lace and the Art of Making the Same. US patent 315,589.
[103] Levey, S. M. (1983). p.116.
[104] Wanner, A. (2004). Textile History. [online] [Accessed 24th July, 2004]. p.9.
[105] Earnshaw, P. (1995). How to Recognise Machine Laces. Guildford: Gorse p.19

the needles were found to be vulnerable to corrosion, consequently the cost of these chemically manufactured laces could be high, according to Earnshaw.[106] However, despite the difficulties encountered with the embroidered lace machinery, the impact of Swiss and Plauen chemical laces was soon evident within the market place.

The chemical lace manufacturers based in Plauen, St Gall, a district also renowned for its innovation of finished cotton goods alongside automated embroidery and Schiffli machines, and Carlsbad in Czechoslovakia initially held a monopoly on the production of chemical lace goods marketing their brand of laces to the rest of Europe and the USA. Accordingly, Wanner in her profile of Otto Alder, from the Swiss firm bearing his name, in co-operation with customers from Paris 'found a market for the *Aetzspitze* (chemical or burnt-out lace) after 1883.'[107] As the textiles were marketed to the rest of Europe and America the process inevitably spread throughout Europe and also to the United States, where Swiss émigrés established a significant Schiffli lace and embroidery industry in New Jersey. Writing of the then 75 year old US industry in 1961, Linton and Pizzuto, Applied Textiles, recorded production had reached '95 % of Schiffli lace and embroideries in the US as well as the rest of North and South America.'[108]

A key period for chemical embroideries and lace spanned the decades of the late nineteenth and early twentieth century. In The Lace and Embroidery Review for April 1912, a journal 'exclusively for the buyer of laces, trimmings embroidery veilings neckwear and handkerchiefs,' companies such as George F. Owen inc., were noted for their 'splendid line of domestic embroideries, displaying distinctive ideas in flouncings and excellent burn't out laces' for the Fall, see Fig. 8.[109] While Sontheimer and Stern, were said to have produced 'tasteful and original designs in burnt-out laces, of the kind that is meeting good favor this season', see Fig. 9.[110]

The development of the Schiffli chemical laces greatly benefited the new middle classes as traditional hand made laces had been largely unaffordable. Formerly, only wealthy patrons could purchase hand crafted laces, which generally required considerable time

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[106] Earnshaw, P. (1995). Ibid.
[107] Wanner, A. (2004). Textile History. [online] [Accessed 24th July, 2004]. p.9.
[108] Linton, G. E & Pizzuto, J. J. (1961).
[109] The Lace and Embroidery Review. (1912). Periodical Publications. New York: Clifford and Lawton. April, 1912. v. 8. p. 33.
[110] The Lace and Embroidery Review. (1912). Ibid. p.66.

and skill to manufacture, (as discussed with Claire Brown, archivest and lace historian, during a visit to examine machine manufactured lace at the V&A textile rooms in September, 2001).[111] The mass produced chemical laces were popular for fashion and the interior not only because greater quantities of lace could suddenly be employed within single outfits or within the home, a fashionable trend of the 1890's, but also because of their continuous repeating design and the close resemblance these laces products had to the laces they were replicating.

The process of aetzing or corroding when employed in conjunction with the embroidery machine presented the embroidery lace manufactures with the freedom to more rapidly alter patterns while offering a broader range of imitation lace textiles to the consumer. The manufacture of novelty laces by the chemical processes continued in Switzerland during the early 20th century, with experimental and modern designs, taking precedence over imitation, reflective of new dress fabric trends but also marking a change in the way the home interior was being decorated. Accordingly, as chemical lace manufacturers were beginning to realise the reproduction of hand made laces was less economically viable, prior to the First World War the market for lace was negatively affected by the move away from lace textiles in both dress and the interior, and consequently the chemical lace product was marginalized, a change also reflected in the historical patent record for 1920's chemical embroidery.

The decline in chemical lace manufacturing was also in line with the reduction in woven devoré processes that occurred after 1910. The revival of both techniques at the secession of war in the early 1920's was also synchronized, however, while the woven devoré textile reached its peak in the fashion textile market during the mid 1920's, chemical laces if purchased by consumers were mainly chosen for the interior. The chemical lace industry along with other machine and hand made lace manufacture faced considerable difficulty during the 1920's. In post war Britain, The Lace, Embroidery and Silk Industries Committee's interim report of 1923 suggested a 33 ⅓ % ad valorem duty on imported machine and hand made laces and on embroidery manufactured on net or dissolvable fabric, in order to counteract the 'psychological effects' of the depression and the heavy unemployment in the Nottingham machine made lace and embroidery

[111] V&A Textile archive, London. Machine manufactured laces. With thanks to Claire Brown. (2001). [Archive review with Claire Brown, 6th September, 2001].

industries since 1920, said to be a consequence of the changes in fashion, 'fall of world demand, and the increase in tariffs.'[112]

A revival of the embroidery lace product for fashion in the mid to late 1920's was noticeable because it had had to become more fashionable in appearance and fibre content. The employment of metallic threads and other modern fibres such as regenerated viscose or cellulose acetate by leading fashion designers also influenced the embroidery lace industry, however, the earlier dress designs that had almost been overwhelmed by decorative lace were redundant, the new laces were used in streamlined garments often in association with diaphanous fabrics, or metallic nets under which they gave a suggestion of sophisticated but restrained decoration. The increased use of the woven devoré textile appears to have been partly responsible for the decline in the embroidered lace textile. The woven devoré product also employed these new bright fibres in its fabrics, they were cheaper to employ but most significantly the nature of the patterning and the effect of etching out of the fibre imparted a lace like quality to the textile. The reference to 'lace like' effects in woven devoré patents was reflective of this patterning during this time.

The connection between embroidery and woven devoré was established early on in the two processes development. While the union of machinery and carbonising to create the chemical embroidered lace textile emerged only slightly earlier than woven textile carbonising treatments that advocated the use of temporary dissolvable scaffold fibres. Furthermore, the embroidered and woven carbonising processes were conceptually different from the established carbonising treatments, the majority of which were patented from the 1850's onwards. The simple burr removal treatments by carbonising, of the 1840's and early 1850's, were purely focused on the cleaning of raw wool or the recycling (and extraction) of wool fibre, while the early 1880's saw the birth of fibre and fabric manufacturing processes by chemical carbonising methods. The only difference between the stitched and woven processes was that initially the chemical embroidery process favoured protein carbonising and woven cellulose carbonising, however, this distinction soon ceased.

[112] Great Britain. Parliament. Board of Trade. Lace, Embroidery and Silk Industries Committee. (1923). Lace, Embroidery and Silk Industries Committee: interim report. London: HMSO

The chemical carbonising of silk fabric ground in chemical lace manufacture also traces its origins to both temporary yarn manufacturing and chemical fibre extraction practices developed in the mid nineteenth century. For instance, Southam, Stead and Martin's (1856) separating or recovering vegetable fibres from fabrics containing wool, silk or other animal fibres, A. Gélis and L. Dusart's (1862), separating and recovering vegetable fibres, by dissolving silk or wool out of rags by boiling in a solution of sulphides of potassium or sodium or similar alkaline salt (the rags once removed were used for paper making), and W. Lorberg's (1863) carbonising rags of linseys, stuffs, fabrics, chintzes and other printed goods, which were steeped in a hot or cold solution of caustic soda or potash to dissolve out the wool or other animal fibre.[113] All employed the same chemicals and treatments later used in the Swiss chemical embroideries.

The implication within some of the chemical lace patents of the latter 1880's was that the silk backing used in the manufacture of chemical laces could also be made of an economical extract silk and be relatively thin, having been reconstituted and pressed. While embroidered lace made of cotton continued to be the standard product, wool and silk lace manufactured with a dissolvable cellulose ground were also patented in 1889. The style of carbonising was identical to wool carbonising treatments and wool and silk fibre extraction processes previously mentioned.

The use of embroidery machinery and carbonising does not appear to have been limited solely to the production of laces. In 1891, C. Jenny of St Gall, developed a style of chain stitched embroidery using a process of manufacture that required a dissolvable fabric ground.[114] The technique involved applying two layers of chain stitch onto a fabric, their backs coming into contact and crossing over where possible, with one layer of the chain stitch serving as a connection or skeleton for the other once the fabric has been carbonized. Patricia Wardle, in her historical survey of machine embroidery (1961), noted the chain stitch machine for embroidery was developed in 1865 by the French engineer Antoine Bonnaz, of Paris. To create the stitching the needle of the machine was moved about by a rotary handle situated underneath the machine to follow the design. The chain stitch machine was manufactured by the Cornely company (Cornélly machine) and was said by Patricia Wardle, to have swiftly come into use in

[113] A. Southam, S Stead & J. Martin. (Provisional protection only April 1, 1856). Separating or recovering vegetable fibres. GB patent 783. A Gélis, L. Dusart. (Application accepted November 7, 1862). GB patent 3011. W. Lorberg. (Provisional protection only, March 18, 1863). GB patent 731.
[114] Caspar J. Jenny. St Gall, Switzerland, assignor to Strauss & Co., (Application filed August 3, 1891 accepted January 5, 1892). Embroidery. US patent 466,566.

the all the existing embroidery centres, which 'together with the schifflé machine... was one of the principal factors contributing to the rapid expansion of the industry in the latter years of the nineteenth century.'[115] The accompanying patent images submitted by Jenny as part of his American specification reveals a Cornely manufactured decorative trimming which was considered suitable for 'curtains, tidies and covers', see Fig. 10.

Moreover, the discovery of this unique chain stitch utilising the carbonising process was completely unforeseen. Reference to the nature of the trimmings development and the nature of its design and retail is unknown, and therefore future researching and testing of the devoré chain stitch technique is planned. The chance discovery of this technique was made during a search of the historical patent abridgements for embroidery. The terminology used in association with this process was vague.

Throughout the researching of devoré and the processes various manufacturing procedures it became apparent that a breadth of terminology had been developed to explain the unique effects of the chemical treatments. The shared use of terms such as open work and lace-like across the textiles disciplines reflected the inherent etching effect of chemical destruction procedures. The lack of any clear definition of devoré terminology, how it was employed and which discipline used which terms was clearly lacking. The subsequent classification of devoré terminology was categorised using the following headings:

- Chemical lace and embroidery terminology
- Woven fabric and devoré terminology
- Knitted devoré terminology and fabric development

The cross-disciplinary nature of devoré meant the researching of past devoré patent abridgements required a clear definition of terminology use. The following analysis of terminology by manufacturing and fabric style enabled a more targeted approach to any references made to chemical textile manufacturing in both primary and secondary published sources. The emergence of devoré terms during the research supported the

[115] Risley, C. with historical survey by Wardle, P. (1961). Machine Embroidery. London: Vista Books. p. 20

belief that there is a correlation of manufacturing between chemical lace, chemical embroidery, woven devoré and knitted devoré practices.

Chemical lace and embroidery terminology

Chemical lace and embroidery terminology was most influenced by the union between embroidery machine and chemical carbonising. Alternative terminology used in association with the stitching of fabrics reflected the structural characteristics of the original textile or original lace centres. Essentially the terms used in association with hand laces were reassigned to the new chemical lace embroideries, for instance the description guipure was historically used to describe a lace without a net ground structure, and in due course, this also came to denote Swiss chemical lace guipure fabrics, as according to Earnshaw. Moreover, the range of terms used, uncovered as part of a patent review of chemical lace manufacture spanning 1875 to 1930 and a literature survey of traditional lace and embroidery made by chemical carbonising, tended to reflect either the nature of product or the manner of its formation. The following terminology has been employed in association with chemical lace and embroidery laces and the varying methods of their manufacture.

1. Table of Chemical lace and embroidery terminology.

Term	Date	
Artificial lace	1912	The Lace and Embroidery review
	1960	Encyclopedia of Textiles[116]
Burn-out embroidery:	1979	Elsevier Textile Dictionary: classification 8081
bordado químico (e) broderie	1989	ITS. Textile Dictionary: classification 2681
chiminique (f), Aetzspitze,	1991	VDI Textile Dictionary
Ätzpitze (d),	1992	A. Wanner.
Ausbrennstickerei; Stickerei in	2001	Rouette [117]
Ausbrenntechnik (d).		

[116] The Lace and Embroidery Review. (1912). v.8, p.86; Editors of American Fabrics and Fashion Magazine. (1960). Encyclopedia of Textiles. Englewood Cliffs N.J.: Prentice Hall. p.431.
[117] Elsevier Scientific Publishing Co. (1979). Elsevier Textile Dictionary. London: Elsevier Scientific Publishing Co; International Textiles Services Ltd. (1989) ITS Textile Dictionary. CH-8952 Schlieven, Zurich Switzerland International Textiles Services Ltd; Textile Institute of the university of Aachen, ed. 2nd edition. (1991) Textile Dictionary: English/American-German-French-Spanish-Italian. (1991) Düsseldorf: VDI-Verlag.

Term	Date	
Burnt out lace: **etched lace.**	1939	Evans/ B McGowan
Burnt out laces, dentelle par	1985	Earnshaw
rongeage (f), pizzo per	1989	ITS, classification: 2683
corrosione (i).	1991	VDI Textile Dictionary[118]
Chemical lace, Swiss chemical	1983	Levey
lace.	1985	Earnshaw
	1986	Reigate
	1991	Ginsberg[119]
Dentelle fin de siècle **(end of the**	1994	Earnshaw, see Hénon[120]
century lace).		
Embroidery lace.	1884	Wuillemin.[121]
Embroideries, embroidery	1885	J. Krüsi. Process of Making Embroidery Laces. US
lace, embroidery laces.		patent 337,687[122]
Edelweiss Lace.	1983	Levey
Guipure,	1881	J. Steiger;
guipure embroidery.	1953	Ferrière.[123]
Guipure Lace Embroidery.	1881	J. Steiger;
	1986	The Textile Institute.[124]
Swiss embroideries,	1912	Manufacturers Oppenheimer Adler & Co.[125]
La Suisse.		

It is evident from this classification of chemical lace and embroidery terminology that there are clear crossovers between knitted and woven devoré textiles and their style of manufacturing. Whether the chemical lace industry was the at the forefront of all devoré

[118] Evans, M. & Beers McGowan E. (1939). A Guide to Textiles. New York: John Wiley and Sons. Inc. p. 92

[119] Levey, S. M. (1983); Reigate, E. (1986) An Illustrated Guide to Lace. Woodbridge: Antique Collectors' Club. p.239; Ginsburg, M. ed. (1991). The Illustrated History of Textiles. London: Studio Editions.

[120] Earnshaw, P. (1994). Lace Machines & Machine Laces. Guildford: Gorse publications. p.253. With reference made to Hènon, H. (1901) Dentelles, broderies et passementeries; rapport du jury internationale de l'exposition universalle. Paris: Internationale de 1900.

[121] Wuillemin. (Application filed May 24, 1884 accepted April 14, 1885).US patent 315,589.

[122] J. Krüsi. St Gall Switzerland. (Application dated July 8, 1885 accepted March 9, 1886). Process of Making Embroidery Laces. US patent 337,687.

[123] Ferrière, M. T. (1953) Swiss Textiles. Leigh on Sea: F. Lewis Pub. Ltd.; J. Steiger 1881/ 1882.

[124] The Textile Institute. (1986). Textile Terms and Definitions. 8th Ed. Manchester: The Institute.

[125] Advert in the Lace and Embroidery Review. (1912). v.8.

fabric designing is unclear, however, it is likely the similarity in terminology is an indication of the open work effect that chemical etching use produces on all devoré fabrics.

Woven fabric and devoré terminology.

The researching of woven devoré terminology revealed the applied and carbonising practices associated with woven devoré manufacturing seldom influenced the development of woven devoré terminology. Moreover, woven devoré terminology reflected chemical lace and embroidery textiles terminology, in that woven devoré terms tend to indicate the physical styling of the textile for instance brocade, jaqueline, or the patterning effect of the treatment or the etching effect, as in open work or burn out.

The employment of devoré in the manufacture of decorative textiles was routinely concealed from late nineteenth and early twentieth century consumers. Moreover, the woven devoré process when employed to create fabrics in the style of exclusive woven fabrics often resulted in the method of imitation being intentionally difficult to identify. Marie Hélène Guelton of the Musées des Tissus et des Arts Décoratifs de Lyon, France, when asked about the breadth of devoré textiles within the Lyon collections pointed out the difficulty of recognising the devoré style of fabric manufacture. For instance, 'figured muslin velvets', a manufacturing speciality of Lyon, could on face value be easily and mistakenly classed as devoré in style. 'You can only check the warp pattern step (découpure) in figured velvet, but at first glance, it is impossible to see.'[126]

Where the lace and woven devoré terminology crosses over is in the use of phrases such as open-work, a description common to both, while 'lace-like' is confusingly used to describe devoré printed textiles, while 'web', from 'gewebbe', or net is also a shared stitch and woven description.[127] The common employment of chemicals and the effect of their use upon these textiles also resulted in 'burn out', or 'chemical' being an obvious mutual prefix. What became apparent from the comparison of stitched and woven terms is the absence of associated place names in regard to woven devoré. This is thought to be as a result of woven devoré manufacture either being considered a

[126] Guelton, M. H. (2003). [e-mail from Marie Hélène Guelton of the Lyon Museum of Textiles, France. Guelton@lyon.cci.fr>, 25 July, 2003].
[127] gewebbe- patent fancy laces. With reference to E. Zeidler, Guntramsdorf, Austria. (Application filed March 8, 1915, accepted April 17, 1917). Process for Manufacturing Fancy Webs having Raised Designs. US patent 1,223,018. 'The production of raised designs on cotton-webs.'

novelty process by manufacturers or possibly because the technique did not become exclusively linked to one specific style of woven textile and therefore a particular textile region or centre, a consequence of the spread of woven textile manufacture by the mid to late nineteenth century.

The history of the woven devoré textile, its origin and associated terminology, and fibre and chemical usage, from 1860 to 1940, will be subsequently presented within the following chapters, however, with regard to the researching of woven devoré terminology the period under review covered 1875 to 2000. Accordingly, the various woven devoré terms uncovered have been intermittently employed in the naming of the woven devoré process or its style of manufactured fabric.

2. Table of Woven fabric and devoré terminology.

Term	**Date**	
Acid cut back.	1966	Marsh.[128]
Brocaded effects.	1924	Cadgène. Jeandros.[129]
Brocaded velvet.	1946	Bendure & Pfeiffer.[130]
Burning out printing, also defined as extract printing.	1979 2001	Elsevier Textile Dictionary classification 879; Rouette.
Burn out print. Burn out print.	1960 1986	Encyclopedia of textiles; Yates.
Burned out.	1998	Kadolph, Langford.[131]
Impression par rongeage (f), Aubrennen; Drucken für Durchbrucheffekte, Drucken für Ausbrenneffekte (d) estampado por corrosion (e)	1960 1991	Encyclopedia of Textiles; VDI, Textile Dictionary.[132]

[128] Marsh, J. T. (1966). An Introduction to Textile Finishing. London: Chapman and Hall Ltd.
[129] Ernest Cadgène and Jules Jeandros, Patterson, New Jersey, Jeandros assignor to Cadgène. (Application filed February 15, 1924. Accepted October 28, 1924). Soda-Print Process. US patent 1,513,370.
[130] Bendure Z , Pfeiffer G. (1946). p.655
[131] Yates, M. P. (1986). A Handbook for Designers. New York: Prentice Hall; Kadolph, S. J., Langford, A. L. (1998). 8th ed. Textiles. New York: Macmillan (ISU) p. 289.

Term	Date	
Burnt-Out. **(Etched-Out)**	1980 1983	Encyclopedia of Textiles; Corbman. [133]
Burnt out fabric: dévore, devoré printed fabric or *en tissue dévoré* (f), Devorant-Artikel (d), and articolo devoré (i).	1989 1991	ITS classification number 2682. VDI, Textile Dictionary.
Burn out velvet.	2001	Rouette.
Burnt-out work.	1938	Woolman, McGowan.
Carbonizing processes.	1930	Dickie and Hill.
Chemical printing	1992	Miller.[134]
Cut out, cut out paste, cut out printing, cut out velvets.	1937	Hillman.[135]

Term	Date	
Damasse (Damask).	1937	Hillman.
Devoré, devoré wool.	1983	Wool Record.[136]
Devorant pattern, devorant process, cauterised pattern: known as dessin dévoré (de dévorage) (f); Ausbrennmuster (d)	1991	VDI, Textile Dictionary.
Etched-Out fabric**, etched fabrics, Etched-Out effects.**	1945 1960 1996	Potter; Encyclopedia of Textiles; Fairchild's Dictionary.[137]

[132] Editors of American Fabrics and fashion Magazine. (1960).; Textile Dictionary: English/American-German-French-Spanish-Italian. (1991).
[133] Corbman, B. P. (1983). Textiles: fiber to fabric. New York; London: Gregg. p. 179
[134] Miller, E. (1992). Textiles. Properties and behaviour in clothing use. London: B.T. Batsford Ltd.
[135] Hillman, B. S. (1937). Soda prints on pile fabrics. Rayon Textile Monthly. February, 1937. p. 54 (94).
[136] Wool Record. (1983). Rare and Speciality Fibres. Wool Record. October, 1983.

Term	Date	
Façonné velvet.	1946	Bendure & Pfeiffer.[138]
Jacqueline (a woven brocade)	1937	Hillman.
Lace effects	1928 1966	Dreyfus, Dort, Platt; Marsh.
Printed velvet effect.	1927	Rivat, Dreyfus.[139]
Mordanting.	1925	Müller.[140]
Open work effect	1925	Stevenson, Wakefield.[141]
Soda print, soda printing, soda print process	1924 1937	Cadgène, Jeandros; Hillman.[142]

Of the woven devoré terms listed, the earliest known use of the popular term 'burnt out' or 'burn out' was discovered in an America publication dated 1938, (see Woolman and Beers McGowan) however, it was the use of 'soda print' in 1924 that first recognised the woven devoré technique as a distinct process and one that differed from carbonising. The terminology used to describe woven devoré process prior to this time was typically based upon the visual or design effect the process created on the fabric, for instance an open work effect, a lace effect, a figured fabric, etched out, or cut out. Furthermore, as a consequence of the classification systems established by varying patent offices, patent abridgements and patent titles tended to include the terms ornamenting, decoration or

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[137] Potter, M. D. (1945). Fiber to Fabric. New York: The Gregg Publishing Co. p.237; Editors of American Fabrics and fashion Magazine. (1960). Tortora, P. G. ed. (1996). Fairchild's Dictionary. New York: Fairchild.

[138] And online dictionaries such as www.texindex.com.

[139] George Rivat, Camille Dreyfus. Assignors to the Celanese Corporation of America. (Application filed December 16, 1927, accepted August 11, 1931) Process of Treating Fabrics. US Patent 1,818,505.

[140] Herman Müller of Herisau, Switzerland., Assignor to the firm Aktien-Gesellschaft Cilander, of Herisau, Switzerland. (Application filed February 25, 1926, accepted February 21, 1928). Method for Producing Pattern Effects in Fabrics. US patent 1,660,042.

[141] Giesler (1913/1915). GB 10,867; Robert Stevenson and Frederic William Wakefield, Co. Tyrone. (Application filed March 28, 1925, accepted October 1, 1925). Improved Method of Manufacturing Decorated and Mercerised Woven Fabric. BP Patent 240,378.

[142] Hillman, B.S. (1937); Cadgène and Jeandros (1924). US 1,513,370.

decorated, pattern, design, fabric or marking within their titles as standard, and on occasion in conjunction with a description of the style of fabric they were to be employed upon, for instance velvet. Subsequent describers of woven devoré textile design often used the terms brocaded, drapery Madras, façonné, and Jacqueline, which were already used to describe non-devoréd woven textiles or patterns. Of the devoré patents examined as part of this research a minority simultaneously detailed the decorating of knitted and net textiles and the creation of new style yarns within a single specification, with the result that a broader range of terms were applied such as the aforementioned open-work or lace effect.

Knitted devoré terminology and fabric development.

The knitted devoré processes were intermittently alluded to in woven devoré patents exactly simulated woven devoré techniques, with the fibre combinations used in such textiles consistent with the fibre content of the woven fabric counterpart. Evidence of the employment of devoré in combination with knitted textiles began to appear in the textile patent record from the 1880's onwards. Initially classified as carbonized fabrics processes, F. H. Bowman's 1888 patent was typical for its inclusion of other fabrics, such as lace and woven. By adding temporary "draw threads" of cotton or linen within a knitted, woven or lace fabric constructed of silk or wool, followed by carbonisation accordingly resulted in 'peculiarities' in the fabrics pattern.[143]

In contrast Louis Chaux's knitted (and woven) devoré textile process of 1891 suggested rabbits' hair or other animal hair, mixed with wool or silk, be supported by a temporary thread during fabric construction and subsequently incinerated by carbonising.[144] In explaining the process used to make such a knitted fabric, Chaux remarked 'the front may be of pure wool and the back of hair,' a possible reference to the combined use of plating and carbonising. The use of devoré processes on knits continued to develop in the early twentieth century. For instance Camille Dreyfus proposed the creation of patterns on cellulose derivative fabrics in 1927 (including knits) and then in association with Dort and Platt in 1928 suggested a combined devoré treatment for woven, netted or

[143] F. H. Bowman (Patent abridgement November 28, 1888). Carbonized Fabrics. GB patent 17,283.
[144] L. Chaux. (Patent abridgement February 18, 1891). Carbonized Fabrics. GB patent 2978.

knitted fabrics manufactured of cellulose with a protein or cellulose acetate fibre; the aim of the process somewhat confusingly being the creation of 'lace effects'.[145]

Where the combined woven and knitted devoré processes diverged was in the effect the devoré process had on each style of textile. Where a devoré print on a woven textile created relatively crisp edges, on a knitted fabric unless the aim was to have the full fibre removal of a temporary yarn the technique appeared rather crude or jagged in style. Consequently, the combining of plated knitting and applied devoré by printing in 1927 meant the localised destruction of yarn could be sharply defined within a knitted fabric.

The devoré process worked well on plated fabric because according to H. E. Houseman (1928) it is 'formed of a backing yarn or body yarn and a facing or plating yarn by feeding two yarns under different tension to the needles; the plating yarn appearing on the face of the fabric, while the body yarn is concealed.'[146] Because two yarns were used, usually of different properties, and positioned behind each other, each exhibiting its own characteristics on its own side.[147] A plated knit from the viewpoint of the devoré manufacturer was almost identical to a woven fabric constructed of two differing yarn types within the warp and the weft, and as such was treated in a corresponding manner. This combination of knitted textile and devoré should be considered the basis of the modern day knitted devoré technique, with its inventor, Josef Mahler of Czechoslovakia, assignor to the Fidelity machine Company of Philadelphia, responsible for developing the method to achieve a 'Jacquard effect' on plated stockings or other plated knitting.[148]

Where the (plated) knitted devoré textile differed from its woven counterpart was in its exclusive use as a fashion textile, in particular within hosiery and lingerie. Mahler's accompanying patent illustration registered in America accordingly revealed the manner

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[145] Camille Dreyfus, New York. (Application filed December 16, 1927, accepted May 12, 1931). Ornamental Fabric Containing Derivatives of Cellulose and Method of Producing the Same. US patent 1,804,529; Dreyfus, Dort & Platt. (1928/1931). US 1,834,339.

[146] Harold E. Houseman, Edge Moor, Delaware, assignor to Standard Trump. Bros. Delaware. (Application filed March 15, 1928 accepted February 4, 1930). Process of Knitting Plated Fabrics. US patent 1,745,619.

[147] Textile Institute. Textile Terms and Definitions. (1986)

[148] Josef Mahler, of Nemecky Brod, Czechoslovakia. Assignor to Fidelity Machine Company, Philadelphia. (Application filed October 10, 1927 accepted June 24, 1930; patented in Czechoslovakia July 1, 1927). Process of Producing Patterns on Plated Knitting and the Corresponding Product. US patent 1,768,125.

in which patterning could be achieved on a plated knitted stocking, with areas of the plating (the top surface) removed to reveal areas of groundwork, see Fig. 11. The effect of the devoré treatment was dependent upon the yarn selection, with Mahler describing the employment of wool as a resistant fibre and the cotton included for localised destruction. Moreover, the back ground once made visible by the devoré treatment could have been be of a lighter or similar yarn weight, and of a comparable or contrasting colour, achieved by cross dyeing.

In contrast to the plated knit of Mahler, but equally important in the development of the knitted devoré process was the employment of a temporary yarn in the manufacture of stockings of uniformed stitch and acceptable appearance, see Fig.12. John L. Meade, assignor to the Paramount Machinery Co. of Chicago instigated the protection of a nylon base yarn in response to the difficulty in producing perfect loop formation for predetermined conditions of fabric stretch, both lengthwise and transverse along the fabric, a result of static electricity on the machine which had previously caused the fabric to "bunch up" and twist.[149] Moreover, the loosening of the knit tension, on a machine such as the 'well-known Scott and Williams Model K', resulted in the fabric being marred by distorted stitches. The inclusion of an auxiliary 'body yarn' to the needles enabled controlled stocking manufacture which exerted a 'neutralizing influence' on the fabric distorting effect of the body yarn. The fabric was then subjected to a setting treatment to stabilize the body yarn, a process followed by the removal of the temporary yarn by a caustic solution, which accordingly had no effect on the nylon filament.

Contemporary knitted devoré such as Krizia's wool devoré dress shown in Vogue Paris (1999) is reflective of both Mahler and Meade's devoré processes although updated by the removal of the wool fibre to show a lightweight synthetic ground, see Fig.13. The trend in irregular removal of wool fibre in modern knitted devoré creating a textural feel to the fabric may initially appear to contradict Mahler's attempt to neaten the edges of the fibre removal, however, this is not the case. The late twentieth century knitted devoré textile has modified Mahler's technique to suit modern fibres and contemporary design trends in constructed textile patterning.

[149] John L. Meade, Gary Indiana. Assignor to Paramount Textile Machinery Co., Chicago. (Application filed February 17, 1941, accepted October 26, 1943). Method of making Stockings. US patent 2,332,738.

Woven devoré fabric.

The equivalent adaptation of early devoré processes can also be seen in modern woven devoré designing. However, the basic principles of fibre destruction have remained virtually identical. Within the category of woven burn out design there are two distinct forms of woven textile employed in conjunction with the technique: two-element weaves, for instance plain woven textiles and satin weaves, and three-element weaves, for instance compound weaves such as pile fabrics and velvets. For the devoré process to work in conjunction with these textile structures a chemically vulnerable and chemically resistant are required, with the composition and inter working of the resistant yarn within the woven textile paramount to the successful use of a devoré treatment as it constitutes the scaffold, ground or networking of the fabric, and sustains the textiles overall shape and strength.

Therefore for the successful eradication of a fibre from a two-element weave textile the arrangement of the vulnerable yarn can be designed in such a way as to aid the actual creation of a textile. Furthermore, when the temporary yarn is partially removed from the structure of a two or three element weave decorative effects can be achieved, bands of lightweight yarn or threads can be revealed if, for instance, the vulnerable yarn is woven in strips and then removed from within a plain woven textile, according to Bowman (Halifax, England1888) and Stevenson (Ireland, 1925). Partial elimination of the vulnerable yarn can also be executed in such a way as to create delicate patterning of fluid shape and form, often figurative in style, on for instance either a satin (two-element weave) or pile (three-element weave) woven textile.

Analysis of patent evidence shows woven burn out manufacture as having developed in association with both of these two forms of textile during the latter part of the nineteenth century. Distinguishing between these two forms of woven fabric construction is straightforward if an understanding of their basic structure or the method of manufacture of the textile is known. Emery in The Primary Structures of Fabrics, (1994), noted 'The particular nature and order of the *interworking* is what distinguishes one such fabric structure from another, and consequently classification of the structure rests on classification of the 'systems of interworking'.[150] If an 'element' is defined as a

[150] Emery, I. (1994). The Primary Structures of Fabrics. London: Thames and Hudson. (Washington D.C. The Textiles Museum). p.27.

being a yarn, thread or strand, natural or synthetic in composition, with a unit of fibre or filament interlaced to form a fabric, the term two element weave therefore describes a textile constructed from two separate elements, for instance simple weaves such as plain weaves; balanced, warp faced, weft faced, ribbed, multiple element units,[151] and float weaves; even twill, uneven twill, satin weaves, float weaves derived from plain weaves. These woven fabrics are defined by their interlaced warp and weft yarns lying flat in longitudinal and transverse parallel lines. Emery states 'Variation of structure is effected by varying either the numerical order in which the elements or units of one set interlace with those of the other, the alignment of the interlacings or both.'[152] Identifiable by their interlaced warp and weft yarn structure, the devoré patterning of these two-element weave textiles, when seen in relation to the documentation of compound weave burn out (pile weave) has received limited recognition. This specific style of woven devoré designing has two basic forms of application. The earliest registered method enabled the actual construction of a plain woven textile as with Chaux (Pairs,1883) and the Scheppers' (Philadelphia, 1887). The second style of devoré practice associated with this two-element weave style was totally decorative in its objective. Varying methods of fibre removal such as carbonising and applied carbonisation could be employed, however, the aim of manufacture was to ornament or pattern the structure of a previously constructed two-element weave often with the aim of creating the effect of a three element weave as with a brocade.

Lace-like effects, open work fabric, areas of voile or mesh, networking and gauze were created wherever areas of fibre were removed locally from within a simple or float weave structure. Remaining areas of yarn unaffected by the treatment maintained the structure of the woven textile. Inventors such as Fulton (Scotland, 1908), Giesler (Belgium, 1915), Stevenson and Wakefield (Ireland, 1925), Müller (Switzerland, 1928), Bodmer (Watwill, Switzerland1928), Dreyfus, Dort and Platt (Maryland USA,1931), Golding (New York, 1934), Dickie, Wainwright and Allan (England, 1941), Döring and Grassmädder (1943), all relied upon selective fibre removal for their plain or float weave fabric designs. Of the two forms of two-element weave textile devoré profiled, the later decorative fabric style (float weave) appears to have been the most popular choice of devoré manufacturers. However, an examination of the many two element

[151] Plain weaves can vary in style and weight according to their use of yarn, fiber, etc. Plain weaves can be light, medium and heavy, this is determined by their fabric count or yarn quality. Note: The effect of using varied weight yarns on the devoré processing of such a textile was rarely detailed within the historical patent record.
[152] Emery, I. (1994) p. 75

woven devoré manufacturing procedures suggests the development of the two element weave woven devoré technique was heavily indebted to both practices of temporary support yarn carbonising and applied carbonisation.

A style of woven textile that is thought to have significantly influenced the creation of the two element woven devoré fabrics is the decoupé (cut out) textile, whose method of manufacturing comprises threads floating over or under the surface in certain areas.[153] After weaving these threads are mechanically snipped leaving areas of transparency. This process of manufacture is relevant because the popularity of these two element weave textiles was a necessary precursor for the devoré manufacturer to risk devoré manufacturing. Leading textile designer and weaver Jack Lenor Larsen remarked of the fabric that 'although more costly than devoré, decoupé can achieve far more varied effects and can be used with a greater range of fibres. Some approximate the cut-work sheers of India, which are slowly and less perfectly clipped by hand.'[154]

The connection between India and the two element weave devoré process has been intermittently mentioned within textile texts, although never developed in any depth or with any clear interpretation. The relationship between devoré or 'burnt out' as it was referred to by the Dyestuffs Division of I.C.I. Ltd., Manchester was said to be 'long popular in India' and that in the mid 1950's a style of 'negative reserve' was in operation in Ahmedabad which made use of a block printed resist.[155] It is thought the style of textile created by the Indian devoré process would have been similar to a marquisette textile (or possibly a decoupé weave) although most likely classed as a drapery Madras fabric. Clearly this relationship between 'Indian' sheer fabrics and the devoré process latterly discovered during the researching of this thesis requires further investigation.

While Muslin Madras, (sometimes referred to as Drapery Madras) comprises a plain muslin ground weave, or gauze (leno), with loose thread ends around a Jacquard style pattern, which shows on the wrong side,[156] somewhat confusingly a curtain madras is

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[153] Larsen, J. L. (1989). Furnishing Fabrics: An international sourcebook. London: Thames and Hudson p.56

[154] Larsen, J. L. (1989). Ibid.

[155] ICI Dyestuffs division. Negative Reserve methods. The areas of fabric to be retained were printed with a resist prior to the fabrics' carbonization.

[156] See Rathbone, L. & Tarpley, E (1931). Fabrics and Dress. Cambridge USA :Houghton Mifflin Company, The Riverside Press. p.368.

not a madras fabric which is in fact distinguished by a check or cord or stripe running in the direction of the warp. Bendure and Pfeiffer state that curtain madras is in reality a marquisette (or grenadine) with clipped spots and not a madras.[157] Accordingly, the marquisette with its sheer open weave with variable fineness determined by one, two or three ply yarns, and woven with dots, dobby or Jacquard patterns (while originally a silk dress fabric) should also be considered a strong source of inspiration for the two-element woven devoré textile.[158] The similarity between the design of this drapery textile and woven devoré textiles is first evident within the structural design of the two fabrics. However, for the woven devoré textile to achieve the look of the marquisette the selective removal of fibre by carbonisation was required to create a relief design, moreover, as a result of using this print process the same irregularly trimmed ends would have been evident at the edge of the devoré printing.

An exemplary collection of early twentieth century 'Madras muslin' fabrics (decoupé weave) of plant and tree inspired fabrics, are currently held within the V&A's furnishing textile archive in London.[159] The fabrics trade marked as la Treille (vine arbour), la Digitale (Foxglove), Feuille de chêne (oak leaves), la Tulipe (tulip), la Begonias (begonias) and Vigne et Cépage (grape and vine) are dated between 1915 and 1920. The subtle balance of muslin ground weave to raised Jacquard patterning is reminiscent of the devoré fabric described by Maertens in 1884/1886. The striking contrast between the lighter and denser areas of weave only becomes evident once the fabric is held up to the light, see Fig.14, this is also thought to have factored within lighter weight woven devoré textiles.

While Poiret is generally recognised as a fashion designer, his interest in furnishing fabrics began with his early association with the drapery trades. Inspired by the activities of the Viennese avant-garde, by 1911 Poiret extended his designing to every area of the decorative arts including interior design and haberdashery, opening an art school (Martine) in 1914 to promote interior design education and in 1915 a shop 'Martine' in the Rue du Faubourg Saint-Honoré retailing exclusive interior products and textiles. The success of the 'Martines' resulted in concessions being established within

[157] Bendure & Pfeiffer. (1946). p. 637.
[158] Bendure & Pfeiffer. (1946). Ibid. p.638.
[159] V&A, Department of Furniture, Textiles & Fashion. With thanks to Lynn, E. (2004) [Textile appointment with Eleri Lynn, Assistant Curator, 29 July, 2004].

department stores in London, Berlin and the USA.[160] These natural coloured Madras muslin fabrics (as classified by the V&A) are attributed to Atelier Martine and Paul Poiret and therefore are thought to have originated during this period of the companies thriving interior designing and furnishing fabrics retailing evident in Europe and North America.

The simplest designs in regard to weave patterning within the Atelier Martine collection of Madras muslins are the oak leaf (T.613B-1974) and the tulip (T.613F-1974) see Fig. 15. Evidence of their style of manufacture can be seen in the spots of the tulip fabric where float threads remain uncut. The employment of muslin Madras textiles, marquisette's and lightweight devoré textiles within the interior were popular, according to Larsen, because they 'provide a modicum of privacy and reduce glare without blocking out precious daylight, devoré curtainings are particularly popular in the relatively gray climes of northern Europe. The two (or three) densities provide a play of light and, depending on the colour contrast, may be subdued or lively as desired.'[161]

Three Element weaves, also referred to as three-dimensional weaves, are characterised as having more than one set of warp or weft elements or both and are classed as being compound weaves, 'compounded by adding extra sets of elements.'[162] For instance supplementary sets, an extra weft, extra warp, incorporated during construction to provide reinforcement, backing or a facing float or pile structure to a fabric. Larsen also suggests the brocade was probably the first three-element weave, with brocading usually continuous, from selvedge to selvedge, and therefore continuous brocading long floats are either carried on the backing of an opaque cloth or clipped on a sheer cloth. With regard to the classification of such brocade textiles Larsen also states 'In hand weaving this is called *cutwork*. Machine clipping is called broché.' Larsen goes on to state that 'An effect similar to broché is produced by printing a plain, patternless brocade cloth. Here, the supplementary yarn, a different fiber than the ground, is dissolved by printing with an acid.' Furthermore, 'Both broche and the etched prints described... derive from laid-in, or discontinuous, brocades, in which small areas of patterning weft are laboriously woven back and forth in the manner of a tapestry.'[163]

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[160] Baudot, F. (1997). Poiret. London: Thames and Hudson. p.10.
[161] Larsen. (1989). p.54.
[162] Emery. (1994). p.139.
[163] Larsen, J. L. & Weeks, J. (1976). Fabrics for Interiors: A guide for Architects, Designers and Consumers. New York/ London: Van Nostrand Reinhold Co. p.88

The inclusion of a supplementary yarn also refers to the addition of a fibre that adds a design feature, such as a pile surface, to a plain woven textile, moreover, it is not required to create the fabric or maintain its structure, merely enhance the basic design, so if picked out it would leave a complete simple cloth.[164] These woven fabrics are defined as having more than one set of warp and weft elements, having a minimum of three elements, with fabrics classified as velvet, velveteen, plush, terry, fustian, or corduroy. While the devoré process was predominantly associated with the embellishment or reproduction of brocade styled textiles during the late nineteenth and early twentieth century the enhancement of velvet textiles was also a key manufacturing style. Often credited as being the original form of woven burn out design, patent evidence indicates pile fibre devoré as having developed after two element weave devoré, three element weave brocades, and embroidered lace and some basic knitted devoré. Recognised by its selective removal of pile fibre, the devoré process of pile fabrics targets the supplementary sets of yarns used within the construction of velvet and other pile fabrics to create figured patterned effects. Structurally this fabric's form lends itself perfectly to the concept of devoré designing, and to an extent explains why the relationship of devoré and velvet was thought to have been the original woven devoré style.

A fabric traditionally used to reflect the owners wealth and status, the luxurious, alluring, tactile, velvet pile fabric differs structurally from two-element weave fabrics because a secondary 'pile warp' is added to that of the main warp during the interlacing of the ground weave scaffold. In effect the pile fibre behaved as if it were a temporary yarn, and to some extent explains why pile fabric was so popular with the devoré manufacturer. Prior to the development of the pile fabric devoré technique it was widely known by velvet finishers that by attacking this additional pile warp at its most vulnerable part, i.e. the point at which it was secured on the ground, through an application of heat, the 'pile loop' could be detached from specific areas of the ground with ease. Traditionally, velvet was created from two chemically dissimilar fibres, one of which was employed for the ground (scaffold) and the second for the pile warp.

The removal of pile fibre solely through burning, a process that may be considered a precursor to the printed devoré technique, exploited the individual sensitivity of the two

[164] Emery describes 'Pile' as loops or ends of yarn or fiber projecting from the plane of a fabric to form a raised surface; 'which tends to conceal the foundation fabric in which the yarns are secured.' With reference to Larsen, J. L. & Weeks, J. (1976). p.88

fibres to heat. The pile warp had to be readily destroyed by heat (carbonisation), as in the case of natural cellulosic fibres such as cotton. The scaffold fibre remained unaffected as protein fibres are relatively resistant to burning. Therefore when using a fibre degeneration technique such as a chemical bath or suitable printed chemical agent, on its own or with a combination of heat, the pile fibre was also found to have been either chemically 'disintegrated' or 'dissolved'. Adverse effects to the scaffold were found to be negligible if a fibre selected for its resistance to the chemical agent, or a combination of both chemical and heat, was employed for the ground weave. Moreover, the nature of pile loop construction is such that the devoré process was particularly accurate in its removal of targeted pile. Once an area of pile had been treated and then separated, neighbouring untreated loops remain firmly intact. Consequently fabric designers for the last hundred years have realised intricate and delicate etched designs on these three-element weave textiles, creating a balance between unaffected pile and exposed ground weave.

The visual effect of the devoré process when used in conjunction with woven textiles was such that it attracted descriptions such as 'lace-like' or 'open work', with pile devoré fabrics also said to have the appearance of a Jacquard or brocade. Rather confusingly these terms were also used in relation to two element weave textiles patterned by devoré, a reference to the creation of a fabrics differing heights of fibre within its patterning. In the case of velvet fabric the selective removal of pile fibre exposed the scaffold or plain weave networking, often delicate or light weight in form, which gave the finished textile the appearance of a figured patterning created by weaving. The use of chemical devoré on these textiles also had the added advantage of imparting colour to the destroyed area of ground weave at the time of application, further enhancing the imitative Jacquard effect. Hillman states in his review of 'Soda Prints on Pile Fabrics' for Rayon Textile Monthly 1937, that velvets were often carbonized with aluminium chloride pastes to which a print colour had been added, with the resulting textile having a differently coloured background wherever the cloth has been carbonized.'[165]

The pile woven devoré processes such as Wissel, Girard and Brunier's 'Ornamentation of Velvet' (Lyon, 1895), Timme's (New York, 1901) coloured and figured pile fabric, are most representative of the earliest techniques designed to exploit the inherent

[165] Hillman. (1937) Soda Prints on Pile Fabrics. p. 94.

structural nature of this form of woven textile. With the development of commercially viable viscose and cellulose acetate during the early twentieth century, the velvet and corduroy weave was to strengthen its position as the textile of preference for many woven devoré manufacturers. The fibres employed for three-element weaves and those used to create two-element weave textiles could be identical in their content and physical properties. However, the visual quality of a three-element weave devoré fabric was considerably different in style to that of its simple woven relative. Although velvet or pile fabric was frequently selected for use in conjunction with the devoré process, the final products visual style and physical handling was not always intentionally imitative of other pile-based fabrics.

A connection to lace design and embroidered textiles should also be considered a factor in the patterning of some three-element weave devoré textiles. However, for the most part, pile fabrics that exhibited figured effects 'created by forming pile patterns on a flat ground, or by a contrast of cut and uncut loops, or different heights of pile'[166] were a popular source of inspiration for devoré patterning. The nature of pile fabrics that devoré imitated included embossed velvets,[167] and voided velvet a style of fabric that misleadingly has a pile warp added during construction rather than removed during finishing, but most importantly a woven fabric recognised by its contrast of ground and pile height.[168]

Highly regarded for their increasingly automated procedures of design and manufacture, the late nineteenth and twentieth century velvet and pile fabric designer considered such historical textiles as being economically worthy of modern adaptation. Brocade textiles, traditionally intensive to manufacture and costly to produce, were of particular interest to the velvet finisher in the early twentieth century. While George Leyland Hunter writing in 1918 of decorative textiles for the interior noted 'All of the more complicated velvets, such as those developed in Venice, figured by using pile of two different heights; and Genoese velvets having cut pile that contrasts with uncut pile and often with flat satin or twill or taffeta ground, the last sometimes in gold... are still woven on

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[166] Miller, E. (1968). Textiles Properties and Behaviour, London: B.T. Batsford Ltd. p. 178.
[167] Velours Gaufré (Fr. pr.) Embossed or Stamped Velvet (Eng.). A figured velvet with the pattern in relief. The effect may be obtained in the weaving, or by printing with embossed rollers. Dooley, W. H. (1910). Textiles. DC; N. Y.; Boston; Chicago: Heath and Company. p.389.
[168] Emery (1994), p.174, states 'the word *voided* is presumably used, as in heraldry to mean "pierced through to show the field". See Ginsburg, M. ed. (1991) The Illustrated History of Textiles. London: Studio Editions. Velvet 'when covered with pile it is referred to as 'solid' and when free as 'voided'.

hand looms, like many of the more complicated brocades, but usually with the Jacquard attachment.'[169] The opportunity for velvet manufacturers to exploit the inherent exclusivity and sophistication of patterning and design that was associated with these textiles seemingly could not be ignored.

While the devoré process was just one process among many that was used by textile manufacturers in the creation of decorative pile textiles, the ease with which the devoré technique could be used on pile fabrics resulted in its being consistently adapted, with the result that from the early 1920's the focus of its use was almost totally directed towards new fibres. Only after the First World War did the devoré pile textile begin to be patterned in a modern less derivative manner. Corduroy and velveteen fabrics were two of the most popular three-element weave fabrics, with velveteen considerably cheaper to produce than velvet, so when used in association with devoré it is thought it would have been marketed as a reasonably priced textile product.

Summary and conclusion.

- The devoré processes that developed in association with chemical lace, chemical stitch and embroidery, thread and woven and knitted textile manufacture are closely related in terms of chemical use and manufacturing practice.

- The carbonising of wool stock, extract fibre carbonisation and early fabric devoré are clearly linked by a similarity of practice, with devoré textile chemical processes evolving from the wool carbonising and fibre extraction industries of the nineteenth century.

- However, the devoré process clearly differs from wool cleaning, fibres extraction and finishing techniques because it can:

  Facilitate the creation of a thread, yarn or fabric that was previously unworkable through the removal of a temporary yarn or fabric support.

[169] Hunter, G. L. (1918). Decorative Textiles. Grand Rapids: JB Lippincott Co (The Dean Hicks Company). p.8.

Enhance an unadorned or plain constructed textile by imparting decorative patterning through the physical alteration of the structural composition of the fabric.

- The basis of all devoré manufacture is the partial or total removal of a secondary, supplementary yarn or support (temporary) fibre (or fabric) by chemical means without causing injury to the body of the textile.

- The supplementary yarn is rarely considered to be structurally integral to the fabric's creation, however, when only partially eliminated the remainder can enhance the physical design of the textile.

- The devoré process customarily exploits the chemical composition of fibres and their specific vulnerability or resistance to heat and chemical reagents, and therefore the base fabric requires a balance of chemically resistant and vulnerable fibres within a suitable structure that can with stand the removal of the supplementary yarn.

- The devoré process is based upon a single concept of fibre removal although three different procedures of production have been employed, these being;

    - Chemical disintegration as used in wool carbonising.
    - The dissolving of a fibre in a suitable solvent.
    - Applied carbonising pastes achieved through printing or stencilling.

- Alternatively a devoré textile may also be manufactured using two chemically identical fibres, one of which may have had a chemical resist or pre-treatment to ensure its retention within the textile.

- A devoré textile may also be classed as such if a temporary yarn or fabric has assisted its creation, but which has subsequently been completely removed by chemical means after stitching, weaving or knitting.

- The devoré textile had until the late twentieth century rarely been classified by its method of production but rather by its style of design, for instance, lace, stitched, woven or knitted in style.

- The location of the devoré manufacturer tended to dictate the style of devoré textile manufactured.

- The design of the devoré textile, whether a lace, stitched, woven or knitted fabric was until the mid to late twentieth century reflective of popular fabric tastes.

- After 1920, the woven and knitted processes supplanted the highly popular chemical lace techniques, with the manufacturing basis of the contemporary woven devoré techniques fully established by the early 1930's.

The early development of the devoré textile is complex. The correlation between stitched and woven forms of the process is evident both within the historical patent record and in the development of devoré terminology. The basic principles of devoré chemical practice, established in the wool carbonising and fibre extraction industries, were applied to all forms of early devoré manufacturing. However, what separates woven devoré form other forms of chemical fabric making is the extent of its development and the breadth of fabric designs that can be created. The manufacturing origin of woven devoré is little known, and until recently, received limited consideration or review. The presentation of a broad range of devoré material within this chapter and the formation of a new definition of devoré chemical practice, designing and manufacture has gone someway towards addressing this historical deficit.

Chapter 2

The origin of woven devoré.

Chapter 2

The design and manufacturing of woven devoré textiles, until the later part of the twentieth century, has been largely dictated by the textile engineer rather than the designer. The employment of the chemical devoré technique in the making of fashionable trend driven textiles is reflected in the processes origins of manufacturing. The tracing of past woven devoré processes and the origin of woven devoré has shown there to be a limited understanding of the technique in the textile history accounts. Moreover, the motivation for manufacturing a textile by chemical means has been largely ignored. The investigation of woven devoré origins and development has focused upon the evolution from wool carbonising and fibre extraction to thread making, the environmental and economic factors that supported the manufacture of such a textile product and the significance of the woven devoré textile to the general textile industry.

Staple yarn and fabric development.

Woven devoré manufacture during the latter part of the nineteenth century was remarkable for its diversity and breadth of practice. The devoré techniques that are familiar to us today can be directly linked to this twenty year period of devoré textile manufacturing. Moreover, with key processes, for instance carbonising and caustic printing, firmly established the procedures of devoré fabric manufacture that were developed during this time should actually be classed as developmental processes as they provide the link between wool carbonisation, wool extraction and fibre reclamation practices. The manufacture of plain woven fabric manufacture using short-staple wool fibre and carbonising with heating, the manufacture of fabrics from coarse long-staple wool or hair using carbonising and heating, and significantly plain woven wool fabric decorated by a printed devoré paste and finally velvet and pile devoré were all patented during this time. The origin of plain weave and twill weave wool devoré was clearly developed from specialist textile cleaning and wool fibre preparation techniques.

The carbonising process that developed during the mid-nineteenth century was, as previously noted, traditionally employed as a means of removing unwanted cellulose matter, such as burrs, from untreated wool fibre. By soaking scoured wool in a chemical bath of either hydrochloric or sulphuric acid and drying with heat, contaminant

cellulosic matter could be carbonized or reduced to ash, generating a cleaner more workable raw wool textile product. Woven burn out practice, most notably that of wool fabric construction by means of temporary yarn support, similarly employed this concept of cellulose matter removal.

Precisely why the practice of carbonisation was adapted for use in the making of new innovative textiles is clear once the wool reclamation and wool reuse industry of nineteenth century is considered. The development of the carbonising process supported the use of *shoddy*, wool reclaimed from soft rags such as knitted garments; *mungo*, wool reclaimed from harder rags for instance *heavier milled cloth*; and *South American wools*, as described by Jenkins (2003).[170] The textiles industry in the latter part of the nineteenth century, both in Europe and America, was significantly disrupted by an irregular supply of raw materials. The nature of textiles merchandise and the industries developed to manufacture these textile goods were from the 1860's regularly adapted to face times of material shortage, in part a result of the spread of the western wool industry. The creation of a new textile product from previously unusable wool material made economic sense at this time.

The practice of fibre retrieval from piece goods and textiles waste, often thought to be a resource of low-grade quality, was prevalent within the industry at this time; the notion of recycling and material salvage being familiar and accepted procedures. Britain in particular, but predominantly Yorkshire manufacturers, had become a world leader in rag reclamation, initially developing a monopoly in the extraction of wool from rags, 'rag collecting, rag importing, sorting, marketing and grinding...' after 1830.[171] By the second part of the nineteenth century the wool extraction industry was highly competitive, with Jenkins (2003) highlighting other significant centres as Berlin, Vienne in France, Prato in Italy, and the United States.[172]

The industrial expansion of 'reused' wool manufacture resulted in the continuous modification, improvement and updating of wool reclamation practices. The composition of recovered wool was not necessarily inferior in quality, as its source of origin determined its level of worth; essentially a low grade new wool could

[170] Jenkins, D. ed. (2003). Vol. 2. Ch. 19. See Jenkins, D. The Western Wool textile Industry in the Nineteenth Century. p.764,767.
[171] Jenkins, D. ed. (2003). Ibid. p.767.
[172] Ibid. p.769.

conceivably be inferior in quality to a reprocessed wool of higher-grade origin. Writing of wool reclamation in 1946, Bendure and Pfeiffer observed 'Many fabrics, constructed of reprocessed and reused wool by highly reliable manufacturers give satisfactory wear, appearance, and warmth (if required) at a price lower than is possible with the use of good-quality, new wool.'[173] The extraction process used to obtain this 'second hand' wool was based upon the carbonisation technique of burr removal. Woolen goods that had previously been mixed with cotton or other vegetable fibres were treated in a chemical bath, dried by heating and then cleared of any carbonized cellulose fibre residue. A series of processes registered with the British Patent Office in 1855 show the breadth of innovation linked with the practice, for instance J. L. Horton's separating fibres from mixed fabric (Blackfriars, Surrey 1855), J. B. Rüttre's treatment of rags (Paris, 1855), and P. E. Thomas's extraction of wool (1855), all of which advocated the employment of a dilute acid and carbonising, with or without heat in the destruction of cotton fibres from wool union textiles.[174]

The spread of the process to other wool processing and manufacturing centres was to be anticipated given the industry's competitiveness. Moreover, J. G. Perzél's 1863 US patent 'Improved Process of Recovering Wool from Mixed Fabrics', outlined a wool fibre reclamation process that along with the British 1885 patents should be considered precursors to the development of the first woven devoré fabrics created by means of temporary yarn support and simple dissolution.[175] Perzél's invention focused on the destruction of cotton from old mixed woolen goods using 'chloride of zinc or analogous chlorides, either alone or with the aid of diluted sulphuric acid, whereby the wool remains, without being injured, as a new and useful article of manufacture.'[176] This 'extract' fibre, as it was described by E. Ostick in his guide Textiles for Salesmen (1931), was 'the name given to wool obtained from wool and cotton union fabrics from which the cotton has been extracted by sulphuric acid or by other chemical treatment...' while 'Extracted wool is short-fibred and is therefore blended with some other material such as low grade wool or cotton.'[177]

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[173] Bendure Z., Pfeiffer G. (1946). p.61.
[174] James Lee Horton, Blackfriars, Surrey. (Application dated 16th Jan 1855, Sealed 5th June 1855). Separating Fibres of mixed fabrics. BP 114; Jean Baptiste Rüttre, Paris manufacturer. (Application dated 6th Jan 1855, Sealed 3rd august 1855). Separating fibres of mixed fabrics. BP 37; P. E. Thomas. Paris. (Application dated 9th January, 1855 provisional specification only). BP 55.
[175] J. G. Perzel. (1863). US Patent 39,828. p.1, 7-13.
[176] J. G. Perzel. (1863). Ibid.
[177] Ostick E. (1931). p.45. Extract: 'This process of destroying the cotton by acid is known as carbonising.'

The motivation behind fibre retrieval in the United States during the latter part of the nineteenth century was almost certainly the acute need for textiles and the accessibility of woolen goods at the time of its registration. The American Civil War, 1861-1865, raging for two years prior to Perzél's claim, was both a positive and negative influence on the more industrialised northern states of America and significantly its cotton textiles industry. The Civil War years generally stimulated new invention and accelerated the industrialisation of established industries in the north. Moreover, northern manufacturers unable to obtain cotton from the southern part of the United States shifted their production towards wool textiles and the development of woollen goods. Schoeser and Rufey in their examination of English and American Textiles observed 'The increased demand for printed wool, wool cotton blends and silks was another result of the cotton shortage.' When the Morrill Tariff Act was introduced in 1861, a duty of 25% was levied on the importation on all textile goods, as a result the development of techniques dedicated to the cleaning or recovery of wool from mixed fabrics or felts notably increased in terms of patent registrations in America.[178] This concentration in wool processing engendered a period of rapid development within the industry leading to combined wool carbonising and reclamation of the carbonized product, with H. Sherwood (1866) promoting recovery of the destroyed cellulose for papermaking.[179]

The divergence in manufacturing between the wool preparation and wool fibre extraction industries in the United States clearly extended during the 1860's. Manufacturers continued to invest in wool cleaning practices.[180] Concurrently, extract fibre manufacturer's advocated techniques where refuse wool could be cleaned of vegetable matter using sulphuric acid and steaming. L. T. Stiastny (New Jersey) considered such inferior merchandise to be destined for use as hatters' wool and the

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[178] Schoeser M. & Rufey C. (1989). English and American Textiles from 1790 to the present. London. Thames and Hudson. p.106.
[179] H. Sherwood. (Application January 26, 1866). Carbonizing fibres, rags, e&; BP 265.
[180] Manufacturers such as James Fullen, of Saxonville, Massachusetts and Frederick M. Ruschhaupt in conjunction with Perzél continued to develop processes, as did William Sykes of Glenham, New York, 1866 similarly treating wool in acidulous solution, followed by limewater processing and subsequent drying, with the intention of 'Removing Vegetable Matter from Wool'. James Fullen, of Saxonville, Massachusetts. (Application dated December 8, 1863). Improved Process for Removing Burrs from Wool. US patent 40, 832; Frederick M. Ruschhaupt and Jno. Geo. Perzél, of New York, N.Y. (Application dated July 1864; antedated April 29, 1864). Improvement in Cleaning Wool. US Patent 43,647; William Sykes of Glenham, New York. (Application dated July 10, 1866). Improved Process for Removing Vegetable Matter from Wool. US patent 56,291.

like.[181] Despite the variation in source material, the shared objective of both processes was to secure employable wool for the manufacture of a range of woollen goods. Without doubt their use of acid treatments markedly boosted the wool textiles industry of America at this time. Post Civil War, from 1865 onwards, the rising industrialisation of the United States and in particular its northern textile industries, was to further support the development of wool treatments. From the early 1870's the separation of wool from rags and the destruction of vegetable matter from wool were practices recurrently adapted by the American industries.

In Europe, the wool fibre extraction industry also improved their methods of fibre retrieval. For instance F. R. Joly, of Paris, France (1874) demonstrated how vegetable matter trapped within previously coloured or dyed woolen fabrics could be extracted without detrimentally affecting the existing tone or depth of dye shade.[182] Remarking on Perzél (1863) and Ruschhaupt and Perzél's (1864) inventions as processes that changed the colour of dyed goods or caused spots or blur on fabrics, Joly explained his process would allow for the removal of 'vegetable substances' from fabrics without causing undue injury to any remaining fibre. Key within Joly's specification was the process of chemically eradicating cellulose contamination from a previously constructed woven textile. 'For woolen fabrics, the fabrics, held on a reel or proper holder, are immersed in the bath, which should be from 3° to 5° Baumé, according to the kind of cloth operated on. When the fabrics are well impregnated with the chloride, they should be first dried at a high temperature, and afterwards washed.'[183]

With techniques such as Joly's employed within the wool reclamation industry the progression from cellulose impurity removal to cellulose fibre removal to aid in the creation of a woven textile was a logical and predictable step. Joly's procedure heralded the further evolution of the carbonisation technique, his patent registration also lends credence to the theory that the devoré or carbonisation of vegetable fibres from a wool mix fabric originated from within the wool and woolen waste fibres industry.

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[181] Leonard T. Stiastny, of Hoboken, New Jersey. (Application dated January 3, 1865). Improved Process for-Preparing Refuse Wool for Use. US Patent 45,768.
[182] F. R. Joly, of Paris, France. (Application filed August 17, 1872, accepted October 13, 1874). Improvement in Processes of Destroying Vegetable Matters in Wool and Woolen Fabrics. US Patent 155,802.
[183] Ibid.

The types of waste fibres that could be recycled by means of chemical carbonisation were highlighted by Linton and Pizzuto in their work on Applied Textiles (1961). Carbonized Noil, with its ½ and 2½ inch staple length,[184] was acquired from cloths that contained cotton or other vegetable matter and was used within certain types of woollens and lower quality worsteds.[185] Extract wool obtained from cloths that were carbonized or scoured had a fibre length from a ¼ to 1½ inches,[186] and mungo 'obtained from all kinds of felted cloths, tailor's clippings, overcoatings, etc.' ranged from a ¼ to ¾ inch fibre length. 'It should be borne in mind that shoddy and mungo may be of excellent, good, fair or poor quality, all dependent on the stock from which they were obtained.'[187]

A.F. Barker also made reference to remanufactured woolen materials in his work Textiles (1910). 'The terms mungo, shoddy, and extract refer to the original quality of the goods from which these materials are produced; mungo being produced from soft short wool goods, shoddy from longer and crisper wool goods, and extract from goods made of cotton and wool from which the cotton is removed by the "extracting" process, the remaining wool being then torn up into a fibrous mass.'[188] Bendure and Pfeiffer writing of the carbonising or burring process in their examination of America's Fabrics, (1946), explained that from a 'tangled mass of millions of fibers' clothing such as 'a tailored topcoat, a colourful dress, luxurious drapery, a soft downey blanket, a child's warm snowsuit, a serviceable covering,' were all feasible textile products. Moreover, the purpose of the fabric was to dictate the nature of the reclaimed fibre employed 'The warm blanket or snowsuit requires differently processed wool fibers from those utilized for hard-textured suit and dress fabrics.'[189]

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[184] Carbonized Noil: 'Obtained from cloths which contain cotton or other vegetable matter. Staple is from ½ inch to 2½ inches and it may be white or coloured. Handle is fairly good but does not cope with that of combed noil. The fibers have a shreddy appearance and are used in certain types of woollens and lower quality worsteds.'; Noil is a short soft fibre separated from longer fibres by combing, or other processing prior to spinning. A.F. Barker states noil is undoubtedly superior to mungo, shoddy, and extract: they may have lost a little of their elasticity; but their sale structure is not so much damaged, nor are they so much broken up.' With reference to Linton, & Pizzuto. (1961). p.28.

[185] Linton & Pizzuto. (1961). See Types of Waste Fibers used. p.251.

[186] Bendure Z and Pfeiffer G. (1946). p.39 state 'There are two types of wool fabrics, woollens and worsteds. The steps in yarn making are different for each. All wool fibers are carded but already in this initial process the fibers are beginning to be laid parallel for worsted yarns, while this is not essential for woollen yarns.

[187] Linton & Pizzuto. (1961). p.251.

[188] Barker. A.F. M.Sc. (1910). Textiles. London: Constable and Company. p.28.

[189] Bendure Z. & Pfeiffer G. (1946) Page 61.

With a range of varied quality reclaimed wool fibres being readily obtainable, their further utilisation within a devoré fabric constructed by means of a temporary yarn and the carbonisation process seems perfectly in keeping with the contemporaneous procedures of the wool reclamation industry. Therefore when Louis Chaux, of Paris, France, registered his 'Art of Manufacturing Fabrics from Short-Staple Fibre' patent in 1883, one of the earliest examples of cellulose carbonisation being employed in the creation of plain or twill woven wool textiles appears to have been created. Chaux declared:

> 'In order that what I claim as my invention may be clearly distinguished from what is old and well known, I will say that the practice of mixing wool with other fibers, both animal and vegetable, for spinning and weaving into fabrics, has been well known for many years. This of course I do not claim. In all of these fabrics, however, the vegetable or other fiber remains, and is intended to remain. The practice of treating woolen fabrics to a bath of some acid – as hydrochloric, for example- in order to incinerate or destroy any vegetable substance (as the debris of burrs, for example) that may be entangled with the wool, and remain after spinning and weaving, has also been in use for many years, and I do not of course claim this, although I employ it as part of my method. My method consists in mixing cotton with a common, short-fiber wool, to serve as a provisional support, and enable the wool to be spun into fine yarn and woven, and then, after the weaving, removing the cotton entirely by means of any known incinerating bath- of hydrochloric acid, for example- whereby a fine all wool fabric remains composed wholly of common wools.'[190]

This declaration of yarn manufacture is the first source to show carbonising as a method of yarn and fabric creation. The processes unique approach to the manufacture of all-wool flannel fabrics by means of commoner grades of wool was until the registration of this invention so Chaux states, virtually impractical as certain of these wool fibres could not be spun finely enough to create this specific style of fabric. The inclusion of a cellulose temporary supporting yarn during spinning and weaving enabled the manufacture of a wool yarn with a 'proper degree of fineness.'[191]

The construction of staple or spun yarns from staple length fibres, which being short, required unification by some means in order to be formed into continuous yarn. Collier

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[190] Louis Chaux. (Application filed June 13, 1883, accepted November 6, 1883; Patented in France May 11, 1883; in Belgium May 15, 1883; England May 18, 1883, No. 2,496). Art of Manufacturing Woolen Fabrics from Short-Staple Fibre. US Patent 288,015.

[191] See Collier B. J. &Tortora P. G. (2001). 'Flannel: 'if made of wool, is usually a twill weave with a napped finish.' p. 303. certain of these wool fibres could not be spun finely enough to create this specific style of fabric the inclusion of a cellulose temporary supporting yarn during spinning and weaving effected a wool yarn with a 'proper degree of fineness.' Chaux (1883)

and Tortora stated 'multiple processes required to make staple yarn add significantly to the cost of the yarn, the aesthetic qualities such as comfort, warmth, softness and appearance make these yarns highly desirable in many products.'[192] If this were true of short staple fibre manufacture in 1883, Chaux's use of a cotton support fibre would have greatly reduced the cost and difficulty of short staple fibre manufacture whilst potentially allowing the creation of a superior textile product.

With regard to the completed fabric, upon removal of the cotton "provisional assistant" little sign of its temporary inclusion was said to be found within the original fabric structure: 'there is no appreciable change in the character of the fabric- that is to say, no spaces are left, and the texture is full and soft as in any all-wool fabric', as the wool fibre expanded simultaneously producing elasticity and suppleness within the fabric structure.[193] Whether the final wool textile was thought to be economical in its manufacture was dependant upon the quality of the short staple fibre employed, as previously stated. However, at the time of Chaux's invention France along with the rest of Europe was midway through a world wide depression, 1873-1896, triggered by 'improving levels of economic integration in the world', expansion in transportation, including shipping and rail, which meant raw materials could effectively be imported anywhere at low cost; 'this was good for the consumer, and, on the face of it, cheap raw materials of all kinds were good for the industrialist.'[194] Increased transportation links gave rise to competition between industrial manufacturers, and strong economies such as imperial Germany and the United States were able to maximise on the exportation of their own goods and release themselves from the restrictions of economic depression. What sustained Germany, France and the United States was their association with chemical and electrical engineering technologies; 'by the early 1900s, Germany produced 80 per cent of the world's output of artificial dyestuffs, was by 1907 the world's largest producer of chemicals...'[195]

At the time of Chaux, Europe and the United States of America were clearly undergoing massive economic development brought about by expanding industrialization. Increased urbanization, particularly in Europe's cities, which were also experiencing a

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[192] Collier B. J. &Tortora P. G. (2001). See Staple Yarns. p.238,239.
[193] Chaux. (1883) As the provisional support could be used in either the warp or weft or both. Where the mixed thread is used solely as a warp or weft element the other thread consists totally of wool.
[194]Blanning, T. C. W. ed. (2001). The Oxford Illustrated History of Modern Europe. Oxford: OUP. With reference to Trebilcock, C. Industrialization of Modern Europe. p.44.
[195] Bendure & Pfeiffer. (1946). p. 628.

concentration in population brought about by the development of industries within towns, created a greater need for a range of woolen textiles. The migration of workers to the cities, while initially generating high urban poverty, was in most industrial countries to bring higher living standards as well as new employment opportunities.[196] An improvement in the railway systems of most countries, but particularly America, meant textile products could be easily transported to consumers in remote towns and cities.

The opening up of the American continent brought the department store catalogue to a breadth of new consumers who requiring a range of fabrics including wool flannels. Consequently manufacturers were able to advertise their textile merchandise to a broader economic range of buyer. Chaux's wool flannel fabric, generally recognised as a soft textured plain or twill wool fabric often with a lightly napped soft surface, would along with other wool flannels have been simply employed in 'women's dresses, suits, coats, skirts; girls' dresses and coats; mens' and boys' suits, trousers, jackets, and shirts, etc.'[197]

The incentive for creating a plain or twill styled woolen fabric manufactured from short staple fibres was likely to have been based upon the increase in production of reclaimed wool material and the improved availability of the chemicals used in treating such stuff. The manufacture of this fabric by means of carbonisation was clearly created at a time when woollen fabric was undergoing heightened levels of demand. However, the possibility of the woven burn out process being conceived as a technique to exploit the availability of cheap goods requires further investigation.

Chaux's technique of creating a fabric made from short-staple wool fibre was within a year of its patenting similarly employed in the creation of long staple fibre fabric. Edward and Emile Scheppers, Belgian citizens based in Philadelphia, registered and patented the 'Art of Making Fabrics from Coarse Long-Staple Wool or Hair' in Europe in 1884 and the United States in 1887.[198] Following the principles set out in Chaux's earlier patent, the Scheppers' claimed it was hitherto impractical to use long staple wool

[196] Philip's Atlas of World History. London: Philip's Limited 2002. p.210,211. See World Population Growth and Urbanization 1800-1914.
[197]Louis Chaux. (1883). US Patent 288,015.Line 46.
[198] Edward Scheppers and Emile Scheppers, of Philadelphia, PA. (Application filed May 5, 1884, accepted May 3, 1887; in England October 7, 1884 No. 13,274; in France October 7, 1884 No. 164,648; and in Belgium October 7, 1884 No. 65,523). Art of Making Fabrics from Coarse Long-Staple Wool or Hair. US patent 362,317.

in the warp of fine fabrics, and suggested twisting a fine spun thread of wool with a strand of cotton or any other vegetable fibre prior to the weaving of a worsted fabric. This spun fibre could be used for both the warp and the weft (filling) or in the warp alone with an all worsted weft 'as the strength is mainly desired in the warp'.[199]

Where Chaux's invention required a cotton thread to facilitate the fine spinning of the short staple fibres, the Scheppers' invention advocated a strand of long-staple wool fibre to be first spun singly and then doubled with a strand of cotton. The inclusion of the vegetable yarn in this invention was designed to protect the long-staple fibres from damage caused during the weaving process: 'the cotton strand serves not only to add strength to the fine wool strand, but it also performs the important duty of confining at their bases the fibers which project from said wool strand, and thus prevent said fibers from being loosened and torn from the strand when they are caught by the bars of the reed, the rapid abrasion and weakening of the said wool strand, such as usually results from the catching of these projecting fibers, being effectively overcome.'[200]

As with Chaux's technique the woven fabric was then subjected to the action of an acid, in this case sulphuric, which destroyed the protective vegetable fibre without harming the wool leaving a fabric composed entirely of fine worsted threads. Constructed only of 'long, combed, parallel fibres, tightly twisted, smooth and strong' these worsted yarns were used to create 'clear-surfaced, hard textured fabrics, such as gabardine, serge, poplin, and other twilled and ribbed worsted fabrics', subsequently used in the manufacture of men's and women's suits, coats, raincoats, sportswear, uniforms, mens shirts, dresses, trousers; draperies, upholstery, and linings.[201] Furthermore, worsted yarns in the eighteenth and nineteenth centuries were often heavily glazed and used extensively for high quality furnishings and clothing.[202]

Despite their differences of wool fibre origin, the Chaux and Scheppers' practices shared the exact same concept of textile manufacture. Two fibres combined during

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[199] Edward Scheppers and Emile Scheppers. (1884/ 1887). US patent 362,317.
[200] The reed is a 'comb-like part of the loom which separates and spaces the warp yarn or ends, and beats up the newly-inserted pick or weft yarn into the main body of the cloth.' Anstey Weston Guide to Textiles Terms. (1997).
[201] Bendure, Pfeiffer. (1946). p.40.
[202] Mendes, V. (1992). The V&A Museum's Textile Collection. London: V&A Museum. see British Textiles from 1900 to 1937.

spinning were woven within the structure of a fabric. The temporary fibre was chemically dissimilar to that of the fibre intended to remain. The destruction of the temporary fibre was achieved through the use of chemical carbonisation, i.e. by soaking in a chemical bath. After saturation the fabric was dried and heated until the vulnerable yarn was carbonized and reduced to ash. The remaining woven textile contained only one fibre type.

The use of a carbonising technique to aid in the creation of a woven textile was, from this point onwards, periodically called upon whenever a yarn, be it short staple, long-staple or merely delicate in character was considered a worthy material for a woven textile. During the subsequent hundred years a variety of two element weaves were created or ornamented using such a combined process, with compound weaves such as velvets also manufactured by means of this carbonising procedure. The Chaux and Scheppers' legacy was the establishment of a manufacturing process that allowed a temporary cellulose yarn to aid the creation of another yarn, facilitating the making of a woven fabric. Using extracted wool fibres that were previously unworkable in the style to which Chaux and Scheppers eventually employed them, new and useful techniques of fabric construction were invented that in turn may have given consumers both inexpensive or luxurious interior or dress textiles. Furthermore, the Chaux and Scheppers' techniques should be seen as the origin of woven devoré manufacture, calling upon carbonising as the method by which a secondary, temporary or supporting yarn could be destroyed.

Devoré and the decoration of woven textiles.

The making of a fabric by chemical means that didn't require the total removal of the supporting thread was the next significant development in temporary fibre and carbonising manufacture. Concurrent to the registration of Scheppers' coarse long-staple product of 1884, New Yorker Emile Maertens application simply entitled 'Art of Making Fabric', aimed to provide a single ply fabric with the effect of a double-ply fabric or one woven with two sets of threads.[203] In essence an economically manufactured fabric developed in imitation of a costlier double-ply weave, improving upon the practices of Chaux and the Scheppers', and preceding inventions that likewise

[203] Emile Maertens, Oswego falls, New York. (Application filed November 13, 1884, accepted May 18, 1886). Art of Making Textile Fabrics. US Patent 341,927.

employed carbonisation to extract vegetable matter from mixed fibre goods, Maertens registered what is probably one of the earliest procedures of plain woven textile ornamentation by means of devoré printing. Consistent with the Chaux's and Scheppers inventions, wool and cotton fibres were combined a single yarn. These two fibres, united either during carding or by the doubling of a wool and cotton yarn, were used to form the warp and weft, or just the warp, of a woven fabric. Moreover, the fabric preferably woven in the white was then scoured, set, and prepared as though for piece-dyeing.

At this point within the process there was little to differentiate it from the accepted practice of woven textile manufacture by means of carbonising. However, where it quickly diverged from the Chaux, Scheppers' technique was in its approach to cellulose fibre elimination. Maertens declared within his patent specification that 'the destroying agent, when in liquid form, may be printed upon the surface of the fabric in a manner similar to that adopted in the production of print- cloth paper-hangings, &c.' Patterns or figures could be created of 'any desired character' to create a subtle positive or negative design. Spraying of the agent was also suggested, as this would enable spotted designs, once the fabric was heated to encourage carbonising and disintegration of the cellulose fibre.

However, it was the direct printing of the destructive agent that first allowed the designer to control and localise the removal of the cotton element of the mixed yarn. As to the exact patterning design of the printed method Maertens provided an illustration within his British Patent application, see Fig 16. It is evident from this drawing that a fine lightweight wool weave would have been all that remained in the area of treatment, rather than loose threads. Maertens also stated that by using this technique his fellow manufacturers were 'enabled to produce in a single-ply fabric effects which have hitherto been possible only in two-ply fabrics containing both plain and mixed threads; hence my improved fabric can be made at less cost than the usual fabric and may be of less weight, an advantage for some purposes.'[204]

The manufacturing cost of Maertens fabric could have been further minimised if extract wool was employed within the mixed fibre, as with the Chaux and the Scheppers' specifications, although it must be emphasized the quality of such a product would not

[204] Emile Maertens. (1884/ 1886). US Patent 341,927.

necessarily have been reduced. The full weight of the mixed thread fabric was probably relatively fine, as the addition of a cotton element may have supported a finer level of spinning, and in consequence created a lighter weight fabric in the areas of the cotton destruction. Similarly, if the mixed fibre was employed for both the warp and weft of the fabric, the subsequent carbonisation of both would result in a lower weight of textile than if the mixed thread were used solely for the warp.

The primary function of such a textile was most likely for dress goods, but equally plausible is the theory that these textiles were created solely to add decoration to dress and clothing. For instance, wool piece goods patterned with delicate decorative trim or gauze like decoration could have been used for skirts and dresses. Larger areas of the carbonized fibre textile would most probably have been inappropriate for clothing, whereas tapestry upholstery cloth was often made with a worsted weft and cotton warp, and lightweight ornamented wool for the interior may have been an alternative use for such a textile. Schoeser and Rufey, in their study of English and American textiles, describe lightweight wools printed in bright new colours, a reflection of the developing chemical dye industry, being 'widely used for furnishings in middle class homes since they were less expensive than silk but equally brilliant.'[205]

The colouring of such a fabric would further increase the sense of decoration and contrast between thread weights, therefore Maertens advised dyeing to be completed subsequent to any vegetable fibre removal as the devoré agent for the cotton could deteriorate the dye. However, the use of a wool dye on this mixed fibre fabric would not have coloured the cotton elements, therefore after dyeing the full weave would appear speckled and the plain wool threads visible in the areas treated by carbonisation would be coloured. Conversely the same effect would be achieved if a cotton dye were to be similarly applied to the textile. A woven fabric with varied weights of yarn could be further accentuated if said wool and cotton yarns were dyed in contrasting colours, such a result would ensure Maertens fully realized his objective of two-ply effects within a single ply fabric.

[205] Schoeser, M. & Rufey, C. (1989). p.103. Bright new chemical dyestuffs such as aniline blue, and orange azo dye, both for wool, and 'Several shades of violet, green, black and yellow were also introduced for silks and wools, and in the 1880s several new blues were added' Ibid, supporting the possibility that these wool flannels could have been printed and dyed for use in the interior.

Within the general history of devoré, Maertens patent of 1886 is most notable for its differing methods of fibre destruction and fibre protection. It was advised that 'portions of the fabric may be protected from the action of the acid by stencil-plates, or may be treated with an impermeable size prior to the subjection of the whole piece to the action of the destroying agent, or the latter may be sprayed or distributed in drops on the surface of the cloth in order to produce a spotted effect.'[206] In theory an impermeable size would act as a resist and protect portions of the fabric during the printed application of the carbonising agent. Moreover, the stencil plates also had to withstand the destructive nature of the applied agent; an issue that was considered within Knect and Fothergill's The Principles and Practices of Textile Printing. Stencil plates, they advised, should preferably be made of 'stout cartridge paper or two-sheet Bristol Board'.[207]

Maertens inclusion of these processes within his claim helps establish the breadth of development of the devoré process by 1886. It is clear that this is the origin of the printed devoré technique and therefore the precursor of all plain woven printed devoré as we recognise it today. Significantly in the specification of his British Patent application of 1885 Maertens also proposed the manufacture of pile fabrics, whereupon he described the open work or gauze effect being created on any fabric constructed of a vegetable and animal fibre be it 'pile, looped, matelassé, repousseé, sunken or other fabrics.'[208] The reference made to pile fabric manufacture related to the following method, whereby animal fibres were woven over vegetable fibres, which were then carbonized and removed. The remaining animal fibre 'loops or bridges' were then either 'sheared off' or cut down.

This pile fabric manufacturing process should be considered a precursor to the full printed pile devoré patent registered by Wissel et Cie., in 1895. While Maertens never advocated full vegetable pile removal, his technique establishes the connection between

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[206] Maertens. (1884/1886). p. l.

[207] Knect, E. Fothergill, J. B. & Hurst, J. G. (1952). The Principles and Practices of Textile Printing. London: Charles Griffin and Co.; see 'Stencil Plates' p. 45. 'Stencil Plates may also be made of thin sheet copper or zinc, but they are dearer than those made of paper, less easy to cut with accuracy, and, in any but small sizes, more difficult to handle in practice. Whilst they are superior to paper in so far as durability of material is concerned, their thinness has the disadvantage of rendering them more liable to damage in the course of working'.

[208] Emile Maertens, Oswego falls, New York. (Patent accepted AD 1885, 20th January. Complete Specification). Clark's Improvements in Producing Textile Fabrics. BP N° 821; The following definitions were provided by Dooley. W. H. (1910). 1. matelassé: A figured effect, well stuffed out, quilted or stuffed; 2. repousseé: patterns of a raised character, pushed back pulled up.

plain woven and pile woven devoré manufacturing processes and therefore should be considered a landmark registration in the history of the woven devoré technique. The year 1884 marks the point at which the woven devoré textile began to be developed as a process of fabric decoration. Moreover, this process of plain and pile fabric decoration was registered in America by an American resident, who had a working knowledge of stencilling, printing, pre-applied resists, sizing, wool carbonisation and wool extraction processes, as evidenced within the one patent and which he employed in the creation of decorative textiles.

Towards the end of his American patent claim Maertens declared the 'destructive agent may be one which will affect the wool or animal fiber and leave intact the cotton or vegetable fiber; but this is not always economical, and is therefore inadvisable in most cases.'[209] The inclusion of this comment, although succinct, suggests silk fibre elimination as having been employed on woven textiles prior to Maertens patent application of 1884, and as previously stated the carbonising of silk in the chemical lace industry was well underway by the early 1880's. An explanation as to why Maertens considered silk fibre destruction to be uneconomical was possibly high value of the pure silk product in America during this time.

The development of wool and cotton devoré textiles continued throughout the 1880's, with F. H. Bowman suggesting the use of carbonising in the creation of tapestry cloth, for furnishing purposes or woven fancy dress goods, combining wool with cotton (also flannel).[210] However, the key product of his cellulose fibre destroying process was a woollen lace, created by first embroidering onto a temporary cotton ground weave. Similar wool laces were found advertised in mail order catalogues such as Bloomingdale Brothers of 1886. It marketed a range of house wares and textile products to the 'practical housewife who enjoyed pretty things.' The wool lace range included black, navy blue, cream garnet, myrtle green, olive, brown medium and seal brown chunky trimmings, at three to six and half inches wide for between 19c and 39c. Moreover, highly decorative tapestry fabrics, also suggested by Bowman, were popularly fashioned into table covers retailing at $3.50 for a sixty eight inch square, see

[209] Maertens. (1884/1886). US Patent 341,927. p.1, l.92-96.
[210] F. H. Bowman of Halifax. (Application dated 13th November 1888, accepted 20th July, 1899) Improvements in the Manufacture of Lace and other Reticulated Fabrics from Wool and other similar Animal Fibres, GB patent 16,420.

Fig 17.[211] These patterned fabrics were densely patterned and colourful but lacked any individuality of design, however, they were long-established products and as such were shown on pages filled with similar embroidered woven fabrics and solidly decorated nets and laces.

The development of velvet and pile fabric devoré.

The manufacturing basis of the contemporary velvet devoré textiles evident within our winter season high street fashion and now interior collections is directly connected to a system of devoré manufacture registered some ten years after Maertens system of textile printing. Developed in France the textile patent record reveals Wissel, Girard and Brunier, of Neuville-sur-Saône, Lyon, (Wissel et Cie., 1895), as the first company to patent a process of full pile destruction that employed a specially developed 'chemical remover' to ornament velvet and pile fabrics.[212]

Lyon manufacturers were particularly noted for their fine quality muslin velvets. In 1895 Lyon textile industry was legendary for its silk manufacturing and skilled weavers. Some 30 years later Neuville-sur-Saône was to become known as the home of the new mills of the '*soieries*' F. Ducharne,[213] the renowned Jacquard woven dress silks manufacturers.[214] During the latter part of the nineteenth century the Lyon textile region, along with many other traditional textile manufacturing areas in France, faced continuous competition from the more mechanised and industrially conscious Swiss and German producers. The Lyon textile firms did not fully embrace total industrialisation, instead they opted for a middle way, accordingly 'Lyon became known for its diversity, improving its use of cheap raw materials (such as the silk waste yarn, filoselle or bourre), exploiting entirely new fibres (such as 'art silk', a nitrocellulose form of rayon developed by Comte Hilaire de Chardonnet in 1884), and dyeing en pieces, after weaving.'[215] The Wissel et Cie woven pile devoré process seemingly originated in an environment where innovation in manufacturing techniques was being embraced and

[211] See Introduction Bryk, N.V. (1988). Bloomingdale's Illustrated 1886 Catalogue. New York: Dover Publications Inc. p.55, 82. Note within the same catalogue the pricing of these wool lace trimmings was equal to those constructed of cotton.
[212] Wissel, Girard, Brunier. (1995/1996). US patent 556,794; BP 17,502 (1895).
[213] Vogue. (1925). The Romance of French Fabrics. Vogue. (Early February 1925). p. 45.
[214] See Jackson, L. (2002). Twentieth Century Pattern Design. London: Mitchell Beazley. p. 50; and Samuels, J (2003). p. 50. F. Ducharne established the company in 1920. It had mills in Neuville-sur Saône and design studios in Paris, with Dubost responsible for 'dazzling patterns'.
[215] Schoeser, M. & Dejardin, K. (1991). French Textiles. From 1760 to the Present. London: L. King. p.138.

industrial change was imminent. The Textile Industries and Journal of Fabrics reporting on the Lyon trade for November 1895 noted brisk markets for the French manufactures in nearly all classes of fabrics, with printed silks, stripes and checked effects largely in vogue.[216]

By 1925 the progression from hand weaving to industrialised and mechanised textiles weaving was well underway, being of great interest to Vogue Magazine who dispatched a reporter to the region to observe the manufacture of woven fabrics, in particular lamés, velvets and printed textiles.[217] Where block printing by hand, roller printing and piece dyeing with hand painted finishing were customary processes. Previously Wissel, Girard and Brunier had proposed their chemical paste be applied by plates, platens or rollers cut in relief or by brushes, to create figured or sculpted effects by removing areas of pile 'while leaving intact the groundwork, backing or canvas', which was most likely relatively solid in its weave style. Furthermore, this printed devoré technique was to be used in connection with other finishing processes such as stamping, impressing or printing other designs 'either upon the relief or the ground.' As a process devoré manufacturing was considered complementary to the family of pile fabric treatments, which was also undergoing continual improvement with a breadth of new machinery and cutting processes accordingly patented by engineers such as cloth dressers, gas singers, gentlemen and warehousemen of the period.

Woven textiles that were popular at the time of this Wissel et Cie registration included Utrecht velvet, an embossed mohair plush used for home furnishings and apparel, with its voided and decorative mohair pile easily simulated by the pile devoré technique. Figured plush was considered to be both economical and highly regarded within the industry, The Textile Journal of Fabrics in 1895 describes plush as 'those beautiful fabrics which are of such infinite value for the decoration of the home. What can be more effective or of better taste than a suite of furniture upholstered in a neatly design plush fabric.'[218] Subsequent pile woven devoré processes registered in the 1920's point to mohair and cotton interior fabrics as being suitable for decoration by devoré. Moreover, the processes used on these twentieth century fabrics are clearly based upon the Wissel process.

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[216] Lord, H. & R.T. Co. ed. (1895). Ornamental Textile Fabrics. Textile Industries and Journal of Fabrics. November 12, 1895. p.53.
[217] Vogue, UK. (1925). The Romance of French Fabrics. Vogue. (Early February, 1925). p.84.
[218] Lord, H. & R.T. Co. ed. (1895). Ornamental Textile Fabrics. Textile Industries and Journal of Fabrics. November 12, 1895. p.50.

Alternatively the popular silk ciselé velvets were traditionally designed with a 'motif made of tufts of cut pile on a ground usually in satin', according to Orsi Landini in her examination of velvet for clothing.[219] Likewise Gandin velvet, with its contrasting pattern of pile velvet on a ground weave may have influenced the patterning of the Wissel devoré fabric, however, it appears likely that a figured fabric such as Damask velvet, constructed of one warp and one weft showing motifs created by contrasting two different weaves and used in furnishings but also widely for apparel, may have been the inspiration behind the Wissel pile devoré technique, although it is also possible that the rationale of the Wissel process was actually to reduce the manufacturing time that the decoration of pile textiles required. For instance the manufacture of embossed velvets required considerable attention. The fabric was first imprinted with a design which flattened the pile, the remaining untreated raised areas of pile were then sheared, only when the fabric was steamed did the uncut pile stand above the sheared pile and the textiles decoration was complete.[220]

Although the Wissel patent provides no specific information regarding the visual style of the textile created by the process, mixed fibres were required in order for the process to work. Accordingly, a basic alkaline such as potash or caustic soda was used for silk or wool pile removal and a mixture of oxalic and sulphuric acid for cotton.[221] The technique was unworkable if the woven backing, to which pile fibres were interwoven, were not immune to the devoré paste. Where a velvet fabric constructed of a silk or wool pile would have required a scaffold weave of cotton or other vegetable fibre, conversely a cotton pile velvet required a silk or wool scaffold. The yarn used for the scaffold weave would have given the completed textile an individual feel. Moreover, a plain but possibly shiny woven wool or silk scaffold would be revealed in the areas cotton carbonisation.

The differences in the fibre content of the pile and scaffold were further contrasted by colouring the fabric with dyes that worked in accordance with individual fibre types, for instance simultaneously cross dyeing with silk dyes and cotton dyes, silk or wool could

[219] With reference to De' Marinis, F. ed. (1994). Velvet. London: Thames and Hudson. Milan: Idea books. Utrecht velvet p.195; see Landini who writes of Ciselé velvet 'This type of velvet has patterns in uncut and cut pile, presenting different shades due to the differing refraction of light, create a variety of light effects.' p.189

[220] With reference to Bendure & Pfeiffer. (1946). p.655.

[221] The proportion of the ingredients in the solvent depended upon the nature of the thickening substance (gum, dextrine, starch) and the quality of the cotton to be removed.

be dyed burgundy red and the cotton pile fibre dyed ochre. A velvet or pile fabric constructed of a cotton backing and silk or wool pile would appear noticeably different. The pile fibre may have had a high lustre with the exposed scaffold cotton weave distinctly matt. This variation in fibre appearance would also have been accentuated by its dyeing. When both fibres were dyed to a similar tone, contrast was achieved by matt and shiny fibre qualities or variation in the height of the pile fibre. As no specific details are given in regard to the processing of the fabric, once printed with the devoré chemical and allowed to dry, the fabric would have been further dry heated to accelerate carbonisation. Maertens similarly used heat to carbonize cotton printed with sulphuric acid, followed by brushing to remove the destroyed pile fibres, a familiar practice in velvet finishing, as was neutralising a chemically treated fabric by washing.

Traditional methods of pile fibre removal, such as cutting, embossing, and singeing, were not to be replaced as a consequence of the development of this technique. The machine-based manufacturing of pile fibre cutting and patterning was continuously patented during the 1890's and well into the 1900's reflecting the profitability of the pile decorated textile. Moreover, the traditionally manufactured pile fabric had to be popular for the devoré process to have been developed and employed, as the pile devoré textile was seemingly promoted alongside other novelty pile woven textiles and printed pile textiles. The cost of the devoré manufactured textile was not necessarily low, as the quality of the materials used in its construction could clearly be wide ranging, however, what the devoré fabric ornamentation actually allowed manufacturers was the opportunity to provide consumers with an alternative to figured velvets patterned entirely and therefore somewhat laboriously through weaving. The greatest benefit afforded the manufacturer by being able to alter the figuration of a velvet pile textile by printing was the rapidity with which any patterning changes could be made.

Consequently a greater range of patterns or designs were attainable because the same machinery used to apply printed design onto other pile woven textiles could be used on these textiles incurring no extra cost. From an economic viewpoint this was a sound assessment of the contemporaneous textile market, which at the time of this Wissel et Cie patent in 1895 had seen the use of velvet as a fashion fabric become increasingly popular. Its application within contemporary women's fashions as "artistic" pieces to be decorated by textile artists was advanced by the mechanical production of double velvets, which had, according to Roberta Orsi Landini in her work on velvet for

clothing, had been restricted to the wealthier classes.[222] Silk velvets attained an unparalleled lightness on account of the development of crêpe and its use as the lightweight backing. Accordingly this 'light base of crepe' was considered to be 'the great innovation of the 1890's.'[223] It is reasonable to believe the Wissel et Cie devoré process may have been employed on a velvet with a fine woven crepe ground, moreover, there is evidence of crepe being used in devoré fabrics of the 1930's in much the same way as the Wissel et Cie technique.

From the late nineteenth century onwards the early pioneers of pile devoré design described their fabric inventions not as chemical or finishing techniques, but as processes of 'ornamenting' or 'figuring' velvets or other pile textiles. Decorative pile textiles were fundamental to the interior of the late nineteenth century, where ornament was employed to emphasise a sense of luxury, a retrospective glance towards any time but the present. French interiors of the late nineteenth century especially relied upon textiles to make an interior cosy. Leslie Hoskins in reviewing Interior Decoration and Art Nouveau in Britain observed the relationship between textiles and furniture meant the 'fashionable upper class tended to the French, to the styles of Louis XV and XVI, while factory made approximations of these and English renaissance forms, rich with ornate machine carving and elaborate upholstery, were popular at the lower end of the market'.[224]

The styling of fabrics employed within the interior were comparable to the second empire, for instance 'velvet, plush, moquette, tapestry and damasks: lightweight muslins and tulle (seldom plain, but having Jacquard-woven patterns or designs in appliqué or embroidery)...'[225] This replication of the decorative patterning of earlier periods was common, with the prevailing taste centred on eighteenth century style textile designs. However, purchasing high quality crafted textiles was only possible for the affluent European and American consumer, as alluded to by Hoskins. Furthermore, Schoeser and Dejardin, in their examination of 'French Textiles' think 'Because the costliest fabrics, such as velours de Génes (a closely woven all-silk velvet) could cost 80-100

[222] De' Marinis, F. ed. (1994). Velvet. London: Thames and Hudson. See Orsi Landini Essay Luxury and Practicality. The thousand faces of velvet for clothing. p.102.
[223] De' Marinis, F. ed. (1994). Ibid.
[224] Hoskins, L. (1986). Interior Decoration and Art Nouveau. The official catalogue for the exhibition Art Nouveau Designs from the Silver Studio Collection, 1885-1910. [Hunterian Art Gallery, University of Glasgow 1986]. London: Middlesex Polytechnic London. p.15
[225] Schoeser & Dejardin. (1991). p.143.

francs per metre, there were many imitations which mixed cotton or linen with silk to achieve the same effect. Effect, after all, was of great importance – no matter that these substitutes did not feel the same and quickly lost their dusky sheen.'[226]

The development of chemically patterned but cheaper velvets was the textile manufacturers response to the popular trends in clothing and interior furnishing tastes set by the affluent fashionable elite of the nineteenth century. The middle classes, influenced by the prevailing tastes in interior décor of the wealthy, could imitate their sense of style and desire for comfort by incorporating those design elements that were the easiest or cheapest to replicate, notably decorative textiles. In profiling the latest trends in ornamental fabrics for 1895 the editors of the Textile Industries and Journal of Fabrics magazine commenting on 'those beautiful fabrics which are of such infinite value for the decoration of the home' epitomized the industries thinking when it asked 'What can be more effective or in better taste than a suite of furniture upholstered in neatly designed plush fabric?'[227]

The interior pile woven devoré textile was created in response to the accompanying expanding textile market that the trend in interior furnishings engendered while exploiting the changes in the retail of textiles that occurred during the late nineteenth century. Department stores established in Europe and America from the 1870's onwards were hugely influential in providing the latest dress and interior textiles, mainly to the 'leisured wife', a respectable woman who remained at home.[228] Judith Flanders speaking of Women and the Ideal Home (Museum of London, February 28th, 2004) describes the domestic interior of this period as a site for display, but also a refuge from the working day. While the lower classes were able to add a few decorative objects into their interior, the middle classes were competitively driven to extravagant exhibition.[229]

The creation of a mass produced pile woven devoré textile was not necessarily an attempt at emulating the bespoke hand crafted velvet interior textiles of the commissioned decorative textile artists. Its purpose was to impart a sense of novelty, decoration or luxury to the interior while still being affordable. The distinction between the mass produced textile and the hand crafted piece is exemplified by the fabric

[226] Ibid.
[227] Lord, H. & R.T. Co. ed. (1895). February. p.50.
[228] Flanders, J. (2004). Lecture notes. [Museum of London study day Girl about Town: Dressing the 1920's Flapper, Saturday February 28th 2004].
[229] Flanders, J. (2004). Lecture notes. Ibid.

manufactured using Caroline Cameron's ornamenting velvet process of 1899. An art decorator located in central London, her studio ran parallel to Regent Street an area recognised for fabric and interior retail. Cameron, a quirky designer decorator, employed an ingenious fabric scorching process that allowed a sense of the 'artistic' to be given to an otherwise standard velvet textile. The technique involved a silk cotton velvet or velveteen having areas of pile fibre burn't away using a 'Paquelin Thermocauter', a platinum hollow pointed implement supplied with 'benzine vapour', that allowed for an adjustable level of heat to suit the fabric fibre content.[230] Cameron described the effect of using the tool as if drawing with a pencil. The way in which the designer varied the contact of the tool and fibre dictated the amount of burning. This resulted in 'graduations of light and shade in the design', see Fig.18.

The way in which fibres respond to the application of heat is dependant upon their chemical composition. Relying upon the differential burning properties of fibres, Cameron exploited protein fibres reluctance to burn. Cotton fibres in contrast are combustible and continue to burn once exposed to a flame, hence their use as the pile fibre. Cameron appears to suggest that once the designer had become familiar with the effects of the tool and the reaction of the cotton pile to the heat source, ground weave damage was negligible and variations in patterning and sculpting were limitless. [231] This trend in using a hand decorated velvet textile within the interior was also reflected in the short lived but popular pile fabric picture, a textile whose sole purpose was to ornament.

A series of patents registered during the latter part of the nineteenth and early twentieth century reflected the interest shown by the textile crafts market wanting to protect their decorative craft techniques. Thomas Swinnerton's decorative artwork process of 1901 is noteworthy because it recognises both the stylus and chemical treatments. In attempting to display true 'artistic taste and talent' Swinnerton surmised 'I do not wish to confine myself to the use of the stylus or a hot iron in scorching the pile and producing my design, for it is apparent that the same or a similar result may be produced through the use of chemicals, such as acids or alkalies; but I prefer the stylus, because of the danger attending the use of chemicals.' The patterning of these velvet or plush pictures was apparently very much nature inspired, with autumn leaves, bouquets, wreaths, birds,

[230] Caroline Beatrice Cameron. (Application filed November 1, 1899 accepted April 17, 1900). Ornamenting Velvet. US Patent 647,474.
[231] Although silk fibres when exposed to a direct flame will burn, the removal of the flame causes the fibres to self extinguish, consequently silk is not regarded as an especially combustible fabric.

butterflies shown in bold relief and bright colour having a velvety softness on the standing pile, which accordingly rendered the finished textiles 'things of beauty.' While Cameron's textile was clearly designed for affluent customers, Swinnerton's craft textile was reflective of the enthusiasm for hand craft and hobby crafts evident within mainstream women's magazines in America, for instance The Ladies Home Journal.

Summary and conclusion.

- The technological changes in woven devoré production during the late nineteenth century reflected the larger industrial changes in textile manufacturing during the late nineteenth century.

- The development of new textile products from previously unworkable material was in direct response to increased industrialisation, but also due to economic necessity.

- The staple fibre made by temporary support yarn and carbonising developed in the 1880's, set the manufacturing standard of staple fibre processes for the twentieth century.

- The development of fabric processes that retained part areas of the supporting temporary fibre are the earliest examples of woven devoré designing and patterning.

- The pile devoré process developed alongside plain woven devoré. However, not until the latter years of the nineteenth century was the ornamentation of velvet and pile textiles by printed devoré firmly established.

- The woven devoré process allowed the manufacturer to rapidly alter the figuration of a velvet pile textile by printing. This allowed the manufacturer to respond to popular fabric trends of the day.

- Consequently a greater range of patterns or designs were attainable on velvets, as the same machinery used in the printing of velvets and other fabric could be

employed. The woven devoré process was economical to perform as it required no new or specialised machinery.

The design and manufacture of woven devoré textiles during the latter part of the nineteenth century continued to follow the consumer's passion for highly decorative textiles, for both dress and within the interior. The editors of the Textile Industries Journal of Fabrics summarised the textile industries fickleness in dress fabric trends stating that 'ornamental fabrics for personal adornment assert themselves at recurring periods. They come and go; at times their reign is brief, at others, they maintain their popularity until highest and humblest wearer is satiated, and fashion declares in favour of plainer clothes.'[232]

[232] Lord, H. & R.T. Co. ed. (1895). March, 1895. p.26.

Chapter 3

A period of transition and design diversity.

Chapter 3

At the turn of the century, woven devoré fabric manufacture together with embroidery lace textiles processes reflected the shift toward mass produced commodities supplied to an even greater range of consumers. The devoré textile of the early twentieth century was designed for both fashion and the interior. Its structural patterning was styled to reflect the designs of other figured textiles, often imitative of bespoke woven fabrics. The combining of fabric processes, as previously advocated by the Wissel et Cie patent of 1895, continued during the decade, with the machinery commonly used in the creation of printed textiles adapted for use in devoré manufacturing. The styling of woven devoré textile designs reflected the modern-day printed fabric design trends as a result of this modification. Meanwhile the increasing sophistication of regenerated cellulose fibres began to impact upon woven devoré manufacture, with the treatment of fabrics containing the filament registered between 1910 and 1913. These viscose (regenerated cellulose) devoré processes were the foundation of all future viscose devoré manufacturing (see appendix 3).

The woven devoré textile manufactured between 1900 and 1914 was a modern product. In all instances, its production during this period involved a breadth of machine manufacturing processes, from the fabrics printing to it's final washing and brushing. As a consequence the manufacturing cost of the devoré textile was considerably lower than the labour intensive hand manufactured textiles it was aiming to compete with in the market place. The standard of manufacture of the woven devoré textiles during this period is thought to have been variable, in part because roller printed fabrics had a reputation for being low-quality with their applied images and patterns often inaccurately aligned, but also because of the economic fluctuations in material costs experienced in the years prior to the out break of war. The devoré textile seemingly occupied a unique position within the fabric market place, its clear patterned weave structure ensured it wasn't commercially bracketed with the printed reproduction textiles at the lower end of the market, yet it clearly wasn't intended to be marketed as a sophisticated, hand woven or bespoke Jacquard woven textile. Overall its method of devoré manufacture enhanced its visual styling establishing it within the novelty and fancies category, a status the woven devoré textile and particularly the pile woven devoré textile retained for most of the twentieth century.

Within this twenty year period review there were found to be four distinct devoré fabric manufacturing processes which encompassed pile woven fabrics, to etched felt, plain woven paisley textiles and open weave regenerated cellulose devoré techniques, the latter being the first sign of the new artificial silks being used in conjunction with the woven devoré process. The varied employment of devoré during this period clearly reflected the personal interests of the individual textile engineer, however, these processes also emphasize the primary markets for the devoré textile during this period of rapid industrial textile change. For instance European textile scientists were extensively involved in the improvement of new dye stuffs and commercially viable regenerated cellulose filaments. The significance of a commercially viable artificial silk fibre was to hugely impact the design and manufacture of woven devoré textiles for the next hundred years. While this period of devoré textile manufacturing clearly reflected a marked transition in textile design in general, the diversity of devoré manufacture shown within the historical textile patent record was to influence the future designing, patterning, fibre content, weave structures and dyeing of woven devoré textiles well up to the Second World War.

The colouration and devoré of pile fabrics.

The most significant of the four woven devoré procedures, for which patents were registered during this period, advocated sequential devoré and colour application. The economic incentive to create figured effects within a printed pattern was due to the popularity of Jacquard manufactured textiles. Jaquard manufactured velvet, with its patterned areas of raised pile and flat weave, intricately coloured through the use of assorted coloured yarn, was labour intensive, costly to manufacture, yet elegant and elaborate in design, although Lyle regarded Jaquard woven fabrics as being 'purchased for their beauty not their durability'.[233] Based in New York, Otto Timme, clearly recognised the economic potential of Jacquard manufactured textiles market. Accordingly, a primary objective of his devoré invention was the close imitation of a Jacquard-produced pile fabric, more specifically the devoré fabric was intended to attain a sense of the Jacquard's styling, its patterned relief and colour composition. Using a technique of devoré pile fibre destruction Timme employed a printed devoré process with the aim of manufacturing textiles of reasonably cost, moreover, he considered the 'exclusive' Jacquard textile as being 'justifiably' imitated by this simpler and

[233] Lyle. (1976). p.182.

economically inspired production method.[234] The emphasis of the technique was the sequential printing of the colour and then the destructive medium, using engraved roller printed designs that matched in regard to the blotch (or field) and the pattern, see Fig 19, where B^1 is the colour print and B^2 the 'remover'.[235] Effectively the foundation weave, which was either silk or cotton depending upon the fibre content of the pile also silk or cotton, would have appeared coloured in the areas of fibre removal and supposedly matched the print because the complexity of realignment, an issue when fabric shrinkage occurred during processing between the coloured image print on the pile and then the devoré print, had been deliberately removed. The creation of 'decorative Jacquard effects' in this instance were said to be unachievable unless the pile fabric was passed through the printing machine.[236] B. S. Hillman in 1937, advised pile devoré printers to apply the carbonising chemical to the reverse of the fabric, the point at which the pile fibre is weakest. Furthermore, the matching of colour and carbonising chemical was almost guaranteed if a duplex, or double-sided fabric printing machine was used which could print the face with a coloured design and sequentially print the back with the carbonising chemical.[237] The Duplex printing machine was in operation in the late nineteenth century with reference to Chapter five, however, the majority of print works in America apparently lacked such machinery.[238]

The latter period of the nineteenth century was extraordinary for its increase in textile machine fabrication, although initially the source of patterning of these fabrics were frequently hand crafted textile design, machine printed fabrics tended toward the highly decorative with added imitation handwork, though often crude in their design interpretation.[239] In particular it was American textile manufacturing during the early part of the twentieth century that was to become renowned for its mass production of textile goods, with Timme's patent of 1901 reflecting this revolution in textile manufacturing. How well made these devoré fabrics actually were has proven to be indeterminable, although Ernest Cadgène and Jules Jeandros commenting in their 1924 patent about the improvements they had made to the 'soda print process', a descendant

[234] Otto Timme, of New York. N.Y. (Application filed December 4, 1901 accepted July 29, 1902). Method of Producing Figured Pile Fabric. US Patent 705,977.
[235] For vegetable fibre removal from a mixed animal fibre fabric sulfuric acid, and to remove animal fibre from vegetable a soda solution.
[236] Note intaglio engraved roller printing is attributed to Thomas bell of Scotland c,1783. It is assumed that the roller printing of devoré paste was attempted prior to this patent. However Timme's sequential colour and devoré printing is unique at this point in time.
[237] Hillman. B. S. (1937). Rayon Textile Monthly. February, 1937.
[238] Hillman. B. S. (1937). Ibid. .
[239] Rutt, A. H. (1948). Home Furnishing. New York: John Wiley. London: Chapman & Hall. p.112

of Otto Timme's invention, noted 'many attempts have been made to combine color printing of designs with the soda print process. Such attempts, however, have not been very successful... it has been found impossible to prevent the colors and chemicals from running.'[240] Accordingly in Timme's process the pile surface once it had been printed with a coloured pattern and caustic agent was steamed. This procedure accordingly allowed fixation of the colour print and promoted the chemical deterioration of the pile fibre, see Fig. 19, where the steaming process has aided the destroying medium in the destruction of the portion B^2 fibers. It is difficult to distinguish from the patent drawings the exact scale of floral image printed and the amount of fibre destroyed as a result of carbonisation. What is evident are the areas of raised pile weave surrounded by coloured plain weave scaffold made visible by carbonisation and the subsequent removal of pile fibres; a cross section of the contrasting heights of pile and scaffold, achieved as a result of the technique, are represented by Timme's illustration Fig. 5.

Figured pile fabrics at the turn of the century were used for both furnishing and apparel textiles. However, the weight and density of the exposed scaffold in Timme's invention would have dictated the form of use the fabric assumed. A lightweight, or even sheer backing would have resulted in the velvet textile being used for both ornamental furnishings and delicate fashion fabrics. Whereas a denser cotton or vegetable foundation, more robust in nature, and possibly less transparent, would have been employed for coats and wraps, interior covers and throws. T. F. Bell, a National Scholar in Design, writing of Jacquard weaving and designing (1895), considered Jacquard machine woven pile work to be 'the most exquisite production of the loom.' With 'Curtains or hangings ...made extremely rich by figuring a rich corded silk ground with a pile of different lengths and colours.'[241] Accordingly Timme's justification for entering the lucrative Jacquard pile textile market is clear.

The trends in fashion fabric design in the early twentieth century were often dictated by the style of the outfit to be worn, for instance an afternoon gown required very different fabric from a street gown or visiting gown. Accordingly, the colour of fabric was to some degree dictated by the outfits purpose, for instance The Draper in 1902 advised their retailers of anticipating greys and browns for the Autumn materials, with black and

[240] Cadgène & Jeandros (1924). US patent 1,513,370.
[241] Bell, T. F. (1895). Jacquard Weaving and Designing. London & New York: Longmans, Green and Co. p.253.

white to be stocked for a 'quick selling purposes'.[242] As for the fabrics, rich brocades, tweeds, silks, embroidery, printed Japanese, and coloured crêpe de chine along with fancy silks were to be 'much in requisition', while the popular fashions these fabrics were destined to be employed within, evening gowns and mantles were always given considerable analysis. The mantle or ¾ length jacket fronted the autumn mode of 1902, with plush and velvet the fabric constituent of many cloaks and jackets, often ornamented by elaborate appliqué or other methods of patterning and with a touch of fur trim. Fashion house Stern and Evans, were typical in their advertisement for 'high class mantles, golf capes and motor coats.' The company's seasonal offering of "CZARINA" a boldly decorated geometrically patterned luxurious styled velvet mantle, was shown in black with fur trim along the collar continuing down to the bodice to a slim low cut waist, and patterning on each of the coats panelling.[243] Kate Heintz Watson writing of velvet prior to the First World War in 1916 also admired the fabric for never having lost its vogue:

> 'For robes and cloaks, for mantles and jackets, for hats and bonnets, for trimming and decoration, velvet has been popular for a greater period than the life of any living mortal, but never before has it been so cheap, so varied and so beautiful as it is now. One can in the passing throng of pedestrians on any crowded street see the use and abuse of this noble material. There is scarcely an article of dress into whose composition it does not enter and is worn on all occasions.'[244]

While the German mantle trade was eventually to flood the London market with cheaper mantles (in 1903 it was said to have dumped 70,000 at 20,30, or even a 40% reduction in price supposedly ruining the British market), cheaper fabric imports were common at this time. Manufacturers in France regularly cleared stock in this manner.[245]

The pile woven devoré textile was accordingly manufactured during a period of high velvet usage, apparently equally suited for use in dress textiles as it was for the interior, although its exact market position during this period remains unclear. How the novelty fabrics such as pile woven devoré textiles were actually viewed by the purchaser is difficult to determine. Helen Watterson Moody in her irreverent review "Amy and I" (being some confidential letters to 'My Pretty Dreamy Niece', published in the Ladies Home Journal), noted in her sardonic article 'The American Woman and Dress' how the

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[242] The Draper. (1902). Autumn Leaves. The Draper. September 27, 1902. p.1239.
[243] Ibid. Stern & Evans. Carter Lane. London. E.C.
[244] Heintz Watson, K. (1916). Textiles and Clothing. Chicago: American Scholl of Home Economics. p. 92.
[245] H. and R. T. Lord, ed. (1895). The Textile Industries Journal of Fabrics. February 1895. p. 26

seasonal changes in dress and the retail of dress fabrics were generally received by the ordinary America middle class consumer:

> 'The costs of dressing grow greater every year, the fabrics themselves more expensive, the variety of trimmings and accessories more bewildering, and the changes and shifts of fashion are prompter and more imperative.
> To whom do the shops cater, with their costly goods and their ever increasing scales of prices? The rich.
> After what do the smaller shops pattern, with their cheaper, but showy and often flimsy and worthless, goods, made to copy "the latest novelties" as closely as possible? The Great Shops.'[246]

The trends in dress fabrics and dress design, as alluded to by Watterson Moody, were heavily derived from the Paris fashions. The latest Parisian designs were effortlessly accessed by wealthier American women, as French textiles were readily exported to the wealthy consumers in the United States during the latter part of the nineteenth century. The boom in French goods was further supported in 1892 by France's new exchange rates and tariffs.[247] A steady influx of French weavers had also established themselves in America during the late nineteenth century, with machine production of French style silk textiles on the increase. By the turn of the century Paris was regarded as the 'Mecca of fashion for all the world.' America's wealthy continued to visit the city to personally select their wardrobes, while those at home received in depth previews of the latest Paris trends in ladies magazines. Katherine De Forest's letter from Paris, 'forecasting the new styles at the capitol of fashion' to readers of the Ladies Home Journal encouraged the middle classes to buy similar outfits at department stores or order complete outfits or adapt their current wardrobe at local dressmakers.[248] This influence of the couture on clothing trends naturally filtered through to the selection and styling of dress fabrics..

In terms of interior styling, a similar influence was exerted on the American domestic interior by European decorating trends, resulting in the decoration of the average house being heavy and dark, with tables covered with tapestries, and windows dressed with multiple layers beginning with shutters, shades, lace, and then heavy drapes.[249] For the pile woven devoré textile to have been used in either dress or interior textiles of the

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[246] Watterson Moody, H. (1901). The American Woman and Dress. The Ladies Home Journal. June 1901. p.15.
[247] Schoeser & Dejardin. (1991). p.141.
[248] Ewing, E. (1974). History of Twentieth Century Fashion. London: B.T. Batsford. Ltd. p.4.
[249] Tate, A. & Ray Smith, C. (1986). Interior Design in the Twentieth Century. New York: Harper & Row Publishers.

period it had either to assume current patterning designs, be a plausible simulation of popular fabrics, or be an attractive novelty textile. From the images supplied with Timme's patent it is evident that the woven devoré textile was manufactured to meet all of these criteria.

The relationship between wool carbonising industry and devoré manufacturing was still evident during the early part of the twentieth century. A commercially dissimilar and relatively unsophisticated textile, when compared to the velvet devoré textile, was the etching of felt fabric profiled within The Textiles Industries Journal in 1903. Portrayed as 'an up to date' invention, the Journals editors advised their subscribers, made up of spinners, manufacturers, dyers, bleachers and finishers, that woollen fabrics created with a complete or partial surface of vegetable fibres, for instance woollen felts covered with a thin layer of cotton, linen, jute or raimie, could be chemically etched using a procedure which removed the cellulose element, based 'in the main' on the carbonising process, 'which serves to destroy vegetable matter woven into material for the purpose of producing patterns according as the fibre is acidified or de-acidified.'[250]

The areas of the fabric that were to be retained and form the surface design were protected by an application of alkaline liquid, while the unprotected vegetable fibres were destroyed by carbonising, leaving the remaining cotton or linen fibres to form a pattern possibly being slightly raised in style. In effect the acidified surface of the fabric was de-acidified before the burning stage. However, it is the manner in which the application of the alkaline liquid was applied that is particularly notable. For instance, if longitudinal and cross lines were to be produced (i.e. in the direction of the warp and weft) a thread saturated in alkaline liquid was pressed onto the surface of the fabric for a moment creating a fine line resist on the cotton or linen surface. In this instance a fine raised line of cotton or linen is thought to remain. Otherwise discs coated in the alkali appearing 'fluted or otherwise' could be run over the material under pressure in the required direction, or alternatively a roller engraved with the patterned designs, printing 'planographic' forms or blocks could also be used to apply the alkaline liquid.[251]

How the wool ground was protected from the alkaline resist treatment was omitted from the processes review, however, it is thought that the protein fibres were able to

[250] Lord, H & R. T. ed. (1903). Up to Date Inventions. Textile Industries Journal. January 12th 1903. p.3.
[251] Ibid. Planographic: the process of printing from a surface (usually flat) on which the printing areas are not raised but still ink receptive. (Platen).

withstand the alkali for the period of time it took for the unprotected vegetable fibres to be removed and the fabric then brushed. The customary function of decorative felt fabrics during this time included hats or coat linings, felt table covers or felt table scarves, with the devoré patterning replacing the customary embroidery work, although this reliance on fabric draping the piano or tables was less popular during the early part of the decade.

Paisley devoré fabric.

A fabric also commonly employed within the interior as a decorative throw or cover was the paisley textile. For most of the nineteenth century Paisley in Scotland was renowned for its manufacture of fine wools and shawls. The Paisley weavers, inspired by the shawls of Kashmir and their stylistic motifs, manufactured Kashmir inspired textiles on mechanical Jacquard looms. These industrially produced textiles were made of fine worsted wools, in rich colours and packed with decorative motifs,[252] moreover, such Jacquard woven shawls were described as 'handsome and relatively inexpensive,' when compared to the original Indian imports, while printed versions developed for the working classes were said to have been even cheaper.[253]

Charles William Fulton, of Paisley, Scotland, registered a woven devoré process in 1905 that proposed printing a carbonising paste to figure plain woven textiles. Central to the Fulton devoré process was the localised destruction of either a cotton yarn, wool yarn (or silk) or both as long as the prints did not overlap. Moreover, the bleaching effect the devoré print had on the coloured fabric was emphasised as being fundamental to the success of the textiles manufacture. In effect the gauze weave in the area of devoré print was discharged, and so constituted the body of the pattern. Furthermore, the use of multi coloured threads was vital to Fulton's fabric designing. A series of effects were possible if pre-dyed threads were used within the construction of the textile. For instance if the cotton and wool threads were of a differing colour and employed uniformly within both the warp and the weft, the whole areas of weave would have appeared multicoloured.

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[252] Meller, S. & Elfers, J. (1991). Textile Designs. 200 Years of Patterns for Printed Fabrics arranged by Motif, Colour, Period and Design. London: Thames and Hudson. p.397.
[253] Ginsberg , M. (1991). The Illustrated History of Textiles. New York/ London: Portland House/ Studio Editions Ltd. with reference to Paisley Pattern and Paisley Shawls. p.217.

Carbonisation of the fibres was achieved through the roller printing of a caustic alkali paste if silk or wool fibres were to be removed, with the preferred method of cotton fibre elimination was with 'aluminic chlorid'. After printing the fabric was subjected to dry heat to 'liberate' the acid and destroy the fibre, subsequent removal of the carbonised threads was achieved by shaking or rubbing. An alternative to the use of two types of fibre within the textile structure a single fibre could be employed for both the warp and weft, the creation of gauze-like effects was still achievable if prior to weaving some yarns were treated with a substance which rendered them 'impervious to the action of the destroying agent. The threads so treated may exist in the warp and the weft and be arranged with untreated threads in any proportion and manner desired'.[254]

Fulton's fabric drawing gives an impression of the design of these sculpted weaves and their overall complexity of manufacture, see Fig. 20. It is evident that areas of contrasting yarn weight would have been used to great effect within this textile. As the structural patterning of a Jacquard weave typically consists of two or more weaves used in some form of combination, such as plain weave, twill, satin, basket, rib, etc.[255] By using this printed devoré process designed areas of full weave to be surrounded by finer gauze, the delicacy and openness of which was determined by the thickness of the yarn that was subsequently carbonized. Varying the size of carbonizable yarn would in theory have allowed for diverse gauze quality, for instance where the carbonizable thread was finer than the resistant thread little variation in density would have been apparent, and the converse if a thicker thread was carbonized. Where carbonisation of two different threads was to be performed contrasting gauze effects may also have been achieved. The combination of differing gauze density within the textile may have heightened the patterned or figuring effect.

Significantly, the Fulton patent also advocated the use of fabrics that were not expressly woven for the purpose of carbonisation:

> 'Any textile fabric having more than one material in its composition may be treated as above described without necessitating any special process of weaving but it is to be appreciated that owing to the nature of the process the ultimate effects produced can be greatly varied by preconceiving these effects and

[254] Charles William Fulton. Paisley, Scotland. (Application filed August 7, 1905, accepted March 3, 1908). Production of Patterns, Designs, or other Similar Markings in Fabrics. US patent 880,983.
[255] Linton. & Pizzuto. (1961). p.94 Furthermore; 'Basic weaves are used, such as plain, twill, satin, basket, rib, etc. Warp satins, filling-effect satins, shaded satins, bright and dim effects, right hand and left-hand twills, and the use of float threads are also important in designing for a Jacquard.'

> weaving fabric accordingly, for example, openwork or gauze-like effects differing in fineness or in structure may be produced at different places in the fabric by arranging the weaving accordingly'.[256]

It is presumed that these fabrics could also have been printed with other designs either prior to or after carbonisation. The application of a print in paisley shawl manufacture during the latter part of the nineteenth century, had in Paisley, been used to either create a design for needle workers to then embroider over, or solely in the creation of 'cheap imitations'.[257] Moreover, while the intended market for this decorative textile is not discussed at any stage within this patent claim, what is disclosed is its measure of life expectancy, and the manner in which the consumer may have treated it. Included within the specification Fulton noted 'Where fabric is to be subjected to some rough or constant usage or to frequent washing or cleaning the raw edges of the pattern may be stitched, bound or corded so as to prevent the ready displacement of the broken threads, but this may not be necessary if the fabric is of comparatively closely woven nature.'[258]

By the advent of this patent registration in 1905, the town of Paisley was already prosperous, with Matthew Blair declaring in 1904 that the town's hand-loom weaving days were almost forgotten. Sewing thread manufacture had taken over from the paisley shawl trade, an industry that had periodically brought severe depression to the town, in part because the trade in shawls was heavily reliant upon the consumers' fickleness for current fashion fabrics and dress. The Paisley weavers by imitating an article associated with the wealthy classes, had offered the paisley shawl to a breadth of consumers. However, 'To stimulate demand, lower qualities were made, until the shawl came to be composed entirely of cotton. The next move was to produce cheap imitations.'[259] The devoré textile advocated by Fulton was part of a new age of manufacturing, said by Blair to be based upon the application of steam power, moreover, 'the invention of labour saving machinery has so lessened the cost of articles of primary necessity, that hand labour cannot successfully complete.'[260]

The finishing of textiles within the Fulton family can be traced to the mid nineteenth century. Charles William Fulton, aged 24 in 1901 was registered in the Scottish census

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[256] Fulton. (1905/1908). US patent 880,983.
[257] With reference to Blair, M. (1904). The Paisley Shawl. (And the Men Who Produced It.) Paisley: Alexander Gardner. p.76.
[258] Blair, M. (1904). Ibid.
[259] Ibid.
[260] Blair, M. (1904). p.45.

as a cloth finisher and dyer and an employer, as was his father Joseph Fulton, aged 63. Both were registered as living in The Glen House in Paisley. Charles Fulton's grandfather William Fulton Esq. had been the Laird of the Glen and had also been involved in weaving in the area, he was photographed with a group of local manufacturers in 1856, an image which was subsequently included within Matthew Blair's profile of local Paisley weavers in 1903.[261]

Regenerated cellulose and woven devoré fabrics.

The development of 'artificial silk' filament during the latter part of the nineteenth century had a profound effect on the advancement of the woven devoré process. Popular as an economic substitute for natural silk, even today the preference for its use within devoré textiles is apparent. Textile manufacturers of the early twentieth century previously limited to utilising cottons, other vegetable fibres, silks and wools gradually introduced this 'new' fibre within their burn out textiles despite its initial visual and physical limitations. In its earliest form artificial silk tended to appear metallic, with a lustre that exceeded the natural silk it aimed to imitate. Softness and general handle were some times 'deficient' and the yarn could be difficult to manipulate 'in the winding loom.'[262] Yet for many textile manufacturers the potential of artificial silk far outweighed any initial drawback. Its source and method of manufacture; 'a regenerated cellulosic material produced by solution of a cellulose source (wood pulp, cotton waste, etc.), followed by forcing of the solution through a spinneret and subsequent regeneration to form the fiber' resulted in a silken fibre with the chemical vulnerabilities of natural cellulose.[263]

Initially produced as a 'long, hairlike filament' its early use within woven and woven devoré textiles was limited to its being 'twisted' with other fibres in a manner similar to that of Emile Maertens specification of 1886. Although by 1910 artificial silk had 'been largely used as a weft yarn, and still more largely in the production of plushes and trimmings' fabrics composed entirely of artificial silk had only been recently

[261] With reference to www.scotlandspeople.gov.uk. Joseph Fulton Esq., of Glenfield Paisley, loaned the photograph to Matthew Blair in 1903.
[262] Barker. (1910) p.61,62.
[263] Needles, H. L. (1981). Handbook of Textile Fibers, Dyes and Finishes. NY/ London: Garland STPM Press. 'Spinneret' is a device resembling a showerhead with many perforations. Each hole produced a fine filament of artificial silk.'

produced.[264] Hottenroth, reflecting on the development of the artificial silk filament in 1928 observed 'The extent to which endeavours were directed to the use of artificial thread as a warp are indicated by the remarkable and certainly somewhat expensive expedient proposed in British Patent 10,186/1910 of Wilkinson and the Bradford Dyers' Association, which consisted in using a warp spun from artificial silk and wool (or silk), followed by the removal of the animal fibre with caustic alkali solution after the fabric had been woven.'[265] Accordingly, the burn out process advocated by Wilkinson in 1910 facilitated the creation of lightweight, delicate, simple woven textiles composed entirely of artificial silk or a mixture of artificial silk and vegetable (cotton) threads. In explaining the rationale behind his patent, Wilkinson commented 'owing to the lack of elasticity of the artificial silk threads, difficulty is experienced in weaving the warp threads in the required positions and at a uniform tension.'[266] The yarn tension difficulties experienced in creating a fabric entirely constructed from artificial silk yarn were in the short term resolved by using a temporary yarn incorporated as a supporting structure at the time of weaving and then carbonized, in the spirit of Louis Chaux's patent of 1883.

The strengths and vulnerabilities of artificial silk filament are clearly recognisable in Wilkinson's 1910 patent; to have destroyed or damaged the artificial silk would have been contradictory to the nature of that process. Therefore the role of this chemical burn out technique was merely to enable the production of delicate woven fabrics rather than create surface patterning. It is not until 1913 that the practice of artificial silk elimination was seriously considered as a means of creating decorative textiles, at which point Henri Giesler used the devoré treatment to create open weave or 'voile' styled fabrics, described as 'A fancy or patterned fabric of substantially all vegetable yarn the pattern of which is demarked by the contrast of relatively thick portions with relatively thin portions...'[267] To create a patterned textile with such extensive open weave using standard devoré techniques would have been costly in its use of carbonising paste,

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[264] Barker. (1910). p.62.
[265] Hottenroth, V. (1928). Artificial Silk. Translated from the German by Ernest Fyleman. London: Sir Isaac Pitman and Sons Ltd. p.372,373.
[266] Joe Wilkinson and the Bradford Dyers' Association, Limited. (Complete specification left 21st October 1910, patented 20th April, 1911). Improvements in the Manufacture of Textile Fabrics. BP10,186. Hottenroth. (1928), states; 'the limited elasticity of the artificial silk fibre, compared with real silk, entails special care if the former is used for warp threads. Fibres of medium counts of about 150 deniers are preferably used for weaving, though lower counts of 80 to 90 deniers are also used for warps.'
[267] Henry Giesler, Brussels, in the Kingdom of Belgium, Manufacturer. (First foreign application 17th Nov. 1913; In the UK, 2nd May, 1914, accepted 25th Nov. 1915). Improvements in or Relating to Processing for the Decoration of Woven Fabrics. BP 10,867.

therefore by pre-treating a fibre to be highly susceptible to the effects of carbonisation and retaining a selected presence of full weave through neutralisation Giesler allowed for a reduction in overall printing.

To manufacture Giesler's basic devoré manufactured voile, a simple cotton weave was created with untreated threads and a chemically impregnated thread added as a supplementary cotton warp.[268] The supplementary warp was eliminated during carbonising except in the area of neutralised print, whereupon a design in relief 'in imitation of embroidery' was said to sit on a ground of voile. The artificial silk filament was frequently combined with other fibres. F. Nasmith, The Artificial Silk Handbook (1926), identified the rationale of an all cotton warp being employed in conjunction with artificial silk filament because 'difficulties in weaving are reduced to the utmost minimum.'[269] An alliance with cotton was established early on in the development of artificial silk textiles. As a fibre it offered a means by which ornamented yarns and fabrics could be easily developed, accordingly Nasmith concluded 'Owing to its similar behaviour towards dyestuffs, the use of cotton with artificial silk in twist and fancy yarns has presented less difficulties than have silk and wool components, hence twist yarns of cotton and artificial silk are by now almost standard productions.'[270]

The destruction of artificial silk by Giesler's devoré process in the creation of patterned fabric required the creation of a satin cloth constructed from a worsted warp and a worsted weft twisted with a pre-treated artificial silk yarn (with sulphuric, hydrochloric acid, etc).[271] A design of large spots was accordingly printed onto the cloth with the neutralising agent, with the cloth passed through a heated chamber to effect carbonisation of the remaining treated fibre. Giesler's employment of artificial silk as a 'fancy thread' within a worsted cloth was perhaps to be expected. According to Nasmith, 'Quite early after the fibre became popular its employment along with worsted threads in twist yarns was widely practiced. Not only for hosiery and knitting purposes, but also for twist yarns for woven fabrics, there was soon considerable demand.'[272]

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[268] Giesler advocated aluminium chloride of 7° Beaumé for the chemical treatment of the supplementary thread.
[269] Nasmith, F. (1926). The Artificial Silk Handbook. Part of The Silk Journal. Manchester: John Heywood. p. 61.
[270] Nasmith, F. (1926). Ibid. p.67.
[271] Worsted yarns: yarn spun form wool fibers which have been carded, and either grilled or combed or both. Collier &Tortora (2001). Note: Giesler states that the artificial yarn can be treated by solution as mentioned within his specification.
[272] Nasmith, F. (1926). p. 61.

Moreover, Wheeler in his work on The Manufacture of Artificial Silk observed 'The lustre, brightness, and sheen of artificial silk enable it to supplement the properties of wool, such as warmth, curl and roughness of the fibre, so that many mixtures of these two fibres enable fabrics to be produced which have advantages over either.'[273]

Paul T. Frankl, a renowned American Interior Decorator, writing in 1954 observed new materials had called for new designs and new textures. Commenting on the rise of artificial silk textile he noted that, 'through it's many uses and low cost it has raised the standard of living of the masses that could not afford the extravagance of silk.'[274] The partnership between artificial silk (classed as regenerated silk) and woven devoré since the registration of Giesler's devoré invention has been incredibly successful, in part because of the affordability of the regenerated cellulose, but also because the devoré process worked exceptionally well with the new fibre.

While the story of artificial silk, its history and evolution has been considerably well documented, often by those closely involved in its development, its association with the devoré process and the effect that this engendered on the process has received little recognition, despite the remarkable relationship that exists between this fabric and high street fashion. Furthermore, the inventors and manufacturers of artificial silk were often actively involved in the creation of devoré processes. Often for a new artificial silk filament to be successfully or whenever artificial silk patents were altered, most often in response to further technical discovery, the burn out process was also adapted to reflect the most recent scientific advances. Moreover, patent specifications reveal commercial artificial silk manufacturers went on to employ the burn out process as a means by which to create textiles woven entirely of this new artificial silk product. Initially many forms of artificial silk filament were unable to withstand the standard weaving process, so the inclusion of a yarn that could provide temporary support during manufacture was fundamental to the early development of a product that we now take for granted.

Artificial silk when used within a devoré textile prior to 1918 was probably manufactured by one of three processes. In 1910 A.F. Barker observed 'All the commercially produced artificial silks are obtained by using some form of cellulose as a basis, and amongst these may be mentioned the De Chardonnet, Pauley, Lehner, Vivier,

[273] Wheeler E. (1928). The Manufacture of Artificial Silk. London: Chapman and Hall. p.114.
[274] Frankl, P. T. (1954). American Textiles. Leigh On Sea: F Lewis Publishers Ltd.

Thiele, Stearn and Bronnert silks, which are also known under such names as "Collodion silks," "Glauzstoff," "Lustro-cellulose," and "Viscose silk".[275] The exact style of artificial silk preferred by devoré manufacturers can only be assumed, however, the proximity of the filament supplier to point of manufacture was ever increasing. Coleman within his comprehensive analysis of Courtaulds, An Economic and Social History, (1969) describes a complex industry of artificial silk manufacturing within Europe during the early Twentieth Century.[276] Artificial silk production was to a level that necessitated the establishment of a manufacturing consortium, the first of which by 1906 represented many of the 22 artificial silk works in operation at that time.[277]

Whatever form of artificial filament selected by the devoré manufacturer, its destruction by devoré would have been considered costly. Dr O. Faust considered artificial silk, when used for clothing, to be a 'luxury article' used in a manner similar to that of natural silk, with Wilkinson's patent of 1910 appearing to reflect this viewpoint.[278] Of the three forms of artificial silk filament in production prior to 1918 it is generally agreed that Count Hilaire de Chardonnet investigations with nitro cellulose solution constituted the start of what would become a commercial production of a viable artificial silk textile filament. His research into fabrics of artificial (Nitro) silk, manufactured from collodion threads suitable for use as textile fibres caused a sensation at the Paris Exhibition of 1889. Fostering this early interest Chardonnet was able to establish the first commercial artificial silk plant in Besançon, France.

The success of Chardonnet's artificial silk inspired manufacturers already involved with the development of regenerated cellulose materials to broaden their field of manufacturing. Cuprammonium artificial silk, also referred to as Cellulose silk, Elberfeld, Oberbruch, Despeissis or Pauly artificial silk and later Bemberg or Hoelken silk, was created by dissolving cellulose in a copper ammonium solution and extruding the fibre into a water bath. This was a process first proposed by Despeissis but patented by Frèmery, Urban and Bronnert in 1897 at Rheinische Glühlampenfabrik, Oberbruch,

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[275] Barker. (1910). p.60.
[276] Coleman, D.C. (1969). Courtaulds. An economic and Social History. In 3 Volumes. Oxford: The Clarendon Press. See Vol 2 Rayon, Chapter IV International Consortia, p. 76.
[277] '7 were in Germany, and 6 in France. Of the remainder, there were 4 in Switzerland, 3 in Italy, and 2 in England.' [4] Hottenroth, (1928). p. 13. According to Georgievics (1920). p.13. This figure had risen to 26 artificial works in 1908 '8 were in Germany, 6 in France, 4 in Switzerland, 3 in Italy, 2 in England and 3 in Austria-Hungary'. Production amounted to over 3000 tons.
[278] Faust, Dr O. (1929). Artificial Silk. Translated from the German by Ernest Fyleman. London: Sir Isaac Pitman and Sons. p. 174. See utilisation of fibres for clothing statistics.

and it is they who were initially able to produce this form of artificial silk on a manufacturing scale. Their so-called Pauly patent of 1897 advocated the addition of silk waste to the spinning solution in order to enhance the strength and lustre of the artificial silk creating 'homogenous and relatively stable cuprammonium cellulose solutions of a sufficient cellulose content, from which lustrous and sufficiently fine cellulose threads could be obtained' capable of competing with the Chardonnet silk filament.[279]

Pauly silk is described by G. Von Georgievics in 1920 as being stronger than Chardonnet silk but 'still too weak to be woven into garments; and it follows, therefore, that the sphere of application of the artificial silks is limited.'[280] The experimental use of the devoré process to enable the manufacture of artificial silk fabric appears to make more sense once the limitation of the early artificial silk filament are realised. It was Emile Bronnert who, despite his early collaboration with Chardonnet and being best remembered for his connection with the cuprammonium process, is considered responsible for 'making it a commercial success'.[281] His brother Henry Bronnert, in Rayon 1942- 1942, describes how early use of cuprammonium silk or 'Lustro silk' had to be demonstrated to English manufacturers as a product suitable for woven fabric manufacture, 'Such difficulty was experienced in getting weaving concerns to take up the yarn, that we decided to get some woven ourselves, and at our own expense. In order to do this we studied the fashion trends of that time and set designers to work who produced patterns....When we began selling these fabrics they proved so popular that textile manufacturers began to order yarn to weave up themselves.'[282]

Cuprammonium silk was eventually to prove its viability as a fibre suitable for employment within many woven textiles, yet initially its application and that of other artificial silks was most often directed towards hand and machine embroideries, hosiery, stockings, knitted underwear, knitted ties, shawls, waistcoat slips, fabric gloves, and decorative furniture fabrics such as 'plushes, curtains, hangings, wall coverings, carpets and so forth, more particularly owing to the highly lustrous effects, which were not otherwise obtainable.'[283] The nature of textiles created by means of artificial silk and the

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[279] Koslowski, H.J. (1998). Dictionary of Man-Made Fibers. Frankfurt: International Business press. As does Despaissis's patent. Note this artificial silk was described by Hottenroth (1928) as being 'bright and glossy ' in appearance. p.353.
[280] Rayon. 1842- 1942. (1942). London: The Maker-Up
[281] Ibid.
[282] Hottenroth. (1928). p.374.
[283] Nasmith. (1926). p.56.

devoré process, were most likely comparable to the artificial silk textiles as formerly described. However, the inclusion of artificial silk filament within a devoré fabric appears contradictory to the economical character that devoré textiles were generally thought to embody.

Clearly the devoré process performed a very different role when used in conjunction with early forms of artificial silk filament, and should be regarded as a key technique that enabled the manufacture of delicate woven textiles. That the devoré process often involved the production of ornamented textiles in an economical manner is relative to the cost of the textiles to which they were compared. Moreover, it is evident that the advent of higher quality artificial silk allowed the devoré process to become associated with innovative and often sophisticated manufactured textiles prized for their lustre. The development of numerous woven devoré techniques using derivative of cellulose fibres, such as cellulose acetate, some ten years after Giesler's process directly relate their existence to the early regenerated cellulose devoré processes. Giesler's devoré process seemingly marks a new phase where the woven devoré textile was contemporary, innovative, and at the cutting edge of fibre usage although this did not necessarily equate to its patterning design.

Of the regenerated cellulose filaments developed during this period it was viscose artificial silk, named after the 'viscose' mass from which it was created, recognised for its economy of manufacture as the raw material used was cheaper than that required by its competitors, its 'high lustre' and 'remarkable covering power in the cloth', that has most influenced the look and feel of the devoré textile over the last ninety years.[284]

Although developed by CF Cross, E.J Bevan and C Beadle in 1892, the commercial production of viscose silk began in Courtaulds Coventry factory in 1905, with the first fabric being made at their Halstead mill in 1906. Initially employed as a weft fibre in conjunction with a silk or cotton warp within dress, blouse and linings, by 1909 artificial silk mixed fabrics of varying quality were available to the consumer, although by 1910 their artificial silk product was mainly absorbed by ribbon, lace, braid and

[284] Georgievics. (1920). p.11. Manufactured according to the Stern process Ger. Pat. 108511/98, 'by forcing solutions of viscose through capillary orifices, and solidifying the resulting threads in sal ammoniac solution. The product requires steaming in order to decompose the xanthogenate completely.' Jackson. (1941).p. 96.

embroidery manufacturers.[285] Early forms of viscose silk filament had a tendency to be wiry, manufacturers had to be convinced of its potential as a fibre that could be easily employed within a range of constructed textiles. In 1941 Jackson noted:

'It should be recalled that in the early days of viscose the yarn was so weak, and its characteristics so little understood, that its employment in woven fabrics was very limited. Not only had the yarn to be improved but the whole technique of textile manufacture had to be overhauled, and much machinery altered or redesigned. In weaving the yarn was used almost entirely with silk or cotton to provide stripe, border or figure effects, in weft and warp; and as the skill of the weavers and the yarns themselves improved, the stripes and other decorations were increased in size.'[286]

By employing viscose in union with other fibres in the construction of a woven textile and then patterning by devoré, these issues of production were in the interim partially addressed.

Courtaulds dominated viscose production in both America and Great Britain, while the viscose manufacturing process had the greatest influence on the American artificial silk manufacturing industry. Courtauld's established their first plant in Pennsylvania in 1910, and once fully operational it was to sustain their monopoly of American viscose artificial silk production until the 1920's.[287] In Europe viscose filament output was on the increase, with Elberfelder Glanzstoffabriken developing the process in Germany. Yet it was the Courtauld's product that Hottenroth regarded as the catalyst for further development of the European viscose product, 'In a comparatively short time they proved the utility and extraordinary importance of the viscose process by placing on the market an exceptionally beautiful silk.'[288]

The manufacture of viscose and other artificial silks was still to be further transformed. The outbreak of war in Europe in 1914 profoundly affected the production and quality of the artificial silk product. The effect on the devoré process was initially a reduction in the use of the technique, however, as war lengthened the availability of materials such as coal, copper, sulphur, oil, soap rubber and glycerine ceased. Central European artificial silk companies, lacking these basic materials, were forced to close. Works that were situated near to the war area 'such as the German works on the Belgian and Dutch

[285] Jackson, C. H. Ward (1941). A History of Courtaulds. London: Curwen Press. p. 96.
[286] Ibid. p.113.
[287] Ibid. p.103.
[288] Hottenroth (1928). p.12.

frontiers, and in Alsace (Niedermorschweiler), the numerous Belgian works (Tubize), the French works at Fresnoy and Givet, the Russian works at Sochaszew and Tomaszow,' were directly affected.[289] Courtaulds were to become the sole commercial manufacturers of artificial silk in Britain during this time. The reduced importation of chemicals such as sulphuric acid resulted in the establishment of chemical plants to support the munitions industry but also to enable the continued production of viscose yarn for furnishing and tapestry style interior fabrics (a Jacquard upholstery cloth).[290] In Germany the majority of artificial silk fibres were requisitioned for military use, replacing cotton, wool and silks, goods that were increasingly difficult to obtain.

To destroy any fibre as a means by which to create decorative textiles would at this time have been economically impracticable. The call for artificial silk continually increased. Central European countries faced demand from not only from military sources but also from the civilian population, and as individuals roles shifted, with many women taking on the responsibilities of an ever increasing absent male population, so too did clothing and furnishing fabrics. The impression of artificial silk as a 'luxury product' inevitably changed, consequently the devoré process when used on a woven textile incorporating the fibre was increasingly geared towards its selective removal.[291]

By the time war ended in 1918, the European textile industry was facing serious difficulties. Eight and a half million people had died during the fighting, (13 million dying as a result of the war, including soldiers, civilians or victims of influenza). Traditional textile regions were seriously damaged. Textile manufacturing globally in 1900 had been dominated by the nation-states of Europe, Britain, France, Austria-Hungary and Germany. So post war textile trade was in chaos. Factories on mainland Europe were still standing, the workers to fill them had been lost. Printed and Jacquard-woven silks were scarce, because the continued manufacture of patterned silks was dependent on a constant demand from the fashion industry, and even in the early 1920s, it was calculated that 80 per cent of Paris was still dressed in black.'[292]

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[289] Hottenroth. (1928). p.15.

[290] 'Courtaulds embarkation on tapestry weaving at Halstead had been modest and restricted by the subsequent outbreak of war. But until 1917 hardly a manufacturer of upholstery fabrics would touch 'artificial silk' and, with a few outstanding exceptions, the production of furnishing fabrics in this country had been confined to low qualities, poor in design and appearance. At Halifax Courtaulds produced entirely new tapestries in which their viscose yarn was mixed with cotton, wool or silk. The effect was soon apparent- other weavers were compelled to copy them and to use viscose.' Jackson (1941). p.119

[291] Koslowski. H. J. (1998). p.296

[292] Schoeser & Dejardin. (1991). p.171.

Summary and Conclusion.

- The turn of the century marked the shift towards mass production and the supply of a greater breadth of textile products to a wider range of consumer.

- The woven devoré textile manufactured between 1900 and 1914 was a modern product. In all instances, its production during this period involved automated processes of manufacture.

- As a consequence the manufacturing cost of the devoré textile was considerably lower than the intensive hand manufactured textiles it was aiming to compete with in the market place.

- The devoré textile of the early twentieth century was regarded as being relevant for both fashion and the interior. Its diverse application reflected the spread of the process amongst textile manufacturers.

- Overall its method of manufacture enhanced its visual styling establishing the more decorative pile devoré fabrics within the novelty and fancies category of manufacture and retail.

- The availability of a commercially viable artificial silk fibre was to hugely impact the design and manufacture of woven devoré textiles. The initial use of the artificial silk fibre in woven devoré fabrics was as a resistant element.

- The decorative potential of the woven devoré process was increasing realised throughout this period. The emphasis of woven devoré invention became the ornamentation of fabric.

- The woven devoré fabric, despite its new automated methods of manufacturing, was not necessarily a product of economy. Innovative and quality fibres were also employed in woven devoré fabrics during this period.

Chapter 4

The influence of the chemist.

Chapter 4

The design, manufacture and retail of woven devoré textiles experienced considerable development during the 1920's, influenced by a broad range of economic and social factors, that ultimately resulted in the establishment of woven devoré textiles structures that we still recognise to this day. The dramatic fluctuations in world trade, advance in textile manufacturing and chemical fibre innovation that influenced the woven textiles industry at this time correspondingly stimulated devoré woven textile manufacturing.

The majority of the woven devoré processes devised during the decade, notably by some of the textile industries foremost designers, chemists and manufacturing companies, advocated the creation of highly decorative textiles composed of both traditional and innovative fibres. Although only a small number of woven devoré textiles survive from this period, the woven devoré fabrics that have been discovered are predominantly pile woven in style, often constructed of mixed fibres such as silks, cottons, artificial silks or metallic threads. While plain and pile woven fabrics were equally popular weaves within patent registrations, figured pile woven textiles tended to dominate in magazine reporting and advertisements during the mid to latter part of the decade. Consequently the lack of surviving plain woven devoré textiles within textile collections may be as a result of the greater popularity of the pile woven textile, or a difficulty in distinguishing devoré woven from traditionally patterned woven textiles, but more likely because of the increased vulnerability of plain woven fabrics to wear and tear. Whatever the exact cause of their absence from the fabric archive, the inclusion of their manufacturing processes within this chapter review of the 1920's devoré styled textile is essential to the historical account of the woven devoré technique and in particular the record of protein fibre removal and the alkali based devoré processes.

The continued development of woven devoré textile manufacturing processes, cut short by economic downturn and the outbreak of the First World War, did not really resume until the latter part of the 1920's. Moreover, the economic burden of the War continued to affect fibre and fabric production well into the mid part of the decade. Although immediately after cessation British fabric manufacturers initially faced high-level demand from consumers for an insufficient supply of textile goods, the subsequent rapid increase in productivity brought about by the recommencement in civilian fabric

manufacturing resulted in a reduction of fabric prices that in turn led to a broader selection of textile goods reaching a wider spectrum of consumer.[293]

When eventually the revival in woven devoré patenting began, it reflected a period of economic stability in Europe and America which gave rise to a market for bold and highly decorative textiles, and consumers an opportunity to wear more novel styled dress textiles. Despite the absence of woven devoré patents in the early part of the decade at least eighteen inventors registered some 16 woven devoré patents, with over half of the techniques being directed towards the utilization of new, 'artificial silk' fibres such as cellulose acetate (see appendix 4).

The development of new derivative of cellulose acetate fibres at the turn of the decade and the improvement in quality of the early artificial regenerated cellulose fibres such as viscose, actually stimulated the development of woven devoré processes, resulting in an increase in American and British patent registrations toward the latter part of the decade, an event of some significance during world wide economic down turn and depression. Moreover, woven devoré processes contributed to the development of novel cellulose acetate fabrics.

The treatment of acetate fibre fabrics with a burn out technique was a meeting of two mutually compatible processes, in that the manufacturing basis of both cellulose acetate fibre and the devoré technique of chemical disintegration (specifically simple dissolution) were technically, ideally suited. Since this innovative cellulose acetate fibre was eventually to become regarded by its inventors and their textile customers (both fashion and interior fabric manufacturers) as an economic substitute for cotton and other cellulose fibres, it was similarly employed as a replacement fibre for cellulose fibres previously incorporated within woven devoré textiles. While the chemical technology associated with cellulose acetate devoré techniques gradually became more complex, possibly as a result of the pioneers of cellulose acetate fibre development being involved in the development of suitable cellulose acetate/ woven textile devoré techniques, little obvious change in the patterning of the actual devoré textile occurred when cellulose acetate fibre was utilised, only the lustre of the acetate cellulose fibre

[293] Laver, J. (1961). Between the Wars. London: Vista Books, p16. Who quotes from Masterman, C. F. G. Right Hon. (1922). England after the War. A study. London: Hodder and Stoughton.

would have revealed the fabrics true fibre origin and even this changed when new delustering treatments were developed to soften the sheen of the cellulose acetate fibre.

In conjunction with cellulose acetate woven devoré development, woven devoré processes that utilised natural fibre combinations were patented by a range of textile manufacturers. The rationale of these technologically straightforward processes was the production of highly decorative and elaborately styled fabrics for use as commercial dress textiles. While both plain woven and pile woven textiles feature within the American and British patent record, the surviving woven devoré textiles discovered within fashion textile, and vintage clothing archives suggest the woven devoré fabrics of the 1920's were principally designed to be employed for highly decorative women's apparel, and although interior devoré fabric patents were registered during the research of this period no actual examples of interior devoré fabrics have as yet been found, although there is sound evidence to show interior woven fabrics such as mohair and cotton pile textiles were definitely patterned by devoré, and lighter weight woven linens and cottons etched with a gauze weave were created by a woven devoré process.

The 1920's woven devoré textile initially appears to have been developed to simulate the structural look of exclusive patterned woven textiles such as brocades, although it is important to note that the style of patterning was not necessarily derived from traditional sources. There is also evidence of a move towards the use of original patterning design within woven devoré textile design at this time, a possible result of the development of floral and then geometric inspired floral prints and weaves. F. J. Ringo in her guide to Draperies, published in 1925, inadvertently provides an explanation for using the devoré process to create originally patterned fancy weaves. Accordingly, she noted 'Since it is very costly to make Jacquard patterns, cloth with a complicated surface is necessarily expensive. When new patterns are developed, it requires an expenditure of thousands of dollars before a single yard of salable fabric can be produced.' Even the creation of new fairly simple pattern was said to have been conservatively estimated at $2000.[294]

The patterning of woven devoré textiles in the 1920's, as revealed by patent specifications of the period, was typically floral, abstract or geometric in design with

[294] Ringo, F. J. (1925). Draperies. Chicago/ New York/London: A.W. Shaw Company. (Ltd). p.24. The average salary in the USA was approximately half of this cost.

reference made to checks and stripes although hand painted splashed and irregular drip (spotted) marks were also popular. Moreover, several of the 1920's woven devoré patents refer to the manufacture of brocades or brocaded styled fabrics, supporting the idea that woven devoré textiles were designed to be structurally reflective of current trends in woven textile manufacturing rather than solely plagiaristic of historical patterning. The brocaded textile, frequently categorised as a figured multicoloured woven fabric, with a Jacquard manufactured pattern in low relief (slightly raised) and formed by floating weft (filling) yarns and traditionally a heavy fabric woven with gold and silver patterning, was widely employed as a fashion fabric during the latter part of the decade, with metal brocades, including tinsel brocades and small patterned lamés, hugely popular with fashion designers and magazine editors alike.

Sir Frank Warner and A.F. Kendrick in their review of the International Exhibition of Modern Decorative and Industrial Arts in Paris 1925, observed of the French Textiles on show in the Grand Palais, that brocades by Veuve Berger, Peyrac, Van Gelder and Chatillon 'had large patterns', and were possibly Japanese inspired. That Giraud 'showed a printed silk stuff overlaid with a gold brocaded pattern', Bianchini brocades had silver and gold with 'several tones of colour produced by a single dyebath', DeMontessuy, Montland Mizgier and Chatillon introduced bold splashes of gold in their brocades, Grassy and Bertrand created designs in the Japanese style using a combination of gold and silver, whereas Voos et Cie showed their brocades alongside printed floral designs on velvets, linen and silk.[295] Surprisingly, the weight of these brocades was far from heavy. In their admiration of American dress fabric trends Vogue commentators in the autumn of 1927 noted the brocade fabrics by Cheney and Haas were 'gorgeously shimmering but not at all ornate or stiff and with none of the old fashioned formality that used to characterise the very word brocade'.[296]

The development of these novel brocade fabrics was indicative of the changeable and exciting fibre trends of the decade. The inclusion of new fibres such as lightweight metallic threads or artificial silk within these textiles was all the more significant because of the woven devoré processes reliance upon the mixing of chemically diverse

[295] England. Departments of State and Official Bodies. Department of Overseas Trade. (1927). Reports on the present position and tendencies of the Industrial Arts as indicated at the International Exhibition of Modern Decorative and Industrial Arts. (by Warner, Sir Frank and A.F. Kendrick, with reference to 'Textiles, French Textiles: Grand Palais.' pp.81,82).
[296] Vogue NY. (1927).Vogue's Gallery of American Fabrics. Vogue. September 1 1927, p.108.

yarn types. Natural cottons, silks, and wools had been consistently employed in woven devoré textiles, however, they too were now combined with metallic threads, cellulose acetate and other new yarn such as crêpes, viscose rayon and other artificial silks. Surviving examples of tinsel and metal brocades thought to have been decorated by a devoré process have been located within the Liberty archive.

The patterning of woven devoré textiles, despite the a move towards a distinctive recognisable fabric style, almost certainly drew upon historical influences as the reproduction of historical decorative arts, i.e. the shapes, colours and patterns of textiles, was widespread practice during the 1920's. Moreover, the employment of historically referenced pattern in 1920's woven fabric was not regarded as a plagiaristic activity on the part of the woven textile designer. Imitating former fabric designs clearly stimulated contemporary woven fabric design innovation during the decade, the interpretation and modern adaptation of past imagery or patterning can be evidenced in new or 'modern' textiles of this period. Alain-René Hardy writing of Art Deco Textiles and The French Designers suggests the French textile manufacturers 'relentless pursuit of novelty', from 1919 to 1931, resulted in a period of intense fabric evolution precipitated by 'constant changes brought about by scientific technological and economical cultural factors'.[297] The systematic development of the woven devoré process, its use of new fibres, chemical treatments, and employment of historical and original patterning during the 1920's appears to have been consistent with the general trends of woven textile manufacturing of the time.

As the patterning and structural design of woven fabrics became more trend directed by manufacturers and designers, and reflected in the seasonal forecasts within women's magazines, the design of the woven devoré textile was also likely to have undergone rapid design changes. With the influence of exoticism, motif and visual imagery from China, Japan, Ancient Egypt, Persia, Africa permeating the Haute Couture houses and the fashion designs of the avant-garde, the textile manufacturers purportedly translated these new themes into woven devoré textiles patterning. Since the printed woven devoré processes could be speedily adapted to suit prevailing tastes in fibre trends and patterning, it is likely woven devoré manufacturers would have modified their fabric designs to exploit the popular designs of the printed and figured woven textile market. A. R. Hardy in his analysis of patterning of the period states 'A rapid overview shows

[297] Hardy, A. D. (2003). Art Deco textiles: The French Designers, London: Thames and Hudson. p.11.

that, not counting copies of old patterns, floral designs accounted for over half the fabric designs of this period, whatever their origin, material, technique, purpose or price.'[298] Likewise, of the woven devoré patent registered at this time over half suggest floral patterning as a suitable design for woven devoré fabrics, although it should be recognised that of the woven devoré textiles still in existence abstract florals or geometric styled patterning predominate, possibly reflecting the move towards simplification of established complex forms and shapes (particularly florals) that occurred within textile print design during the early to mid part of the decade.

The evolution of fashionable and bold 'modernist' repeat patterns, simple in their composition, colouring, shape and linear outline were a popular choice for the design of woven devoré fabrics, in part because chemically etching (devoré) geometric shapes from a comparable geometric structure, whether a plain or pile weave, is often more successful but also because the woven devoré technique allowed the designer to create multidirectional patterning, for instance angular, linear or silhouette shapes diagonally across the fabric, on the bias. Essentially the composition of a design could transform from minimally etched design in one area to mass fibre removal in another, a style of devoré designing successfully employed in conjunction with velvet and lamé pile woven textiles towards the end of the decade. Moreover, in terms of woven devoré fabric patterning, the use of repetitive geometric designs of a small to medium scale was also highly effective and a common feature of many figured textiles of the time, see Fig 21.

The widespread use of this style of patterning on woven devoré textiles led to it becoming a design characteristic of the pile woven devoré textile, still popular to this day. Meanwhile the successful association between small scale repetitive patterning and pile woven devoré textiles may explain why the term 'façonné', usually applied to figured Jacquard woven fabrics with a pattern of small, scattered motif, and generally singly coloured, has in the past been commonly used to describe pile woven devoré textiles.[299]

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[298] Ibid. Hardy. (2003). p.46.

[299] The Anstey Weston Guide to textile terms. (1997). BP: Weston Publishing Ltd.
Also refer to façonné and façonné velvet. [on line] Available from http://www.apparelsearch.com/glossary_f.htm. and http://www.ravistailor.com/glossary.htm respectively. [Accessed 19 March 2004].

The trend for woven (non-devoré) geometric figured pile fabrics during the mid to latter part of the 1920's may have led consumers to consider the devoré manufactured pile woven textile a member of the 'cut velvet' textile family. Although probably cheaper to purchase than the fully woven fabric, the pile woven devoré textile was not necessarily the low quality product often supposed by some textile commentators. While cut velvet fabrics with their figurative pile designs woven to show areas of pile against plain woven ground work were simply and economically replicated using the chemical printed and printed resist devoré techniques the pile textile used in their replication need not have been inferior in quality. In reality it may have been equal to or superior in yarn quality or manufacture to other figured fabrics of the time.

With the development of new transparent velvets with their transparent ground weave during the mid part of the decade, noteworthy as a style of fabric because it could be worn in many guises throughout the day, the pile woven devoré process truly had the potential to establish itself as a viable alternative to the woven cut pile fabrics.[300] Moreover, perhaps some examples of transparent cut velvets still in existence may in fact have been patterned by devoré processes, as there appears to be a general impression amongst textiles historians and archivists that artificial silk pile fabrics were the predominant fabric employed with the technique during the period, and a fabric constructed of a silk transparent ground weave and silk pile could not have been treated by the devoré process, an assumption that the patent record does not support.

The full impact of the relationship between the 1920's transparent velvet and woven devoré processes perhaps only becomes evident some sixty years later, when in the late 1980's the resumption of transparent velvet devoré, this time with using a fabric with silk ground and viscose pile, sparked what can now only be described as the longest running revival of the 1920's styled woven devoré processes, an understandable phenomenon according to Vogue commentator Mimi Spencer, ('Spy', 1993) given that 'The devoré process... enjoys periodic renaissances, tending to surface at times of economic upheaval, when a romantic, escapist breeze sweeps through fashion'.[301] Accordingly, the manufacture of elegant pile fabrics with lighter gauze (ground weave) in the 1920's was in response to the 'simplified and unstructured silhouettes of the

[300] For Transparent velvets see Linton & Pizzuto. (1961). p.88. Lightweight, soft, draping velvet using silk, rayon, acetate (and later nylon) for the pile effect; back is of rayon, silk (and later nylon).
[301] Spencer, M. (1993). Spy, Velvet, eat your heart out! Here comes devoré. Vogue. 1993. For further information on the 1980's/ 1990's revival refer to Nilgin, Y. (1998).Georgina von Etzdorf: Sensuality, Art and Fabric. London: Thames and Hudson.

period',[302] reflective not only of the exotic inspiring the dress and textile styling of the decade but also the move towards freedom of movement in women's dress. The sense of liberation in dress structure and weight of fabrics was particularly resonant in the Autumn/ Winter season of 1927, whereupon the Parisian and London design houses were heavily reliant upon these transparent velvets to provide the look and mode of the period. Warner and Kendrick, when reviewing the velvets shown in the Grand Palais at the International Exhibition in Paris, in 1925 accordingly noted 'Some of the velvets had a heavy pile on a ground of remarkably thin texture; these could have but poor lasting properties'.[303] However, the regard in which these new light weight fabrics were held by the critics of fashion style, was evident in magazines such as Vogue London which profiled the Bianchini Férier's 'NEW all-silk transparent velvet called "velours diaphane",' describing the fabric an 'arresting novelty' and a 'perfect triumph of weaving, having great beauty and richness in all colours from black to the palest pastels and white'.[304]

The popularity of these new velvets and other innovative pile fabrics with both designers and fashion magazine editors was said to be as a direct result of this new and improved weight of the fabric. The availability of 'georgette' velvet, as reported by American Vogue in Sept 1927, with its lightweight sheer backing described at the time as being 'scarcely thinner than semi-sheer crêpe',[305] gave designers a striking textile to include within their collections. When profiled in 'Vogue's Gallery of American Fabrics', September 1st, 1927, readers were advised 'You could pull a width of it through your favourite bracelet and almost leave room for your arm.'[306] Consequently the pile woven devoré textile manufactured with a lightweight silk sheer ground was an inevitable development during this period.

Commercially the market for such transparent figured velvet textiles was becoming established, allowing the woven devoré manufacturer to promote woven devoré fabric

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[302] Extravagant Lengths. Velvet, Plush and Velveteen. 1991. F. I. T. New York. From the Exhibition, November 19, 1991-January 11, 1992.
[303] England. Departments of State and Official Bodies. Department of Overseas Trade. (1927). Reports on the present position and tendencies of the Industrial Arts as indicated at the International Exhibition of Modern Decorative and Industrial Arts. (Report by Sir Frank Warner and A.F. Kendrick, with reference to Textiles, French Textiles: Grand Palais. p.80).
[304] Vogue, UK edition. (1927). French Fabrics: The Bianchini Collection. Vogue. September 7th 1927. p.59.
[305] Vogue, N.Y., (1927). Vogue's Gallery of American Fabrics. Vogue. September 1, 1927. p.56,108,124.
[306] Ibid. p.108.

alongside woven brocades, and cut velvets, with little physical or visual difference evident between the fully woven and devoré woven. For instance, a beautifully floral patterned velvet tunic advertised on the www.vintagetextile.com website, see Fig. 22, illustrates how such cut pile weaves may have appeared, and the extreme difficulty the textile historian faces when attempting to establish whether a fabric has been patterned by a devoré treatment. With a design date of approximately 1923, although a latter date of 1925-27 should perhaps be considered, this richly coloured silk pile fabric design of oriental styled flowers in rust sits on a cross dyed transparent slate silk chiffon ground weave.

While figured patterned velvets of the 1920's have since become associated with artisan designers such as Mariano Fortuny, whose use of renaissance motifs was inspired by the Pre-Raphaelite and Aesthetic movements of the late nineteenth century, similar patterned velvets cut-out transparent velvets and lamé velvets were equally popular within Haute Couture and Worth, Madeline Vionnet, and Louiseboulanger, who, along with other leading fashion designers of the period used such fabrics for both day time and evening wear when seasonal trends permitted.

For women leading a more urban lifestyle clothing designs using these same transparent patterned velvets and pile fabrics were profiled in magazines such as Vogue's Fashion Bi-Monthly. This magazine provided the dressmaker, whether operating commercially or from home with the latest dress trends, garment shapes and suggestions for the latest dress fabrics. Its function as an interpreter of the latest fashions was reflected in its review of the autumn/ winter of 1925 when new cut velvets were described as 'a varied and popular note of the season, both for the bridge frock and for the little dinner dress of simple line.'[307] While cut velvets on chiffon or georgette crepe, so the British and American dressmaker was informed, had 'taken the country by storm. Designs and colours are legion'.[308] Without a range of fashion magazines such as Vogue, Vogue Fashion Bi-monthly, Weldon's Ladies Journal, Les Parisiennes, continually directing their prospective readership as to the popular fabrics of the season, and accompanying luxury consumables, it is unlikely that the cut velvet fabrics would have been such a strong fabric trend and the devoré textile would have been of continuing interest to

[307] Vogue Fashion Bi-Monthly. (USA). (1926). December 1925-January 1926. Vol 1- 2. p.23.
[308] Ibid, p.9.

leading manufacturers such as the Henri and Camille Dreyfus of British and American Celanese, Heberlein A.G., and A. G. Cilander

The level of review these cut velvet fabrics received within the fashion magazines of this decade was considerable given the overall breadth of fabric reviews and illustrations presented within every monthly edition. The range of woven fabrics profiled within fashion magazines during the mid to late 1920's was exceptional, a reflection in part of the periods rapid modernization of the textiles trades. Since fabric was the foremost element of a garment that was most likely to change season to season and year upon year, its importance to the trend conscious consumer was not underestimated by magazine editors. Whereas the cut or silhouette of a garment during this time could remain constant for a sustained period the recurrently changing colours, textures, prints and patterning consistently received in-depth comment. Even functional fabrics such as wools, jersey's and 'Rayon', employed to enhance the shorter and leaner silhouette of less fanciful but practical clothing, received considerable review. However, it was evening wear textiles (and some day wear) that possibly experienced the most dramatic increase in popularity during the decade. Satin silks, satin weaves with crêpe or metallic woven backing, velvets with denser semi-sheer crêpe scaffold or metallic weave, were dominant from the mid to latter part of the decade. Furthermore, velvet, together with satin silks, satin backed crêpe, silk crêpe, silk georgette, lamé including lamé Jacquard and lamé brocades, silk taffeta, silk chiffon and silk Jacquard, silk satin brocades, and silk voiles were to become synonymous with both daytime and evening designer wear of the mid to late 1920's.

These rich textiles with their associations of glamour and elegance, often with a high lustre and chic use of metallic threads were often used in conjunction with woven devoré textiles, further challenging the narrow impression of the woven devoré textile as an economically manufactured reproduction textile. Possibly one of the most distinctively patterned examples of a cut velvet garment from the 1920's is a dress that was advertised at www.prototypevintage.com, an online vintage clothing retail website, see Fig. 23. A luxurious black velvet dress with decorative cut out leaf shapes, carefully placed around the bodice and sleeves, leaving the front modestly covered but flaunting the curve and shape of the shoulders and neck, its velvet sashes are weighted by rhinestone dangle ends. Its current condition is described as silky soft to the touch and

in excellent vintage condition.[309] Although singly coloured, its dramatic patterning and the cut of the garment adds to the glamorous feeling that cut velvet fabric especially engendered within dress during this period.

For the fashion aware, affluent woman of the mid 1920's the style, colour and nature of dress was designed to follow the structure of the day and its related 'social activities'. The growing popularity of leisure activities and sports such as swimming, tennis and golf amongst the middle and wealthy classes engendered a simpler look that permeated into other dress worn in the day, finally impacting mainstream dress trends. Moreover, the increased liberalist attitude in western society coupled with an advancement of artistic expression in Europe and America and a general sense of pleasure seeking influenced not only the latest dress shapes but also the fabric that was employed in their design.

The emergence of devoré manufactured dress fabrics with their transparent patterning and fluidity of drape could only have occurred in a society where an atmosphere of self-assurance about the body and bold decoration that could be worn to enhance the female body in particular, prevailed. Suzanne Lussier, author of Art Deco Fashion, published to accompany the Art Deco Exhibition at the V&A Museum in London 2003, writes of the way in which fashion in the 1920's was regarded as means of expression, but also a way in which to reflect the modern. 'Fashion became a way of life, and suddenly meant much more than the latest dress: it encompassed the latest dance, a foreign accent, a glamorous destination, a banned book. After the atrocities of the war, the general impulse was to seek out the exotic, and adopt the modernity of contemporary urban life'.[310]

The patterning of the woven devoré textile reflected the modern and therefore the manner in which it was sold accordingly reflected the retail of other contemporary woven textiles. The woven devoré textile was made available to consumers in the most contemporary means possible, namely 'ready made' garments, also referred to by

[309] Prototype vintage. (2003). 1637-Luxurious 1920's Cut Silk Velvet Deco Dress. [online] Available from http://pages.prototypevintage.com/6695/Pictpage/1921066298.html [Accessed 28th July 2003]. With thanks to Julie. Dress 1637, Luxurious 1920's Cut Silk Velvet Deco Dress is described accordingly; ' This is an old 1920's silk velvet dress. It is silky soft to the touch and has gorgeous cut velvet designs at the shoulder and sleeves. It is in very excellent vintage condition with no flaws. The dress has side waist snaps and 2 velvet sashes that attach to the collar. they tie in the front and have post metal and rhinestone dangle ends. The dress will fit a 38 bust and hips.' 2003 Price $175.00

[310] Lussier, S. (2003). Art Deco Fashion. London: V&A publications. p.13.

Fairchild's Bulletin as ready-to wear in 1925. The expansion of the women's ready made clothing market directly reflected the changing social trends and the clothing needs of women, who as a result of the First World War had achieved emancipation and a new individual level of wealth through employment. Fabric manufacturers realised that this new clientele preferred a 'finished look' that was 'bought off the peg' and could be worn immediately.[311] The department stores and dress shops reacted to the change in women's social lifestyles by establishing ready-to-wear departments that catered for day, afternoon, evening and sports wear, further advertising their latest ready-to-wear ranges in contemporary fashion magazines, alongside the reviews of the chic dress fabrics of the period, and in store catalogues that offered mail order ready-to wear-garments. Elizabeth Ewing in her analysis of the developments in fashion manufacture between the wars, 1918 –1939, proposed the establishment of ready-to-wear collections meant 'An era of inexpensive fashion had begun, in which change and variety were more valued than costly impressiveness'.[312]

Inevitably ready-to-wear garments that incorporated pile woven devoré fabrics began to appear in magazines towards the end of the decade, effectively when 'signatures' were first used to sell ready-to-wear collections and the branding of ready-to-wear fashion. The 'Barbara Lee' advertisement in Vogue New York, September 1927, profiling a dress made of pile woven devoré textile, is a case in point. The use of the branded name and the full listing of their main stockists across America was typical of the way in which ready-to-wear fashions were advertised.[313] Ewing noted that the ready-to-wear manufacturer or retailer who advertised in this manner brought fashion and fashion fabrics to the attention of an untold number of women.[314] Accordingly the woven devoré textile with its propensity towards rapid manufacturing, having flexibility in regard to the altering of its styling or patterning was more than suited to the change with which dress textiles design trends were beginning to move. With the consumer able to purchase fashionable clothing at reasonable cost, a result of the boom in mass produced fabrics and the development of machine manufacturing, the styling and manufacturing of the woven devoré textile appear to have been consistently adapted and updated to take advantage of the modernizing textile market.

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[311] See shopping for style in Breward, C. (2003). Fashion. Oxford and New York N.Y.: Oxford University Press. p.147

[312] Ewing, E. (1974). p.119.

[313] Vogue, N. Y. (1927). 'Barbara Lee' advertisement. Vogue. September 15, 1927. p.6. also see Ewing, E. (1974). p.119

[314] Ewing, E. (1974). p.119.

The economic instability of the inter-war period stimulated a massive transformation in mass textile and clothing manufacturing, with artificial silk fibres during this time of regeneration finally coming into their own. By 1925 the impact of artificial silk was evident in printed textile manufacturing as Warner and Kendrick, when reviewing the Exhibition of Modern Decorative and Industrial Arts in Paris 1925, observed 'The extension of the range of materials by the invention of the various artificial threads has widened the range of the printer's craft considerably. Not only has he to consider a new material which has to be allowed for in the preparation of his dyes, but new effects are aimed at in proportion as the old-fashioned cotton print tends to disappear'.[315]

The refinement of acetate silk in the early 1920's resulted in a new artificial fibre suitable for commercial use, with a series of new woven burn out techniques soon to follow. Swiss manufacturers Heberlein and Co (1925) registered an invention allied to Henri Gielser's pre-war specification of 1913. In accordance with Chaux's short staple fibre technique of 1883, Heberlein recommended dissolving selected areas of fibre from within a woven structure whereby the solubility of acetate silks, or other artificial silks allowed for patterning effects that 'Hitherto... could only be produced on costly Jacquard machine'.[316] The significance of Heberlein's process firstly demonstrated woven devoré fabrics didn't have to be constructed from a traditional fibre, but also that the textile chemist was now directing the development of the woven devoré textiles manufacturing.

From the mid 1920's through to the start of the Second World War, the destruction of acetate fibres predominated European and American woven burn out patent specifications. Devoré processes developed during the mid 1920's were based upon a new generation of artificial fibres. Prior to the First World War the quality of artificial silk was relatively inconsistent, however, throughout the early 1920's manufacturing processes and improvements in dyeing facilitated a product of far superior quality. The latter half of the 1920's was a time when 'artificial silk' fibres, whether regenerated

[315] England. Departments of State and Official Bodies. Department of Overseas Trade. (1927). Reports on the present position and tendencies of the Industrial Arts as indicated at the International Exhibition of Modern Decorative and Industrial Arts. (by Warner, Sir Frank and A.F. Kendrick, with reference to 'Textiles, printed stuffs. pp. 70,71).
[316] Heberlein and Co. A-G., of Wattwil. Switzerland. (1924). Production of Pattern Effects on Woven Fabrics. BP Patent 237,909.

cellulose fibres such as viscose and cuprammonium or derivative cellulose fibres such as cellulose acetate, were the fibres with which to experiment. Confusion between the terms 'real silk' and 'artificial silk' led to the introduction of the term Rayon in 1924; a marker that was to represent regenerated cellulose fibres and on occasion derivative cellulose fibres, but a commercial name designed for use by and to the consumer and seldom used in the scientific arena. Patent registrations in America therefore rarely applied the term 'artificial silk' after this date, instead 'regenerated' and 'derivative' were used to distinguish the style of fibre employed.

The woven burn out techniques of this period were also significant because they were registered for the most part by individuals or manufacturers who found the varying woven devoré techniques, whether based on carbonising or applied carbonisation augmented their specialised textile manufacturing processes. A number of leading cellulose acetate manufacturers and chemical engineers were involved in the registration of these devoré techniques. Camille and Henry Dreyfus, alongside Dort, Platt, Rivat and Ellis, Olpin, Walker, who working for British Celanese and the Celanese Corporation of America, were extensively involved in the creation of a variety of woven devoré techniques that included the use of solvents, saponification, and applied reserves on cellulose acetate woven textiles with the aim of manufacturing 'lace effects', open work fabrics, dress goods trade novelties and fancy articles. Concurrently, Heberlein and Company, St Gallen, Switzerland, renowned for their parchmentizing and transparency effects on cotton fabrics, adapted their specialist processes, which were closely linked in terms of manufacturing to those of woven burn out manufacturing, towards both cellulose acetate and nitration based devoré. Whereas Irish manufacturers such as Stevenson and Wakefield, prominent in the linen industry, designed ornamental patterns of the openwork type, using an alkali carbonising technique that not only destroyed silk or wool threads but also simultaneously mercerised the remaining linen or cotton fibres.

Woven devoré inventors who continued to use mixed fabrics of natural fibres such as cottons, silks and wools generated innovative methods of either improving upon existing woven devoré processes or facilitating decorative effects. Arthur Swallow allied to the Calico Printers Association Limited emphasized the economic viability of aligning floral patterns with an etched blotch pattern on mixed fabrics made up of animal and cellulose, and some 'acetyl cellulose fibres' (cellulose acetate). While in 1924, Jeandros and Cadgène used the term 'Soda-Print Process' in describing previous

and their own method of creating brocaded effects on fabrics by using an applied resist and printed destructive chemical, their patent is possibly the earliest registered woven devoré process of the decade. Similarly Blumenthal and Co. used the woven devoré technique to simulate Fur Blankets, exploiting the trend of using pile fabrics in the replication of animal furs. In 1925, using a burn out technique based upon the nitration of wool fibres, Henry Flory devised a brocaded styled textile of wool and cotton suitable for use as hangings and tapestries. While Cilander of Switzerland, a company renowned for their work with chemical embroidery, and still involved in the textiles industry today, registered alkaline treatments on plain woven textiles with the aim of creating 'pattern effects in the texture of mixed fabrics'.[317]

Of the patent specifications registered during the decade only one process was devised to form a new textile product. As with Chaux's short staple wool fibre invention of 1883, Camille Dreyfus, together with Dort and Platt registered a yarn manufacturing process whereby "spun yarns" could be made of short staple cellulose acetate by means of a temporary support yarn of cheap cotton thread designed to be removed by carbonisation subsequent to the yarns creation. The limited use of the provisional support and carbonisation process in the creation of yarn and woven fabric from the end of the 1920's appears to reflect the advance in fibre development and woven fabric engineering and weaving.

In terms of tracing the rapid development of the woven devoré textile during the 1920's perhaps the best method is by following the shifts and changes according to primary fibre types and devoré procedures employed. Such a formula also helps focus the generation in particular of cellulose acetate woven devoré whose development was to be central to the period (and key to the process that dominates contemporary devoré production).

Silk and wool fibre devoré processes.

The protein fibre devoré processes registered in the 1920's were used to create reasonably priced cloth with contemporary patterning that replicated the weave structure

[317] Herman Müller of Herisau, Switzerland., Assignor to the firm Aktien-Gesellschaft Cilander, of Herisau, Switzerland. (Application filed February 25, 1926, accepted February 21, 1928). Method for producing Pattern Effects in Fabrics. US patent 1,660,042.

of popular woven textiles of the day, including woven brocades, a fabric that had considerable appeal for consumers during this period. While the protein fibre devoré processes reviewed as part of this study were not uniformly engaged in the manufacture of textiles with historically derived patterning, the devoré textiles created using the alkali techniques were often intended to reflect the manufacturing quality that the traditional styled brocade textile evoked. Consequently the fibres used within the manufacture of traditional brocades, for instance silks, wools, cotton and linen, were respectively incorporated within woven textiles to be patterned by means of the protein fibre devoré techniques.

With the emphasis of the protein fibre devoré being the destruction of silks and wools by alkali carbonising or printing treatments the commercial environment for this style of devoré was somewhat limited during the early part of the 1920's. During the early years of the decade wide fluctuations in material costs were universally experienced by the woven textile manufacturing industry. The UK for instance, shifted from fixed wool prices in 1919 to a period of abnormally rising prices and inflation in the early 1920's.[318] In the British Parliament The Standing Committee on Prices (1921) observed 'A contributory cause of the rise was the heavy demand for high quality fabrics after the Armistice'.[319]

Textile and dress commentator Mary Schenck Woolman, writing in 1920 about the effect of war on clothing in America while cautioning continued economic constraint by the American populace, warned 'All the warring nations suffered from lack of clothing. England brought out standard cloths in cheviots and serge, which gave the maximum efficiency with minimum cost. There were also manufactured for the people standard gloves, hosiery, underwear, suits, and blankets.' ....'Germany, Austria and Russia were particularly short in the raw materials used in clothing. Requests for all varieties of cloth were made by Germany on Belgium until little was left there. Even though the war is over, there will be need of strict conservation in clothing for a long time, for the European peoples are almost destitute of supplies, and the United States must furnish them.'[320]

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[318] Great Britain. Parliament. The Standing Committee on Prices. (1921). Profiteering tops and yarns report. HMSO (Vol no: xvi Paper/Bill Cmd.1192)
[319] Ibid.
[320] Woolman, M. S. (1920). Clothing Choice Care Cost. Philadelphia and London: JB Lippincott Company. p.125,126.

The end of hostilities created an artificial boom, where there was high demand for insufficient goods, lasting until 1921 when prices duly dropped and goods were sold at a loss.[321] The climate for creating and inventing textiles manufactured by alkali fibre destruction techniques was clearly impractical until economic stability and the supply of raw materials had returned to a semblance of normality. Those textile manufacturers who successfully re-established commercial textile production in the early 1920's realized the consumer now lived in a changed society, had diverse tastes and shifting levels of affluence. Dress, lingerie, and fabrics for the home either reflected pre-war designs or were forward looking, inspired by modern ideas of styling, decoration and colour. Accordingly, Mary Schoeser writing of the contradictory nature of this period noted 'interiors described as 'modern' could contain antique, reproduction or entirely new furniture and textiles.[322]

For the re-establishment of protein fibre devoré during the 1920's, the economic incentive to create fabrics that required the destruction of fibres, that during and post the First World War had become highly prized, had to first exist for the devoré textile manufacturers. Wary of taking risks after the post war boom and decline, a narrower range of textile products were manufactured all within a similar price range. Economy of material use and manufacturing was widespread within the industry, and consequently innovation in design and processes was noticeably restricted. The patent record for protein fibre devoré in the 1920's accordingly shows a limited group of inventors who selected to develop the devoré techniques at this time. Furthermore, from an analysis of these manufacturers location and the style of alkali based treatments they registered it would appear they were uniquely positioned to kick start the protein fibre devoré textiles revival, although all were seemingly new to the devoré technique.

Why these manufacturers became involved with protein fibre processes during this period is only apparent once the true nature of the techniques registered are recognised. Essentially the protein fibre devoré techniques created during the 1920's were developed to be integrated with textile manufacturers established fibre treatments, which already employed similar methods of fabric finishing, or corresponded with manufacturers existing textile chemical treatments and therefore did not require new

[321] Masterman, C. F. G. (1961) England After War, Part of a compilation of articles entitled Between the Wars (1922) and edited by James Laver. London: Vista Books. p.16. Also see Schoeser & Rufey. (1989). p.170.
[322] Schoeser M. and C. Rufey. (1989). p.173.

machinery, unfamiliar raw materials or a change in manufacturing procedures. Moreover, it is also apparent the revival of the protein fibre devoré in the mid 1920's occurred in textile regions previously known for their pre-war processing, manufacture, and finishing of cotton, linen, (flax) and other cellulose fibres, in textile regions such as Northern Ireland, Switzerland and New Jersey in the USA.

The mid 1920's was a time when these cellulose fibre manufacturers and merchants, who having withstood the demanding economic cost of the First World War saw an opportunity to undertake devoré production in the creation of novel fabrics. Consequently the revival of the protein fibre devoré process in the mid 1920's required manufacturers who could readily secure cotton, linen, and wool and silk products, but also the chemicals with which to achieve fibre destruction. Companies who previously employed techniques of mercerisation and parchmentising of cotton were essentially equipped to attempt new methods of protein fibre devoré manufacturing.

For other textile manufacturing regions, especially those previously associated with devoré manufacture, the availability of raw materials appears to have been challenging. For instance, The Cotton Growing Committee in their 1919 report had advised the UK government that 'Cotton growing had been curtailed during the war, and there was a world shortage particularly affecting the empire. It was dangerous for the British industry to be dependent upon the vagaries of the American crop.'[323] Furthermore, one of the main recommendations of the departmental committee appointed to evaluate the position of the Textiles Trade after the War was that 'Trade with ex-enemy countries should only be permitted under license' and 'Agreements should be made with Governments of the Empire for the control of the distribution of wool, jute, and cotton, in order to safeguard Imperial requirements and to fulfil the pledges to the Allies as provided by the Paris Resolutions'.[324] Of the protein fibre devoré processes registered during the 1920's it was Stevenson and Wakefield, who in 1925, and based in the north of Ireland, in Dungannon, County Tyrone, an area renowned for its linen manufacturing and flax trade, who submitted their registration at a time when cotton and linen was at a high premium and the destruction of limited amounts of inferior grade wool was an

[323] Great Britain. Parliament. The Cotton Growing Committee, (1920) Empire Cotton Growing Committee. HMSO (Vol. no: xvi Paper/Bill Cmd.523).
[324] Great Britain. Parliament. Board of Trade. Departmental Committee on the Textiles Trades. (1918). Textile Trades after the War. HMSO (vol xiii Paper/ Bill Cd. 9070).

accepted practice.[325] The manufacture of open work or gauze-like fabrics as proposed by Stevenson and Wakefield in their GB patent registration of 1925 was particularly distinctive because of its simplicity of combining a mercerisation technique with a simple devoré process. The technique registered by the Stevenson and Co. made use of the established mercerisation process of treating cotton and linen yarns and fabrics with a caustic alkali, which when used on a cellulose yarn resulted in greater strength, dye affinity, fibre swelling and an increase in lustre, but would also destroy protein fibres.[326]

While the Stevenson and Wakefield devoré technique was clearly derived from woven fabrics created using a temporary yarns such as F. Bowman's manufacture of ornamental fabrics (1888), where cellulose fibre draw threads or drag threads were removed by carbonising, the fabric suggested by Stevenson and Wakefield although similarly treated involved the destruction of protein fibres. The temporary protein fibre was only included within the woven textile at the points where open thread work was required, hence the entirety of the finished fabric consisted of a single fibre, such as linen or cotton. Moreover, as the wool fibre was destined to be fully removed, the amount that was actually required within the woven textile was flexible and therefore could be tailored in order to suit wool and cotton prices at any given time. Therefore if the wool element of the weave was cheaper to destroy than the cotton or linen was to include within the fabric the amount of open work within the textile could have been altered to suit fluctuating materials costs.

Throughout 1924, Fairchild's Bulletin reported on the movements experienced in the worldwide flax and cotton market. In Belfast, linen prices consistently increased throughout the year. In August 1924 there was huge demand for coarse yarns, which were said to be almost unprocurable.[327] Two weeks later in early September 1924 such was the order for dress linen from America, Belfast companies were 'at their wits end to make them'. Of the varying types of linen textiles 'fancy check effects' were in most demand with 'the looms suitable for making them are booked up.' While long term prices for these goods, as stated by Fairchild's, were anticipated to remain high as yarns

[325] Fairchild's Bulletin. (1924). Higher Linen prices in Belfast. Fairchild's Bulletin. August 11 1924. p.2
[326] Robert Stevenson and Frederic William Wakefield, Co. Tyrone. (Application filed March 28, 1925, accepted October 1, 1925). Improved method of Manufacturing Decorated and Mercerised Woven Fabric. BP Patent 240,378.
[327] Fairchild's Bulletin. (1924).Belfast- So many orders for dress linen from the US. Fairchild's Bulletin. August 1924. p.4.

for these goods were scarce.[328] The Stevenson devoré/ mercerisation technique was registered at a time when the linen textile industry was buoyant, orders for novel and decorative textiles were healthy and the industry required a quick and economic process of decorating linen textiles. The ingenuity of the Stevenson and Company devoré process lay in its simultaneous patterning and mercerisation, which addressed the issue of protracted manufacturing at the weaving stage.

To achieve the open work look within a fabric as suggested by the Stevenson and Wakefield patent in 1925, 'animal and vegetable' yarns were first woven together in an arrangement that allowed for the alkali for instance caustic soda (sodium hydroxide) or 'pot ash' to completely remove the animal fibres. The desired effect of the animal fibre destruction was the creation of a striped or checked open weave design in a fabric made entirely of vegetable threads, which were unharmed by the alkali treatment. Using woollen yarn as the animal thread and linen, cotton, ramie, jute or other vegetable threads for the body of the cloth, their specification describes the fabric being run by rollers through an alkaline bath at a temperature of about 180°F. The fabric was passed through this bath two or three times until the alkali soaked into the yarn, and then washed to remove surplus alkali and then placed in a weak acid bath (for example dilute hydrochloric acid or acetic acid) and well soured, i.e. neutralised to remove any residual alkali.[329] The fabric was then washed, squeezed and dried. The alkali treatment removed the animal threads, leaving the vegetable threads intact, and at the same time cleaning, softening and giving lustre to or mercerising the vegetable threads.[330] The washing essentially cleared away any loose, destroyed or partially destroyed threads and any chemical residue.

The process of mercerisation, a cotton and cotton blend fabric finishing technique that uses sodium hydroxide to alter fibre appearance and absorbency, also increases the strength of the cotton fibre by as much as 20 percent, while being both inexpensive and

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[328] Ibid.

[329] Soured, or souring, when washing a fabric with a dilute mineral acid to neutralize any residual alkali, in this instance caustic soda is neutralised in a weak acid bath of hydrochloric or acetic acid. See Collier &Tortora. (2001). p.405.

[330] Mercerisation, a 'process of treating cotton and linen yarns and fabrics with a solution of caustic alkali, generally caustic soda, which is sodium hydroxide. The fibres are swollen, and the strength and dye affinity are increased. The textile is generally held under tension to increase the lustre.' Refer to The Anstey Weston Guide to Textile Terms. (1997). Also see: Foltzer, J. (1928). Artificial Silk and its Manufacture. London: Sir Isaac Pitman & Sons, Ltd. Ch. 11, p2.

permanent.[331] The mercerisation of linen, while providing 'natural lustre and good strength' also improves 'dyeability' and the 'receptivity of linen to other finishes'.[332] Furthermore, the mercerisation of the cotton would result in cotton fabrics being made to look much like linen.[333] The completed textile would have appeared to be glossy, probably dyed, and depending upon the degree of wool fibre included within the original weave be gauze-like or open weave stripes and checks. As regards the intended product, all that the Stevenson patents states is that a great variety of ornamental patterns of the open-work type could be produced simultaneously with the mercerisation of the fabric.[334]

How the open work fabric appeared and what function it performed required the referencing of similar open weave cellulose fibre based fabrics of the period. The editors of Fairchild's Bulletin, of 1924 indicate possible usage for dress textiles. Lou Taylor writing of the hierarchy of fabrics notes open weave cellulose fabrics for fashion was 'seen as a merely practical summer fabric throughout the nineteenth and twentieth century.'[335] In a review of fabrics for the interior F. J. Ringo advised a casement cloth made of mercerised cotton, or glass curtains, a sheer curtain used to provide privacy and a screen from sunlight but not necessarily to darken a room, be prepared with a range of fabrics including dimity, lace, marquisette, muslin, net, pongee, scrim, swiss, or voile. In addition furniture covers and slip covers used to protect furniture with delicate upholstery or during the summer months could either be constructed of Belgian linen or cotton dimity, cretonne, chintz, cotton damask, plain or figured denim, or art linen.[336]

Of the vegetable yarns used in this mercerisation/woven devoré patent it is probable that linen made up the greater part of the weave. Irish Linen in the period of Stevenson and Wakefield's patent was considered to be of excellent quality, while Ringo acknowledged Irish linen as being 'famed everywhere', with flax made into yarn during this period not necessarily grown in Ireland but imported from other countries.[337]

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[331] Collier &Tortora. (2001). See Mercerization. p.405,406.
[332]Collier &Tortora. (2001). Ibid.
[333] Ringo, F. J. (1925) Linen and Bedding. New York: A. W. Shaw and Co. p.18.
[334] with reference to Stevenson and Wakefield, (1925). BP patent 240,378. Line 43.
[335] Schoeser. M, & Boydell, C. ed. (2002). Disentangling Textiles. London: Middlesex University Press. Taylor L. Decoding the Hierarchy of Fashion Textiles. p.69
[336] Ringo, F. J. (1925). Draperies. Chicago/ New York/London: A.W. Shaw Co. (Ltd). p.24. 'Dimity' when used for drapery differs from sheer cotton fabric, in that it is a heavy mercerised cloth in fancy weave, usually striped, used for slip covers and for hangings. Ibid. p.50.
[337] Ringo, F. J. (1925). Linen and Bedding. New York: A. W. Shaw and Co. p.91.

Prior to the First World War Russia produced the majority of the world's flax, with Germany also an important linen producer. Between the wars the chief nations in linen production were Ireland, Belgium, Scotland and France.[338]

In describing the Irish Linen Industry at this time William Carter, A Short History of the Linen Trade, recorded Stevenson and Son as having being in business as flax merchants since 1795. In addition Carter noted that 'In 1875 the weaving of linen was introduced by Stevensons at Moygashel Mills where also the processes of bleaching, dyeing and finishing were carried out.'[339] In 1937 the company expanded and allocated a large part of their production to spun rayon, however, prior to this date the linen trade appears to have been the focus of their manufacturing output.[340] Some twenty years after this mercerisation/ devoré technique was patented, so Harry Stevenson notes when he 'arrived on the scene' the technique described in this patent was no longer practiced. However, drawn thread effects created within a fabric by incorporating calcium alginate yarns that acted as provisional supports and which could be dissolved were in operation, (refer to chapter 5 and alginate yarn development), together with complicated twisted yarn manufacture produced using a 'carrier' yarn, possibly removed after finishing.[341]

In contrast to Stevenson and Wakefield's combined carbonising and mercerisation treatment, Hermann Müller (1926) assignor to AG Cilander of Herisau, Switzerland, patented a printed devoré technique indistinguishable in parts from Fulton's multi-coloured printed (alkali) devoré paisley fabric patent of 1908.[342] A. G. Cilander was established in 1814 under the name of Meyer & Mittelholzer. In 1873 it was converted to a public limited company (AG), and renamed AG Cilander in 1887. Although AG Cilander now has several manufacturing plants, the production centres in Glattbach (Herisau) where this patent originated and Isenhammer (Gossau) remain 'pride of place'

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[338] Ringo, F. J. (1925). Ibid.
[339] Carter, W. (1952). A Short History of The Linen Trade, Vol 2. From the Industrial revolution to the present Time. Belfast: H. R. Carter Publications Ltd. p.29.
[340] Through contact made with Harry Stevenson, a Textile Chemist and the nephew of Robert Stevenson, (aka 'The major', 1886-1960), it emerged Robert Stevenson was the Chairman of Stevenson & Son in the 1920's and William Wakefield was the dyer, shortly to be replaced by Dr M Eitel in the early 1930's. The Modern day company of Ulster Weavers purchased Moygashel Linen Mills in 2001. Visit [on line] Available from http://www.ulsterweavers.com/home.asp. [Accessed: 19 March, 2004]
[341] With thanks to Stevenson, H. (2004) [e-mail from Harry Stevenson. hfs@globalnet.co.uk. 27 April, 2004] who also studied Textile Chemistry at Manchester, and ironically did 'a lot of work to protect fibres, e.g. viscose, from the effects of mercerising, more a caustic shrinking than mercerising under tension.'
[342] Müller (1926/1928). US patent 1,660,042.

within the company.[343] Significantly, AG Cilander continues to produce pre-prepared specialist fabrics for devoré (chemical) embroidery manufacturing. According to their company web site 'this material is coveted above all in embroidery centres such as Spain, Portugal or Italy'. Their specially treated fabric is embroidered by their client manufacturers and then 'etched on afterwards', what remains following the chemical treatment is 'filigree embroidery work on a transparent back'. Company records in 2003 indicated AG Cilander processed a million meters of etched gauze for specialised embroidery enterprises based across Europe.[344]

The inclusion of Hermann Müller's patent within the woven history of devoré may therefore seem incongruous because of A. G. Cilander's connection with the chemical embroidery/ lace industry. However, close analysis of this particular invention reveals this 'method for producing pattern effects in fabrics' specification was directed towards woven textile ornamentation and figuration and not the creation of a removable ground fabric used within chemical embroidery manufacturing. Furthermore, the addition of stitching to the woven textile, a usual practise within the manufacture of chemical embroideries, is absent from the specification, although Müller declares within the opening lines of his US patent registration of 1926 that 'Pattern effects in the texture of fabrics are as a rule produced by embroidering smooth fabrics or by weaving so-called effect yarns into certain parts of the fabric during the manufacture of the later'.[345]

What this specific patent invention proposed was the creation of pattern effects in the texture of mixed fabrics composed of animal fibres (for instance silk) and of vegetable fibres (such as cotton) through the employment of an alkali that destroys the animal fibres of the mixed fabric but not the vegetable fibres. The composition of the vegetable and animal threads within a woven textile prepared for this treatment would according to Müller be contained in both the warp and weft or the animal fibres in the warp with the vegetable in the weft or vice versa. The actual style of the devoré textile was in

[343] Two businessmen from Herisau laid the foundations for the oldest textile company in Appenzell in 1814 when they established the firm Appretur Meyer & Mittelholzer. Laurenz Meyer and Johann Konrad Tribelhorn converted the private enterprise into a public limited company (AG) in 1873. It was renamed AG Cilander 14 years later. Nowadays, AG CILANDER boasts several production plants. Refer to Cilander home page. [online] Available from http:www.cilander.ch; go to history [19 March, 2004].
[344] 'Processing special fabrics for embroidery is extremely demanding. This material is coveted above all in embroidery centres such as Spain, Portugal or Italy. The specially prepared fabric is embroidered there and then "etched" on afterwards – what remains is filigree embroidery work on a transparent back. Cilander also masters this skill – the company processes a million metres of etched gauze for specialised embroidery enterprises throughout Europe'. Refer to Refer to Cilander home page. [online] Available from http:www.cilander.ch [19 March, 2004] and access product area and etched gauze.
[345] Müller, (1926/1928). US patent 1,660,042. Line 9-16.

effect dependent upon the arrangement of the differing fibres, their inclusion or 'binding' within the fabric and the nature of pattern designed to be printed.[346] As to the style of woven textile this process was designed for, at no point is it stated that this was a technique to be used upon pile fabrics, it was clearly intended to be employed on a plain woven textile.

Apart from the use of a plain weave, what characterises this particular devoré technique is the prominence given to the colouring of the fabric. Prior to the application of the alkali, and so that 'the most varied colour combinations can be obtained', the mixed fibre fabric could be dyed, possibly cross dyed, under go simple bleaching, or be coloured by printing or mordanting.[347] With the implied style of Müller's fabric being a sensitively figured weave of mixed colouring with areas of single colour threads or multicoloured fine gauze. Patterning created by printing imagery or a repeat design may have increased the colour range of both the etched areas and the remaining raised portions of weave. Accordingly, Müller recommended the manufacture of a woven fabric constructed of a warp of cotton and a weft of floret silk and cotton.[348] Once bleached and dried, an alkaline paste was printed onto selected areas of the fabric in a patterned design. After the print was dried the whole fabric was steamed, causing the alkaline to penetrate well into the silk. Both the alkaline paste together with the silk threads, damaged during the steaming, were subsequently removed by washing. Effectively, the area of etched print became the background to the remaining weave, serving as the area of pattern.

The printing of a design that called for a large amount of fibre removal, for instance a 'blotch style print', would result in a fine gauze fabric with areas of identifiable design or floating weave (the original full weave), similar to that suggested by Otto Timme (1901) and resembling a brocade styled textile with flowers or figures slightly raised from the background. Accordingly, Müller indicated the areas where silk and cotton remain 'form the patterns in the texture of the fabric'. As a footnote to this devoré process, Müller also declared 'effects' could also be achieved by removing the silk

[346] Binding. The manner in which the yarn is incorporated within the structure of the textile, i.e. the nature of the patterning.
[347] Mordanting. '*Mordants* react both with the dyestuff and the fiber to form a *colored lake*, an insoluble compound, thereby fixing the color within the fiber.' With reference to Collier & Tortora. (2001).
[348] Floret silk

yarns of the woven fabric by mordanting.[349] Mordant printing, with reference to Collier and Tortora (2001), was an inventive means of combining printing and dyeing to add colour designs directly onto fabrics. For instance, the fabric after being printed with a mordant is passed through a dye bath, whereupon the mordanted areas permanently absorb the dye, while the rest of the fabric has only a light dye saturation, which is impermanent, and can be rinsed away. A range of different printed chemical mordants could be used on the same fabric, in theory creating multicoloured patterning from a single colour dyebath.[350]

Amongst the woven devoré textiles manufactured by alkaline based techniques during the 1920's Henry Flory's 'Method and Chemical Mixture for Producing Brocaded Textiles' was exceptional for its decoration of pile woven textiles.[351] A pile textile having a cotton back or wool face such as corduroy, velvet or plush, was printed with a chemical to attack the wool but not the cotton.[352] Flory advised printing a devoré mixture, made up of 60 parts of 15% caustic soda solution, one part sulphuric acid and 140 parts of 10% gum arabic, selectively onto the pile face. The fabric was then run directly from the printing machine to a steaming chamber and steamed for 30 minutes, or until the printed pile disintegrated.[353] In the creation of a velour brocade fabric with a cotton backing (ground weave) and a wool pile a sharp line between the remaining pile and areas of the destroyed pile could be created as the "burning mixture" was designed to be contained in the area of print. The cotton ground weave was simultaneously strengthened by the chemical process and was tightened around the fibres of the unprinted pile, as with mercerisation and the plissé effect (a sodium hydroxide cotton fibre shrinking treatment). Dye could also be applied at the time of printing to 'serve as decoration for the reverse side of the textile in which case hangings, tapestries, and the like may be made which will not require lining.'[354]

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[349] Mordant: (Dyeing & Calico Printing) 'Any substance, as alum or copperas, which, having a twofold attraction for organic fibers and coloring matter, serves as a bond of union, and thus gives fixity to, or *bites in*, the dyes'. Refer to Webster's Dictionary of 1913 http://humanities.uchicago.edu/cgi-bin/WEBSTER.sh?WORD=mordant. [5 August, 2004].

[350] It is assumed Müller was suggesting an alkali mordent proven to destroy silk fibres be printed onto the fabric, which would destroy the silk fibres and permanently fix dye in the area of the remaining fibres. A multicoloured effect could be achieved if various coloured mordants were printed onto the fabric simultaneously to the (devoré) fibre etching mordant. See Collier & Tortora, (2001). p.430.

[351] Henry Flory, Hawthorn, New Jersey. (Application filed October 9, 1925, accepted January 10, 1928). Method and Chemical Mixture for Producing Brocaded Textiles. US patent 1,655,414.

[352] Applicable to fabrics of other combinations of backing and facing. Ibid.

[353] After steaming the cloth it is dried at 200°F. After drying the disintegrated fibres are brushed from the cloth then the fabric is washed and dried and where necessary brushed to bring up the fibres of the pile.

[354] Flory. (1925/1928). US patent 1,655,414. l. 87-90. Sodium hydroxide effect on cotton, refer to Collier and Tortora. (2001). With reference to mercerisation. p.405.

The reference Flory makes to the manufacture of a brocade textile, although practically a standard term to describe the devoré process in patents by this time, with reference to Bendure and Pfeiffer and 'brocaded velvet', its use in this instance describes a textile with raised pattern standing out from the background, or a surface difference in the pattern of the weave. Moreover, Emery observed the use of brocade as an identifying fabric name has been so indiscriminately applied that it has almost become a 'trade name' that identifies any style of patterned and figured fabric where the pattern is apparently 'woven in'.[355] Therefore in this instance the reference to a velour textile is thought to denote a heavy velvet or velveteen used for furnishings.

Furnishing weight velour fabrics were traditionally manufactured from cotton, however, in order for the devoré process to work successfully on a woven pile fabric Flory had to employ a mixed fibre fabric, in this instance cellulose and protein fibres.[356] With regard to velour fabrics of the period adjunct Professors of Home Economics at the University of Texas, Lucy Rathbone and Elizabeth Tarpley in their examination of Fabrics and Dress (1931), noted velour had become a popular upholstery fabric because of its 'pleasing appearance when new', although they warned velour fabric with a cotton pile a was prone to catching lint and dust, 'Velour made of linen is more durable than that made from silk, cotton or rayon; however, it is not as durable as having a wool pile.' [357]

It is feasible that Flory intended to use mohair for the pile yarn within his devoré fabric as its attractive lustre meant it was often employed in fine fabrics, for decorating textiles, and as a fancy yarn instead of silk. Mohair was also a standard yet traditional pile material during this period, whether used for plain, striped, i.e. cut or uncut pile weave, for heavier upholstery fabrics and hangings. [358] Its durability within an upholstery textile was as a result of the wiriness of the fibre which if crushed returned to its original state. Mohair plush in the 1920's tended to be made with a cut pile weave, and although regarded as an expensive fabric it was long-lasting and therefore commonly employed as an upholstery fabric in the automotive industry. [359] The cost of

[355] Emery, I. (1994). With reference to 'Brocade. Brocaded. Brocading. Brocatelle'. p.171. 'In many contexts the word *brocade* is used generically for richly patterned silk fabrics usually characterized by the use of gold or silver thread.'
[356] Miller, E. (1973). Textiles, Properties and Behaviour. London: B.T. Batsford Ltd. With reference to Velour. p.179.
[357] Rathbone &. Tarpley. (1931).
[358] Baldt, L. I. (1929). Clothing for Women, selection and construction, Philadelphia: J.B. Lippincott. Co. p.38. Also see: Georgievics, G. von. (1920). p.67.
[359] Rathbone and Tarpley. (1931). p.380.

using mohair as the pile fibre within an upholstery fabric could be considerably reduced by using a cotton ground weave, along with being a cheap addition it was also robust.[360] A reference made by B. S Hillman in 1937 as to the creation of an upholstery devoré fabric manufactured of a mohair pile and cotton backing (an imitation Jacquard mohair plush) further supports the theory that mohair was a suitable fibre for Flory's wool and cotton devoré process.[361] Of mohair plush decorative manufacturing Hillman noted 'Jacquard mohair plush is made very seldom, due in part to the much higher weaving cost of such fabrics. Jacquard effects may be obtained much more cheaply by printing the grey goods on the back with a paste containing caustic soda.'[362]

A further style of fabric considered suitable for devoré ornamentation by Flory was corduroy. Such a textile having a wool pile and cotton ground weave would have been particularly striking, especially if a colour was applied at the same time as devoré printing. Corduroy fabric, with its distinctive pile weave, during the 1920's was frequently manufactured with a wool pile, often mohair, and either a plain or twill ground weave depending upon the purpose of the textile, for instance men's dress (twill) or interiors (plain). Different depth and width of ribs were created, with thick set corduroy having eight to eleven cords per inch, fine from sixteen to twenty one per inch.

The removal of corduroy pile cords by the devoré process would have been exactly the same as for velvet pile, or velveteen fabric as the connection of the pile to the ground weave was in the equally vulnerable to an applied devoré treatment. Corduroy as an interior textile was used for bedspreads, draperies and upholstery, although its popularity as a dress textile was also in evidence the summer prior to Flory's patent registration. On show in Paris in 1924 'ribbed fabrics' were heavily featured in every silk collection and shown 'in all types from the finest faille ribs to corduroy and wide flay ribs', with a range of textile prints showing larger designs that were geometrical or enormous modern flowers.[363]

American wool manufacturing at the time of Flory's patent registration was undergoing severe depression, with 1924 declared the worst year for the woollen industry 'since the

[360] Miller, E. (1968). With reference to Pile fabrics. p97.
[361] Hillman, B. S. Soda Prints on Pile Fabrics. Rayon Textile Monthly. February 1937. p. 54 (94).
[362] Hillman. Rayon and Melliand Textile Monthly. April 1936. p. 63 (239).
[363] Fairchild's Bulletin. (1924) Paris silk notes. Fairchild's Bulletin. June 10 1924. p.3.

civil war'.[364] A protectionist attitude amongst American wool pile manufacturers prevailed. Five months prior to Flory registering his devoré patent, Fairchild's Bulletin of 25th May 1925, informed UK manufacturers that cheap imports of 'foreign pile fabrics in America', was of foremost concern in the USA. Fairchild's New York reporter notified the British Textile trade that 'The Treasury Department has been asked by domestic manufacturers to investigate the low prices of imported cotton and silk wool pile fabrics.'[365] Concurrently the changes in fashion affected the popularity of wool within knitwear resulting in wool yarn being replaced by silk and artificial silks. The prospect of manufacturing artificial wool, a process to be devised by A. Pellerin that would make use of the large quantities of cellulose waste, was not far away. Wool goods in Britain were also in decline, a result of the self-sufficiency of consuming countries.[366]

Flory's interior wool devoré fabric was developed at a time when a variety of woollen textiles were required to entice American consumers to buy 'American made'. Tariffs on the importation and exportation of textile goods although stringently applied by US Customs were not only the prerogative of America. Britain imposed duties on imported artificial silk and products containing the material, protecting companies such as Courtaulds Ltd., who in 1927 manufactured 80% of UK's overall production.[367] German textile manufacturers and retailers, increasingly vulnerable to insolvency, imported cheaper French goods and resold them to foreign customers as their own products in an effort to retain export markets and vital foreign currency. Austrian and Czechoslovakian importers emulating Germany's import export practices soon began to lose the confidence of foreign textile buyers. With the appreciation of the Franc in May 1924 mass cancellations of French apparel and textiles orders resulted in the establishment of the Comite Central de La Laine, which sent out delegates to sue defaulting European companies. Anxious European exporters sought other ingenious ways in which to avoid paying duty on goods imported into America, for instance the creation of detachable embroidery, imported separately from its designated garment was

[364] Fairchild's Bulletin. (1925). Anglo American Woollen Situation. Fairchild's Bulletin. February 13 1925.
[365] Fairchild's Bulletin. (1925). Foreign Pile Fabrics in America. Fairchild's Bulletin. May 25 1925. p.4.
[366] Great Britain. Parliament. Board of Trade Committee. (1928). Survey of textile industries. (vi 328).
[367] Ibid.

then reattached once through customs, thus avoiding the costly US silk embroidery tariff on embroidered dress goods.[368]

Soda Printing and cellulose fibre devoré.

Of the cellulose fibre destruction devoré techniques registered during the 1920's Ernest Cadgène and Jules Jeandros 1924 process (New Jersey, USA) entitled 'Soda-Print Process' (USA), or 'Improvements Relating to the Production of Brocaded Effects on Fabrics', (GB) was possibly one of the first to mention cellulose acetate as a fibre suitable for use within a devoré treated textile. The emphasis of this soda print devoré technique was the initial protection of vulnerable cellulose fibres, either prior to their inclusion or as part of the weave, while also trying to adapt and improve upon decorative cotton devoré processes developed prior to the First World War.[369] This Cadgène and Jeandros patent was in effect a total reverse process of Giesler's devoré technique of 1914.

Where Giesler had proposed pre-treating threads with a carbonising chemical and applying a neutralising chemical to areas of weave to be retained, Cadgène and Jeandros advocated fibre neutralisation prior to the devoré printing of the fabric. In the creation of multi-coloured 'brocade' styled textiles the Cadgène and Jeandros process employed colour printed resists with the intention of both colouring the fabric and neutralising the devoré agent. The visual effect of such a textile would have been highly decorative with Cadgène and Jeandros describing coloured ornamental designs being applied to a pre-dyed fabric, creating a simulated brocade textile with elements of figuration and ornamentation seemingly created by weaving.

The Cadgène and Jeandros technique of ornamenting woven fabrics by means of a printed chemical that destroyed one fibre type but left another type unharmed was by the mid 1920's, according to Ernest Cadgène and Jules Jeandros, generally referred to in the textiles industry as the "soda print" process, a term indicative of the devoré chemical, in this instance soda alum (aluminium sulphate). While this devoré process

[368] With reference to Fairchild's Bulletin between January 1924 – December 1929, and also BP. Parliament. Board of Trade reports on Textiles and associated manufacturing, including lace and embroidery, 1921-1928.
[369] Ernest Cadgène and Jules Jeandros, Patterson, New Jersey, Jeandros assignor to Cadgène. (Application filed February 15, 1924. Accepted October 28, 1924). Soda-Print Process. US patent 1,513,370.

could be used to create 'very beautiful and effective designs', it had, prior to their suggested improvements of 1924, been limited to solid colour effects or two colour effects by cross-dyeing, possibly a reference to the Otto Timme and William Fulton processes of the previous decade. The employment of 'undestroyed' and reserved figures and designs, while also used as a means combining fibre destruction with colour registration and known for some time, had proven to be unsuccessful as it was 'practically impossible to secure a proper registration of the soda print design with the regular color print and to produce a commercially practical product', while the combining of a devoré and colour print was likely to result in the colour running (refer to Timme 1901/1902) and a print with imprecise areas of colour print and fibre removal.[370]

To compensate for the unsatisfactory manufacture and subsequent appearance of the earlier devoré prints Cadgène and Jeandros proposed a method of devoré printing that refined the 'well-known' soda print process (thought to refer to cotton fibre destruction using aluminium sulphate or soda alum and not caustic soda devoré) by making use of a 'resist composition'. By combining the print colour for the ground weave with a colourless paste to form a resist paste, the chemical destruction of the fibres would be confined to those areas of unprotected weave. In effect the resist composition created a protective coating over the reserve portions of the fabric. When the devoré chemical was applied, the resist composition would have had a neutralising effect protecting the reserved ground weave.[371]

The devoré chemical was printed over the entire surface of the pre-dyed woven fabric using a padding roller which was 'covered with mille points or as commonly termed in the art "petit points".' The fabric was then passed through a dry box to accelerate carbonisation of the resist free threads, which once destroyed at the point of 'binding' on the foundation weave, fell away or were removed by carding or brushing. The remaining resistant threads were then neutralized when the fabric was washed.

[370] Cadgène and Jeandros. (1924). US patent 1513370, 1924). p.2, lines 29-33.
[371] The ingredients of the resist composition could be altered to work with varying types of chemical devoré agent, however Cadgène and Jeandros provided a basic recipe for the resist composition, suggesting a gum arabic printing colour of any desired shade be mixed with 25% blood albumen, 7% chromium acetate and 5 % sodium acetate. The inclusion of albumen within the paste assisted the coagulation of the compound and formed a waterproofing for the printed colours. The chromium acetate also aided the waterproofing effect and helped fix the colours, while the sodium acetate protected the printed parts by neutralizing the burning effects of the aluminium compounds.

The woven fabrics used in association with this Cadgène and Jeandros devoré technique were either constructed of chemically diverse fibres, one for the foundation weave and one suitable for destruction, for instance, animal fibres such as natural silk, vegetable fibres such as cotton and artificial silks, or a single fibre type such as cotton. For the single fibre fabric devoré to work successfully the fibre used for the foundation weave had to be treated with a 'protective chemical' prior to fabric construction. Essentially the chemical used to pre-treat the foundation thread neutralized the effect of the devoré chemical in the areas of weave where the resist composition had not been applied, consequently a fabric constructed solely of a cotton fibre could undergo the cotton fibre devoré if protected by the resist, therefore woven fabrics made solely of cotton were employable with a cotton devoré process.

Cadgène and Jeandros anticipated this particular devoré process being used on plain cotton fabrics in which the whole fabric or just the foundation or the 'covering' was constructed of mercerised fibres in imitation of silk, and fabrics made partially or wholly from artificial silks, 'acetylated cellulose or otherwise'.[372] The significance of this reference to acetylated cellulose or cellulose acetate as a fibre considered suitable for use in a fabric treated by the soda print process should also be highlighted. Acetate rayon filament manufacture was still in its infancy in the early 1920's. As a fibre it was to undergo considerable commercial development by its primary commercial manufacturers British and American Celanese during the remainder of the decade. However, the Cadgène and Jeandros patent while predating the British Celanese cellulose acetate pile fabric devoré process by only a few months was ostensibly used as a resistant fibre within the woven textile, whereas Camille Dreyfus aimed to destroy cellulose acetate pile by printing a devoré chemical.

The finished structural style of the textile, after colouring and devoré was completed, would have closely resembled a figured textile created purely by weaving, with the registration of the reserve weave and the devoré foundation weave closely aligned. The sharpness of the line that separated the colour print and devoré edge would have been as fine as the printed image would allow, while this style of resist printing would also have allowed for the slenderest of weave to be reserved, so a fine line stem of a flower or similar line design would have been attainable. Other forms of detailed design or

[372] Refer to Emery, I. (1994) and Compound weaves: supplementary sets. p.143.

intricate patterning were similarly feasible with this method of devoré printing, however, the nature of the weave would have dictated the fabrics overall appearance, for instance a finer weave would have created an extremely lightweight textile once the areas of unreserved weave were destroyed. The use of the process in conjunction with pile fabrics although feasible was unlikely, furthermore, no reference was made toward the use of pile fabrics within any part of the patent specification. [373]

If these textiles were to be worn it is possible they were printed with bright colour and would have reflected the ready made dress trends of the period.[374] However, prominent within the spring time dress collections exhibited in Paris during 1924, was the bold use of colour, black for the day and white for the evening, with an accent of lacquer red, a distinct novelty shade. Patterning either reflected the influence of the orient, with emphasis placed on Chinese embroideries, or were mediaeval inspired. While cut out hem lines were also a popular note of the spring collections. Tunic dresses, or the 'Tunic Jumper' as advertised in Weldon's Ladies' Journal, commonly incorporated highly decorative brocades with all over pattern in multiple colours, whereas interior fabrics were often beautifully coloured with large scale printed florals in repeat, printed onto cotton or cotton mixtures for draperies and upholstery.[375]

In contrast to the Cadgène and Jeandros process, Heberlein and Co., according to J. T. Marsh (1947), were involved in the manufacture of 'Lace Effects' on fabrics by employing the properties of alkali sensitivity and denitrification.[376] Heberlein and Co., of Watwill, St Gall, Switzerland, dyers and finishers were forerunners in the creation of highly specialised finishes for cotton goods. In 1915 they registered a parchmentising or 'Transparent' process for organdy, which used successive treatment of acid and alkali treatments to selectively create transparent patterning on cotton weaves.[377] Their

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[373] Possibly because of the difficulty in ensuring the neutralising colour permeated the whole area of pile, while remaining in the area of print.

[374] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. 'Ready to Wear' was the term applied to off the peg clothing in the 1920's and should not be confused with the concepts of Prêt a Porter of the 1960's.

[375] See Fairchild's Bulletin. (1924). Paris Couture Openings. February, 1924 . p.3, and an Advert in Weldon's Ladies' Journal. (1925). How to save on your Winter Garments, Robinson Brown of Macclesfield. Weldon's Ladies' Journal. December 1925. p.1.

[376] Marsh, J. T. (1947). With reference to Lace effects. p.332.

[377] Wool-like effects could also be achieved on fabrics. With reference to Ferrière, M. T. (1953). Swiss Textiles. Leigh on Sea: F. Lewis Publishers Ltd. p.13; See Heberlein & Co. A.G. Watwill, Switzerland. (Application date May 1, 1916, accepted September 7, 1916, In Germany May 19, 1915) A process for Imparting Various Novel Effects to Cotton Fabrics. BP 100,483. Note: A. G. Cilander also registered a parchmentising process in 1916, which actually included details of how to employ the parchmentising process in the production of 'pattern effects', with reference to A.G. Cilander,

patenting of woven devoré treatments was established a year earlier in 1914 in association with Henry Giesler, whose process advocated the inclusion of pre-prepared coated threads (with sulphuric acid) within the structure of a woven textile during manufacture. Areas of the textile were then neutralised with a printed alkali agent, and heated to a temperature to carbonise the remaining acidulated threads.[378] Some ten years after this Giesler patent, Albert Bodmer assignor to Heberlein and Co., declared the earlier process prone to commercial difficulties, as the yarns when treated with sulphuric acid were partially destroyed by the drying. To compensate for the fibre destruction the yarns were dried at lower temperature in an endeavour to reduce damage, however, fibre loss still occurred. Further yarn wastage, a result of moisture getting into the yarns whilst in transmission from the spinning mill to the weaving mill, was also cited, while the earlier method of carbonisation necessitated a beating machine to remove the carbonized fibres, a process that was likely to have stressed or shirred areas of the weave.

To compensate for these manufacturing difficulties Heberlein/ Bodmer in their 1926 patent suggested the construction of a fabric with a groundwork of cotton or other 'cellulosic matter', including artificial silk, and have nitrated cotton threads interwoven in the warp, weft, alternate singly, or in numbers with the untreated threads, or twisted with the unnitrated foundation threads.[379] A relatively thick alkaline solution (sodium hydroxide) applied to the fabric in the form of a printed design, then dissolved or decomposed the nitrated threads locally, a process accelerated by steaming or with dry heat. Washing the entire fabric finally removed the attacked nitrated threads. Accordingly, the treated fabric would have shown areas of full weave, what Bodmer referred to as 'dense patterning' on a lightweight ground or foundation fabric, essentially a 'raised pattern effect on the foundation'.[380] J. T. Marsh when writing about the technique in 1947 declared 'Some interesting and spectacular effects have been produced in this manner', while also suggesting the process could be considered the basis of the "Hetex" products. Heberlein in publishing their commemorative book

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Herisau, Switzerland. (Application date July 6, 1916, accepted January 25, 1917). Improved Manufacture of Cotton Fabrics. BP 103,432.

[378] Refer to H. Giesler (1914/1915 and in US 1922) BP 10,867.

[379] Refer to Albert Bodmer assignor to Heberlein and Co., Watwill, Switzerland, (Application filed November 27, 1926, accepted October 23, 1928; in Germany, December 5, 1925). Fabric Making. US patent 1,688,798.

[380] Ibid. (1926).

surveying the history of the company, 1835 to 1960, included an example of a Hetex fine cotton fabric from the 1930's, see Fig 24.[381]

Bodmer considered this new devoré technique to be 'much more reliable, and avoids the losses under the old process.'[382] The nitration of the threads did not have to be very strong, even nitric acid alone, without the aid of the sulphuric acid, would be sufficient for the process to work. After applying the devoré treatment the remaining nitrated threads were denitrated, removing the possibility of further fibre destruction in the areas of untreated weave but also because the denitration made the finished material insensitive to alkalies and more receptive to dyeing.[383]

As an alternative to this printed alkali process a resist could be printed on to the fabric 'immunising' the nitrated fibres. The fabric was then to be passed through an alkali solution where the remaining nitrated treads would be destroyed. By printing the resist in a patterned design the neutralised areas now inert, would make up the raised pattern of the fabric, in effect the resist print would retain the patterned full weave, in direct contrast to the printed alkali process whereby the printed area became the foundation weave.[384] The style of the fabrics created by these processes, although described by Marsh as lace effects, were likely to have been delicately etched lightweight cottons with quite subtle change in fibre height and weave density between the etched and full weave areas, while most likely to have been white or lightly coloured, although this theory requires further investigation. While this style of fabric was created in a similar fashion to chemical embroidery where a woven ground was stitched and then removed by carbonising, unlike chemical embroidery the ground weave in this instance was retained, and was most likely plain woven in style.

This Heberlein technique was clearly aimed at creating a textile that evoked the decorative style of lace or embroidery fabrics, where a lace toile, 'the heavy filling or design of a lace motif in contradistinction to the background' was imitated by the

[381] Marsh. (1947). With reference to Lace Effects. p. 332,333; Heberlein and Company. A.G. (1960). Heberlein 1835 to 1960. Watwill, Schweiz: Heberlein and Company. A.G. p.37.
[382] Bodmer/ Heberlein. (1926/1928). US patent 1,688,798. line 39-41.
[383] Ibid. line 56-76.
[384] The same result can be achieved but in a less satisfactory manner by printing a denitrating agent on the fabric according to a predetermined design thereby rendering portions of the nitrated threads inert to the alkali and then passing the fabric through the alkali solution whereby only the portions of the nitrated threads which have not been denitrated are destroyed.

remaining full weave, and the sheer netting was open styled.[385] A lace styled fabric with an all over small scale pattern would probably have been regarded as a novelty textile. Its use as a dress textile was most likely to have been for evening wear, for instance layered skirts or insets, and may have been incorporated within day wear and used as trimming for skirt panels, sleeve details, or as an inset within a deep v neck.[386] Heberlein's parchmentized fabrics were popularly known as 'Swiss' (confusingly similar to La Suisse or swiss chemical laces) and were recognised for their sheer, crisp cotton fabric with dots or figured embroideries, used for dresses, blouses, and the like.[387] Weldon's Ladies Journal in January and December issues 1926 gave the home dress maker two examples of lace usage in dress. The first 'evening frock' demonstrated layered lace and chiffon creating a pretty skirt and tunic, see Fig 25, while the second 'frock' designed to be warn by the older woman suggested using Nottingham appliqué lace for the trimming; the flared godets at the front and back and deep V-neck, see Fig 26.

In 1936 Georges and Georg Heberlein proposed this Bodmer fabric could be further enhanced by a transparentizing treatment, in effect making the outlines of the dense patterned areas become more prominent ' thus giving these areas a more realistic appearance of embroidery', but also causing the denser areas of weave to become stiffer than the background weave.[388] Contemporary woven devoré fabrics created from cotton and polyester later supplanted this style of transparent and denser weave textile by using polyester fibre for transparency in the areas of cotton fibre destruction, see Fig 27.

Regenerated cellulose devoré techniques.

The initial use of the viscose fibre as a novelty yarn to be incorporated within traditional woven textiles to act as an 'embellishment of other fibres', remained a popular trend during the 1920's.[389] As viscose filament became more frequently mixed with silks, cottons, wools and metallic threads in union fabrics for dress and the interior, or wherever artificial silk could be incorporated within traditional woven textiles, the range

[385] Linton, & Pizzuto. (1961). p.54.
[386] Weldon's Ladies' Journal, (1926). With the Season's Greetings and All Good Wishes. Weldon's Ladies' Journal. December 1926. issue no 570.p 1.
[387] Baldt. (1929). With reference to 'Swiss'. p.40.
[388] Georges Heberlein & Georg Heberlein, Watwill, St Gallen, Switzerland, (Application filed August 26, 1937, in Germany September 3, 1936, accepted USA September 12, 1939). Patterned Fabric and the Process of producing the same. US patent 2,172,443.
[389] Baldt. (1929). With reference to 'Rayon.' p.47.

of textile suitable for woven devoré treatments predictably increased. While in the early part of the twentieth century viscose had been used sparingly as a decorative yarn, its use within the 1920's became more pervasive, in part because the cost of its manufacture considerably reduced, but also because the quality of the filament, and its dyeing and weaving techniques were significantly improved. The extent of viscose filament use was apparent across the whole textiles industry, for instance Irish tweeds and homespuns in the winter of 1926 were constructed with stripe effects of artificial silk 'in bright contrasting colours, such as sky, salmon pink, cerise or emerald green',[390] topcoats of wool and rayon were shown by Lebouvier in the Paris collections of spring 1925, and six months later in the autumn winter collections artificial silk pannes and other rayon mixtures were also publicised. When incorporated within interior textiles it was often considered a substitution for mercerised fibres, and was customarily woven in association with silk for cut pile weaves. However, its employment as a fibre for artificial fur fabrics is where the devoré process and artificial silk was combined to create a rather eccentric product. Considering the devoré fabrics previous market trend directed development, the use of the devoré process in the creation of an imitative fur textile was perhaps to be expected.

Imitation fur was developed in response to the huge popularity of real fur products within Paris fashions. Dress textiles made of fur or embellished with fur were highly regarded by the Parisian Couturier, ultimately becoming a staple addition to the wardrobe of the 1920's fashion conscious consumer. Although fur goods had been available to the British consumer from the late 1880's onwards, as many leading drapery stores had fur departments, the popular use of fur within dress in the 1920's can in part be attributed to trends in Parisian couture of the early part of the decade. Russian émigrés having fled the Bolshevik revolution of 1917 had settled in Paris, and typically educated, upper class, bourgeoisie or from a skilled background, established fashion houses whose skilled workers brought embroidery and dress making expertise to Paris couture. Once established the Russian led couturiers introduced their homelands traditional fabric usage of fur combined with fabric to Parisian couture fashion. Consequently, an extensive range of fur was employed within dress during the mid 1920's, and was most evident during the autumn/ winter collections, when coats, wraps and dresses could be wholly made of pelts or trimmed with furs of any colour and

[390] Fairchild's Bulletin. (1925). Novelty Predominates in Irish Tweeds. Fairchild's Bulletin. November 23 1925. p.3.

texture, although evening dress was more widely accentuated by the addition of fur trim throughout the year, as were accessories such as fur capes and stoles.

For the ready made clothing manufacturer of the 1920's to be able to reflect current couture dress trends and provide the less wealthy consumer with an affordable form of the season's fashions imitation furs were considered a viable alternative.[391] The continuing advancement of simulated fur manufacture, started in the mid nineteenth century, was boosted in the early 1920's by the rapid development and consequent availability of artificial silks. Pile fabric manufacturers, who earlier in the 1880's had initially appreciated the potential of creating imitation fur fabrics, also recognised the potential of using artificial silks such as viscose in the manufacture of pile fabrics, a trend that further advanced the development of artificial fibres for apparel.[392] With the association between pile fabric and devoré manufacturing becoming established by the mid 1920's and evidence of a massive increase in pile fabric manufacturing during this decade it was somewhat inevitable that the woven devoré process was used in the manufacture of imitation fur textiles.

By the latter part of the decade it was apparent that imitation fur products had a receptive dress market. Reporting from London in October 1928, Fairchild's Bulletin announced 'Imitation fur fabrics are expected to have a vogue for women's spring coatings, following on the popularity which has been accorded them by wholesale London makers-up for the winter. Some of the new artificial silk pile fabrics show a futuristic trend in the new designs, and have been produced in light spring weightings. America has also shown an increasing interest in these fabrics during the past few weeks, and manufacturers who have recently returned from America feel that there is a ready market for their merchandise on the other side.'[393]

Sidney Blumenthal and Co. Inc. of 4th Avenue New York, 1924, assignees to Samuel Creasey Manufacturer, registered what is thought to be the only imitation fur manufacturing process using a devoré process to simulate the well-known 'fur blankets'

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[391] With reference to American ready-to-wear clothing trade and Fairchild's Bulletin. (1925). American Men's Clothing for England. Fairchild's Bulletin. January 19, 1925. 'Ready to Wear' was the term applied to off the peg clothing in the 1920's and should not be confused with Prêt a Porter of the 1960's.
[392] See Adburgham, A. (1964). Shops and Shopping 1810-1914. London: Allen and Unwin and Ewing, E. (1981). Fur in Dress. London: B. T. Batsford.
[393] Fairchild's Bulletin. (1928). Futuristic Designs in Fur Fabrics. Fairchild's Bulletin. October 22 1928. p.3.

sold by furriers to garment manufacturers.[394] The term fur blanket, or 'plates' as described by the BFTA, were most commonly of 'musquash, mole, ermine, weasel and squirrel.' These plates are usually between 5 to 6 pelts high and measure approximately 120 cm x (up to) 3m wide, were then used by manufacturers to produce coats and trims. Andrea Martin of the BFTA declared the reason for producing such plates is that 'it is easier to lay garment patterns onto them and there is less waste of the fur.'[395]

The manufacturing aims of the Blumenthal Creasey patent were firstly to produce a textile that had the appearance of multiple pelts sewn together, but also create a continuous piece of textile that gave the appearance of a fur blanket or plate, a product then sold by the yard or square. Moreover, to ensure their woven textile looked as if it had fur hairs firmly embodied in the back of the fabric 'projecting therefrom as animal hairs, do from a skin, with demarcation between the different pelts', a pile fabric was selectively devoré printed to show a permanent demarcation in pelt outline on a continuous length of fabric.[396]

In order to carry out the invention Blumenthal advised careful selection of a suitable yarn for the pile of the fabric. Contingent on the nature of animal pelt to be simulated 'the finer silk would be used for some animals, the glossy artificial silk for other animals, and mohair and other fibres for simulating other animals.' To emphasize the feel of the original Blumenthal declared 'We select the yarn for the back of the goods and arrange the number of picks in keeping with the yarn selected to simulate the fur of the animal.'[397] After the weaving the pile fabric, areas of pile fibre in the so called 'peripheral outline' were removed by shearing or chemically etching a design, representative of the linear design created as a consequence of multiple animal pelts being adjoined, on the back of the cloth 'said method of removing pile being also well known to those skilled in the art of manufacturing pile fabrics but not having previously been applied to the manufacture of simulated furs as specified in this invention.'[398]

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[394] Sidney Blumenthal and Co., Inc., New York, assignees of Samuel Eliot, Massachusetts, Improvement in Pile Fabrics to Simulate Fur Blankets and in the Method of Producing the Same, (BP patent 238,139, application date February 11, 1925, accepted August 13, 1925, US August 27, 1924).
[395] With thanks to Martin, A. British Fur Trade Association. (2004) [e-mail from Andrea Martin e-mail address .com, 1 August, 2004].
[396] Blumenthal/ Creasey. (1925). BP patent 238,139. p.1, line 43-45.
[397] Ibid. p.1, line 76-87.
[398] Ibid. p.2, line 24-29.

The colouring of this artificial pelt fabric could further aid in the overall imitation, as the natural patterning of a real animal pelt could be recreated by using dyeing, printing or bleaching. Alternatively 'fanciful designs' could also be added to the woven fabric, thought to be bold animal style prints or other decorative patterning. From Blumenthal's description it is easy to envisage how this technique would have been implemented, the scale of the devoré or sheared designed was dictated by the style of the real pieced pelts. Accompanying illustrations of a pelt design were included within Blumenthal/ Creasey's British patent registration of February 1925. The bold dramatic design is instantly recognisable for its beaver skin influence, see Fig 28. This multiple arrangement of pelts was a popular style in 1924, with similar multiple pelt designs prominent within The American Album of Fur Novelties.[399] The description 'Youthful and snappy' is applied to a tailored patchwork style jacket of silver muskrat manufactured by Krukal and Krukal inc., advertised in June, 1924, see Fig. 29. While moleskin appear to have been truly popular as a fur throughout the year, with the tiny pelts stitched en masse (purportedly in a fur blanket) and used for long coats, hip length coats, 'tailored jacquette', topcoats, evening wear capes or scarves. [400]

The figuring of pile fabrics as a means of imitating fur did not automatically imply the manufacture of a cheap replica fabric. Imitation in this instance was used because full fur garments were still relatively prohibitive in regards to cost for many consumers. The most expensive fur coats in the Sears, Roebuck and Co. of Chicago, USA, mail order catalogue of 1919 were Hudson seal coats retailing at $420.00 to $500.00, and Nearseal coats and capes from $240.00 to $270.00.[401] Using a dollar price equivalent index these goods would cost between 2500.00 and 5500.00 to purchase in 2003.[402] The Sears catalogue in the early 1920's still advertised merchandise at a range of prices, and although by 1925 it had considerably reduced its product range to low priced

[399] Published by the American Fashion Company, with branch offices throughout North America and Europe, notably in the major Fur industry countries, such as Germany, Canada, Italy, etc.
[400] See American Album of Fur Novelties, (1924/1925). American Album of Fur Novelties. January – December 1924. And tailored jacquette, with reference to American Album of Fur Novelties, (1924). American Album of Fur Novelties. November, 1924. p.21.
[401] Blum, S. (1981). Everyday Fashions of the Twenties, as pictured in Sears and Other Sears, Roebuck and Co., Chicago, 1919 Catalogs. New York: Dover Publications Inc. p.5.
[402] McCusker, J. J. (2004). Economic History Services. Comparing the Purchasing Power of Money in the US (or Colonies) from 1665 to Any Other Year Including the Present. [online] Available from University of Miami & WakeForest University, http//www.eh.net/hmlt/ppowereusd/. ("purchase power" ©2004EH.NET) Accordingly the purchase power of $500 in 1919 is the equivalent of spending $5315.56 in 2003, while $270 in 1919 is the equivalent of spending $2870.40 in 2003.

merchandise, throughout the decade the majority of fur goods were to be found as trim on dresses or coats, or as full scarves and smaller accessories.

The use of fine silks and wools and artificial silk for the pile of the fabric by Blumenthal and Creasey suggests their textile was most probably used for full garments possibly even trimmed with real fur. If manufactured from good quality silk, wool, or artificial silk, the flexibility of their technique would have allowed for a range of imitation fur style products/ garments although at affordable prices.

It seems likely imitation furs such as Blumenthal and Creasey's devoré textile was used as trimming or decoration on dresses or wool coats. Piece goods and accessories made of real fur were popular accessories during the mid 1920's. However, the cost of using these furs within dress was dependent on the source of the animal pelts. Consequently pelts obtained by farming, such as the Karakul sheep from Texas in the USA were frequently cheaper to purchase than wild trapped animals, however, for the middle market range of clothing and ready to wear fashions real furs were still often prohibitive for use in an entire garment.[403] Alison Adburgham in her review of Shops and Shopping 1810-1914 (1964) considered the fashion for the whole animal 'heads, tails, and paws' within garments may have instigated the beginning of the 'anti-fur movement', however, the greatest incentive for manufacturing imitation fur cloth towards the end of the nineteenth century according to Adburgham 'was, and still is, to produce cheap 'fur' coats.'[404]

The use of a pile fabric as an imitation fur fabric is of particular importance when considering the breadth of employment of the woven devoré technique. Moreover, it is plausible other decorative fur products could have been imitated by the woven devoré technique, possibly in combination with other pile woven textiles. In the mid to late 1920's, fur was readily used in conjunction with luxurious and decorative woven fabrics, such as velvets, satin and lamé mixed fabrics, for instance Bianchini Férier. Of the winter collections of 1927, B. Altman and Company, New York announced 'wraps of fur and metal cloth take evening precedence'.[405] The Louiseboulanger collection

[403] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. 'Ready to Wear' was the term applied by the fashion industry to off the peg clothing in America in the 1920's and should not be confused with the concepts of Prêt a Porter of the 1960's.
[404] Adburgham, A. (1964). Shops and Shopping 1810-1914. London: Allen and Unwin. p.214.
[405] B. Altman, Co. 5th Avenue, New York, advertisement in Vogue N.Y. (1927) Vogue. November 1927. p.8, 9.

combined brown velvet with fox for coats, imported into New York by Lord and Taylor, while Molyneux used dark brocade in brown, black and green with dark mink.[406] Vogue New York accordingly readers advised 'Evening wraps are opulent. Fabric, fur, fullness give an air of great luxuriousness. Cape effects, large collars and huge cuffs are chic.' While in previous seasons fur was equally prominent within fashion retailer's collections.[407] For the winter of 1926 Jay Thorpe inc. 57th Street West, New York advertised 'The most formal and luxurious phase of the mode–evening attire–is cloaked with fitting splendor in evening wraps by Jay Thorpe.[408] The breadth of furs used within garments was by the latter part of the decade was remarkable and consequently the range of imitation furs was equally illimitable. Clearly, the use of the woven devoré technique as a means to manufacture imitation fur requires further investigation, in particular the relationship between the pile fabric manufacturer and imitation fur manufacturer.

An alternative to Blumenthal and Creasey's pile fabric devoré process registered in 1924, Camille Dreyfus, Robert Dort and Herbert Platt, Celanese Corporation of America, suggested cellulose fibres or 'reconstituted cellulose', or rayon (viscose) could be destroyed within a woven, knitted or netted fabric, also constructed of 'non-carbonizable fibres of organic derivatives of cellulose, such as cellulose acetate, cellulose formate, etc, with the aim of producing a fabric with novel decorative 'lace effects'.[409] In the Spirit of the Giesler/ Heberlein patent of 1914 and Bodmer/ Heberlein 1926 process, Celanese updated the fibre content of these former lace effect devoré fabrics, by advocating the use of cellulose acetate filament within the devoré fabric structure, with the consequence that it became the predominant fibre within the finished textile. In their 1928 patent (although this was later divided but largely unaltered), Dreyfus, Dort and Platt proposed the application of the carbonising solution, aluminium chloride or hydrochloric acid for when cellulose acetate was present and sulphuric or sodium or potassium acid sulphate may be employed when silk and wool were employed, be applied by either dipping or immersing the fabric in a bath or by padding, also by spraying or in a printed paste mixed with a thickening agent. The devoré

[406] Vogue, N. Y. (1927). Paris Fashions Number. Vogue. October 15th 1927. p.71.
[407] Ibid.
[408] Jay Thorpe inc. 57th st. west, NYC as advertised in Vogue, N. Y. (1926) Vogue. November 1st -15th 1926.
[409] C Dreyfus, Dort, Platt, (1928/1931) US patent 1,834,339. Also cellulose formate, cellulose proportionate and cellulose butyrate or cellulose ethers such as methyl cellulose, ethyl cellulose or benzyl cellulose.

technique they devised for use in conjunction with derivatives of cellulose filament had three applications, which created three very different textile products.[410]

Notably, the first application was the manufacture of a "spun" yarn made of cellulose acetate, or other organic derivative of cellulose.[411] Reminiscent of Louis Chaux's short-staple fibre invention of 1883, the creation of a yarn of short lengths of cellulose acetate filaments was according to Dreyfus, Dort and Platt, previously unworkable because of the lack of cohesion between the filaments or the fibres of cellulose acetate. Hottenroth (1928) noted the use of better quality artificial silk waste of relatively long-stapled waste being spun either alone or together with cotton, wool, ramie fibre, etc. [412]

The "spun" yarn consisting wholly of cellulose acetate staples was prepared by spinning a mixture of the short cellulose acetate staples with a provisional supporting vegetable fibre such as cotton, linen or viscose. Where this Celanese technique clearly differed from Chaux's technique was at the stage of the provisional fibre removal. In this instance the supporting yarn was carbonised prior to inclusion within a constructed textile, consequently a "spun" yarn consisting wholly of short staples of cellulose acetate fibres could be used in a range of constructed textiles, either on its own or in a mixture.

The inclusion of animal fibre, for instance silk, within the yarn prior to carbonising was also suggested, however, once spun with the cellulose acetate and cotton fibres it would have remained a permanent constituent of the yarn and therefore the fabric due to its resistance to the carbonising treatment. In 1928, in the third edition of the Artificial Silk Handbook, the editors of the Silk Journal reported the introduction of the staple artificial fibre had given a new direction to the artificial spun silk trade. Furthermore, the combination of artificial silk with real silk was undergoing considerable experimentation, with the finest staple fibre spun without difficulty along with real silk on existing machinery. Accordingly this staple fibre was said to be replacing real silk altogether in velvets, plush and other pile fabrics.[413]

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[410] 'On the other hand the carbonizing solution may be employed in admixture with a thickening agent such as starch, dextrin, British gum, gum tragacanth, etc, and applied in the form of a paste in any desired pattern or over the entire surface of the fabric.' Dreyfus, Dort, Platt, (1928/1931) US patent 1,834,339.
[411] Organic derivatives of cellulose yarns are made from solutions of the organic derivatives of cellulose by extrusion of the solutions through fine orifices and the removal of the solvent from the filaments thus formed.
[412] Hottenroth, V. (1928) Artificial Silk. London: Sir Isaac Pitman and Sons Ltd. p.375.
[413] Silk Journal, (ed.). (1928). The Artificial Silk Handbook. Manchester: John Heywood Ltd. p.66

The second fabric application proposed in this patent involved the creation of decorative lace or gauze-like effects within the structure of a previously constructed textile. Using a woven, knitted or netted fabric containing a mixture of 'carbonizable' cellulose yarns and 'non-carbonizable' yarns of cellulose acetate, etc., the fabric was apparently subject to a carbonising treatment. Once the carbonizable yarns were removed a textile, similar to that advocated by Stevenson and Wakefield's 1925 patent, with decorative open-work surrounded by a weave consisting mainly of cellulose acetate was created. Moreover, 'by varying the proportion of difficulty carbonizable and readily carbonizable yarns, various patterns and effects may be obtained. Further beautiful effects may be obtained by printing the mixed fabric with a printed paste containing the carbonizing solution with any suitable or desired design...'[414] After heating and then brushing out the burnt fibres, gauze or 'lace-like' weave were apparently visible in the printed portion acting as a light weight background to the remaining solid fabric structure, or unprinted portion.

The third proposal suggested ornamenting Jacquard woven textiles constructed of a mix of carbonizable and non-carbonizable yarns. By removing the areas of carbonizable yarn beautiful designs of 'lace like effects' were produced. The Jacquard textile could be bleached or dyed before or after the carbonising, while delustering of the cellulose acetate, an effect of the carbonising chemical on the cellulose acetate fibre, was avoided by incorporating delustering salts within the carbonising solution, according to A. J. Hall, BP 246,879.[415]. Although cellulose acetate fibre was prized for its lustre, and clearly a primary reason for its inclusion within the textile, from a design viewpoint the inclusion of a delustred fibre would have enhanced an already attractive textile.

Evidently the use of cotton, linen or viscose as a temporary or provisional yarn within these three textiles immediately suggests the destruction of cellulose fibre was considered a viable cost in the making of this devoré textile at the time of registration, and therefore was most likely to have been either cheap a waste fibre. Accordingly, in

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[414] Dreyfus, Dort, Platt, (1928/1931) US patent 1,834,339. Page 2, line 40-46.
Example 2: of the technical manufacturing given within this patent declares; A mixed fabric woven in a Jacquard loom and having designs of a preponderance of cotton, woven on a background having a preponderance of cellulose acetate yarn, is passed through an aqueous bath containing 1 to 2 % of hydrochloric acid at 40 C. The excess acid solution is then squeezed out, and the fabric is then slightly hydroextracted. The thus treated material is passed into a carbonizing drier at a temperature of 120 C. After carbonisation the fabric is washed to remove the carbonized cotton, thus leaving n open work design against the comparatively dense background of cellulose acetate yarns.
[415] Glaubers salt in solution within the carbonising paste (treating solution). See Lipscomb (1933) p.218. With reference to British Patent Silver Springs Bleaching and Dyeing Co. Ltd., and A. J. Hall.

the first technical example of manufacturing provided by Dreyfus, Dort and Platt a fabric of simple weave, was accordingly constructed of alternate sets of five yarns of cellulose acetate (resistant yarn) and three sets of cheap cotton or reconstituted cellulose (vulnerable yarn) both on the warp and weft.[416] Once treated by a carbonising process the viscose or cotton yarn would have been fully removed creating an all over checked effect, while if a printed paste was applied localised fibre removal would have enabled the manufacture of a sheer and full weave patterned effect, a fabric style that was popular during this latter part of the decade and evident both within fashion and furnishing fabric collections. At the fourth annual Exhibition of British artificial silk goods at Olympia, Fairchild's Bulletin for the 21st of January 1929, reported 'Many artificial silk voiles and ninons are shown in big floral designs while other fabrics endorse small effects, both geometric and floral. A few spots are also shown in combination with other designs and stripes,'....'There are many combinations of artificial silk, and artificial silk and silk, and artificial silk and wool in taffeta and ê weaves, also artificial silk and cotton marocains.'[417] The most popular colour trends for this show were red and navy combinations. Moreover, such was the trend for spots and geometric patterned fabrics at this time it is probable this Celanese textile displayed similar patterns and designs, while the overall appearance of the textile, if intended for the interior, thought to have resembled the Atelier Martine for Paul Poiret fabrics held within the V&A woven textile archive, see Figs. 14 and 15. Furthermore, by 1931, Rathbone and Tarpley, Fabrics and Dress (1931), defined drapery Madras as a fabric having a Jacquard pattern on a gauze or leno weave constructed of cotton, rayon or a combination of both, rayon being a term that had by this date come to largely define regenerated cellulose and was used in association with acetate, although it should be noted that Baldt in 1929 said acetate was not classed as rayon.[418]

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[416] 'This fabric is immersed in a bath containing, or padded with, a solution of aluminium chloride of 6 to 13° Bé. At ordinary room temperature. The excess of aluminium chloride solution is then removed by pressing, squeezing, or hydroextraction, etc. and the fabric is then placed in a carbonizing dryer and treated at a temperature of 110° to 115 C. for from 1 to 1½ hours. The fabric is then removed from the dryer and is brushed or washed, whereupon the carbonized cotton is removed. Since the cellulose acetate yarn is unaffected, a fabric having a lace structure with open squares is produced. Obviously by employing different mixed fabrics, different patterns or designs may be produced.' Dreyfus, Dort, Platt, (1928/1931) US patent 1,834,339. page 2, line 85-101.

[417] Marocain, a heavy crepe fabric with slightly wavy and heavy crosswise ribs, used for dresses and blouses.

[418] Rathbone and Tarpley. (1931). p.368 and Baldt. (1929). p.48.

Cellulose acetate devoré processes.

'The acetate process for the manufacture of artificial silk differs from the three other commercial methods in that the resultant product, i.e., marketed silk, is not a regenerated form of cellulose but an acetyl ester of the same.'[419] Although cellulose acetate was manufactured in America and Germany as early as 1902, it only became commercially successful as a textile fibre in the early 1920's. Initial production of this style of artificial silk was of little commercial value. Expensive solvents had to be used in its manufacture and once in filament form it proved to be brittle with particularly poor affinity to dyeing.[420] G. W. Miles, who studied cellulose acetate from 1894 to 1911, credited by the editors of The Artificial Silk Handbook (1926) as having 'paved the way for the ultimate success of acetate silk', only produced a really satisfactory cellulose acetate in 1905.[421] Although Mork, Little and Walker of Boston, Massachusetts, in US patent 712,200, (1902) had previously declared; 'We have discovered that artificial silk can be produced by proper methods from certain stable non-explosive and relatively non-inflammable compounds or of derivatives of cellulose, and notably from the simple or mixed cellulose esters of the fatty acids, and of these compounds we prefer cellulose acetates,' proclaiming their acetate filaments to be of such a suitable strength as 'to permit of their use as artificial silk, for which use, moreover, they are pre-eminently qualified by the great brilliancy of their lustre and the fact that they are waterproof.'[422]

The progression from experimental yarn to a commercially viable product suitable for use within constructed textiles can be in part credited to the work carried out by of Henry and Camille Dreyfus. Based in Basle, Switzerland, the Dreyfus brothers had been working on ways in which to advance the cellulose acetate product since 1910. Initially they sold their non-flammable acetate film products to the motion picture industry, Pathe Fréres, and the celluloid industry of France and Germany, while manufacturing acetate dope for the aircraft industry to coat and stretch fabric on aircraft wings and fuselage. Manufacture of cellulose acetate artificial silk in Great Britain only began

[419] Nasmith. (1926). p.56.
[420] Hottenroth, V. (1928). p.14.
[421] Nasmith. (1926). p.43,61.
[422] With "cellulose tetracetate", the preferred compound. H. S. Mork, A. D. Little, W. H. Newton, assignors by Mesne Assignments to Chemical Products Co., Boston, Mass. Maine. (Application filed January 13, 1902, accepted October 28, 1902), line 52-59 and 65-69. Artificial Silk. US patent 712,200. 52-59, 65-69.

when Henry and Camille Dreyfus, having previously established an aeroplane 'dope' factory at the bequest of the British Government during the First World War (Spondon, Derby 1914), required new ways in which to utilise their production of acetyl cellulose.[423]

The Dreyfus's British Cellulose and Manufacturing Co. (Spondon), renamed British Celanese Ltd in 1924, was at the forefront of cellulose acetate filament manufacture, with the first commercial production of acetate yarn taking place in 1921. The ensuing 'Celanese' trademark, created by Camille Dreyfus in 1922 from a combination of 'cellulose' and 'the easy feeling of wearing acetate apparel', was to symbolize the manufacturing innovation that the development of this commercial fibre had generated: 'from the technique used to spin thread to the treatment of dyed fibres'.[424] In 1917, under the auspices of Camille Dreyfus The American Cellulose & Chemical Manufacturing Company Ltd. (Amcelle) was launched in New York with a production facility established in Cumberland, Maryland. The first acetate yarn was spun there on Christmas day in 1924. However, for this new artificial silk product to become accepted by American textile manufacturers and consumers Camille Dreyfus had to resort to aggressive advertising in order to counterbalance negative publicity circulated by the silk industry.

As the reputation of Celanese grew and manufacturers became more aware of its economic potential, its use in a range of textile products broadened. The earliest textile application of this acetate rayon filament was as an economical substitute for natural silk, partially justifying the silk industry's cause for concern. Textile manufacturers quickly discovered that by replacing the warp or weft of a woven silk fabric with acetate rayon an overall reduction in material costs could be achieved. Margaret Storey, writing in the early 1930's considered the lower costing acetate rayon mixed fibre textile to be stronger than fabric made entirely of silk, a product she warned that routinely acquired its required weight through the use of chemical fillings. Storey cautioned readers 'The silky appearance of rayon and Celanese makes it possible to weave it in combination with silk and yet not be easily detected in the cloth. In addition, rayon by 1931 was to

[423] When used as a coating for aeroplane wings, cellulose acetate caused the fabric to tighten and become impervious to air.
[424] Celanese A. G. - A Company with a Tradition, History 1863-1979. (2002) [online] Available from: http://www.celanese.com/index/about_index/history-1999-1980/history-1979-1991.htm. with reference to 1921. [Accessed: 20 November 2002]

be found as a substitute in the weaving of brocades and novelty weaves, as the backing of velvets, and in satins and crêpes'. [425]

Acetate rayon textiles held other benefits for the ordinary consumer. Thanks to its water-resisting properties acetate materials were less easily soiled and easily cleaned. Its lustre, although harsh at the earlier stages of development improved once the spinning process and various methods of treating the yarn and fabrics made it possible to select any degree of sheen, from matt to high gloss.[426] Such was the sensitivity of acetate rayon to heat and steam that it was found that the creation of varied matt and shiny pattern effects could be achieved on a range of acetate woven textiles, as boiling water and steam could destroy the lustre of cellulose acetate with a prolonged treatment leaving a woolly effect.[427] A series of carbonisation treatments were also developed during acetate rayon's early years and were often used in combination with these lustre altering techniques. Accordingly, the use of a printed organic solvent was initially used to devoré cellulose acetate from mixed fibre fabrics, while the technique of carbonisation was used for fabrics woven solely of acetate rayon, with protection afforded to parts of the textile by an application of an alkali prior to the carbonising bath treatment. Both techniques of acetate fibre destruction were reliant upon the vulnerability of acetate fibre to organic solvents such as acetone.

Examination of the patent record for the early to mid 1920's suggests cellulose acetate devoré was developed solely for the purpose of woven textile ornamentation rather than fabric creation, with the exception of Dreyfus, Dort and Platt's yarn provisional support of 1928. Consequently the emphasis of the devoré patents registered in connection with this innovative fibre are directed towards the creation of a commercially viable decorative textiles, thought to be used both as dress and interior textiles. Of the two methods of fibre destruction previously defined in Chapter One, it would appear the printed style of fibre elimination was developed slightly earlier than the acetate rayon carbonisation technique, however, both should be regarded as inventions of the mid

[425] Storey, M. (1930). Individuality and Clothes. London & N.Y.: Funk and Wagnells Co. p.234.
[426] With reference to Lipscomb, A. G. (1933). p233.
[427] Refer to Lipscomb. (1933). p218. Other treatments include Lustre resist (delustre of selected portions) British Celanese Ltd. and G. H. Ellis BP 266,777. Acceleration of delustring BP 277,414 (a printed treatment). A mottled or printed effect by damping the materials in the required design then ironing at 100°C or higher British Celanese Ltd., BP 295,043. Lustre pattern effects achieved by weaving a fabric with yarn both resistant and vulnerable to boiling water or soap solutions, followed by a delustering process, BP 310,845.

1920's, while the actual date of actual cellulose acetate devoré on pile textiles production was possibly as late as 1928/ 1929.

This later dating of cellulose acetate pile fabric devoré is in part suggested by an article included within Fairchild's Bulletin of November 26th, 1928, entitled a 'New fabric for the spring was announced.' It continues:

> 'The debut of celanese velvet was the outstanding feature of the big dress parade held at Grosvenor House by British Celanese Ltd.,..for the showing of models specially made by Paris couturiers from their Celanese fabrics. This material, which is still in an experimental stage, will make its appearance on the market early in the New Year'.[428]

Therefore if devoré pile fabric was released at the same time as celanese velvet, its earliest appearance was apparently no earlier than spring of 1929.

At the forefront of cellulose acetate woven devoré development was Camille Dreyfus and the employees of British and American Celanese, a company already noted for their comprehensive knowledge of the acetate rayon manufacturing process. Working in association with Amcelle, New York, Camille Dreyfus registered what is possibly one of the earliest printed devoré techniques aimed specifically towards the destruction of the cellulose acetate filament. The Dreyfus/ Amcelle patent application entitled 'Printing of Fabrics and Articles' dated September 1924 (Patented June 1926) exploited the chemical composition of cellulose acetate and the manner in which it was produced by employing organic solvents such as lactic acid (or acetic acid, acetone, etc.), to locally destroy areas of 'cellulose acetate silk', 'cellulose ester silk 'or 'cellulose ether silk'.[429]

The manufacture of acetate rayon fibre in order for it to become a viable product had required extensive modification, from it's spinning through to dyeing and weaving. Even the colouring of this innovative fibre had been unsuccessful until the Swiss inventor A. Clavel developed a dyeing process in 1920. Unsurprisingly the printed devoré process for acetate rayon also required adaptation to suit this new style of fibre.

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[428] Fairchild's Bulletin (1928). New Fabric for the Spring. Fairchild's Bulletin. November 26 1928. p.3.
[429] With reference to British Celanese (Application March 12, 1926, accepted December 30, 1926). Improvements in or relating to the printing of fabrics and Articles made of or containing Cellulose Esters or Ethers. BP patent 263,355. With reference to Sharp. (1990); Esters are organic compounds that are formed by the union of an acid with an alcohol with the elimination of water. Volatile and usually insoluble in water but soluble in alcohol or ether.

The nature of acetate production, from the acetylation of cotton linters through to the dissolving of cellulose acetate flake in acetone, dictated specific solvents for fibre elimination had to be employed. Accordingly, Dreyfus in the opening paragraph of his devoré process sceptically announced 'The success of this invention is rather surprising inasmuch as, for this instance, it was expected that by treating a fabric like velvet, containing acetate silk mixed with cotton with a solvent for cellulose acetate, a film would be obtained which sticks to the cotton fibre without possible removal in a practical way.'[430]

However, Dreyfus achieved his pile woven devoré process on a fabric constructed of a cotton warp and mixed weft, two yarns of cellulose acetate and two of cotton, consecutively. This fabric was printed with a paste composed of 30 parts lactic acid, 3 parts water, 5 parts dextrin and 12 parts 'infusorial earth', onto one or both sides as in the style of discharge printing. To encourage fibre deterioration the fabric was then heated to between 50 and 125°C, after which point the decomposed cellulose acetate was removed from the fabric by washing. The drying of acetate fabric was, according to A. G. Lipscomb to have been as rapid as possible in order to avoid loss of lustre, as exposure to too high a temperature would also cause the yarn to soften, leading to stiffness and brittleness in the finished material.[431]

The effect of the localised acetate rayon destruction created patterned figuration in the textile, with the balance of remaining weave to visible woven ground dependent upon the nature of the printed design employed. In addition, Dreyfus advised; 'By this invention for instance beautiful Jacquard effects are obtained on mixed fabrics (consisting partly of cellulose acetate "silk" and partly of other fibres or on velvets having, for instance, a back of cotton or silk or wool or mixtures of different fibres, whilst the face of the velvet consists of cellulose acetate silk).'[432] The exact patterning of the fabric created by Dreyfus, and in particular the contrast between etched ground weave and remaining pile, is unclear. Perhaps it can be assumed the balance of pile fibre to visible background weave would have been relatively equal, with the fabric appearing to be substantially constructed of velvet pile. Dreyfus wrote of the devoréd fabric as having 'stamped out patterns', implying the fabrics design motif was to be made up of the visible ground weave rather than the remaining pile. Moreover, since

[430] Camille Dreyfus. (1924/1926). US 1,588,951. l. 1-8.
[431] Lipscomb, A. G. (1933). p.236.
[432] Dreyfus, C. (1924/1926). BP patent 263,355. line 65-72.

reference to earlier printing or multi colouration of the fabric is not evident within the patent, it is likely that the ornamentation of the fabric was reliant both upon this patterning effect of the devoré treatment but also possibly a high sheen of the cellulose acetate pile. To accentuate this effect the fabric was thought to have been limited in its colour palette, possibly even just black or white, in line with the evening wear colour trends of the period.

Pile woven devoré samples held within the Liberty of London archive and dated circa mid to late 1920's, reflect this tendency towards moderate fibre removal on single coloured fabrics. Silk cotton velvet devoré prints such as G12108-110, G12173 and G12237 – 38 (manufacturer unknown), whose only form of ornamentation was achieved by removing pile fibre to create distinctive abstract designs and figuration, were sold to consumers as special goods in the Liberty of London store during the latter part of the decade, see Figs.30 to 32.[433] These Liberty single coloured figured samples although constructed with a silk pile, could easily have been constructed of an acetate rayon pile and ornamented by the Dreyfus technique, while not necessarily aimed at the same market level. The same may also be made said for the manufacture of plain-woven devoré textiles such as 'Length with Ovals', held as part of the Tirocchi Dressmakers' Shop collection at R.I.S.D. in the USA. Thought to be of American origin, with an estimated manufacturing date of 1926, this single coloured sample displays a bold hand painted feel, possibly drip painted feel to the printed devoré treatment, see Fig. 33.[434]

Although the exact nature of design used on this acetate pile woven devoré textile remains unknown, Camille Dreyfus by suggesting the manufacture of a decorative acetate pile velvet fabric realised the Celanese target consumer whether a designer or home dress maker would be more likely to accept the innovative fibre if it were incorporated within an already commercially viable form of textile, and in particular a fabric that had by the mid 1920's become synonymous with the latest couture designs. Moreover, taking into account the contemporaneous trends in transparent velvets, it was likely the ground weave of the Dreyfus devoré treatment was sheer in style.

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[433] Liberty's of London archive. With thanks to Buruma, A. (2003) [Interview and archive review with Anna Buruma, 28 May, 2003]. Single coloured figured pile fabrics were contained within a catalogue of fancy goods. The fibre content of the samples is thought to be silk and cotton, however their date and maker was absent from the catalogue. Only small sized samples were retained. The date of the catalogue has been set at the late 1920's, after 1925.

[434] Length with Ovals, ca. 1926. 'Probably an American maker.' Silk; Plain weave; chemical burn out. Gift of L.J. Cella III. 1991.123.45. A&L Tirocchi Dressmakers Project. [online] Available from http://www.tirocchi.stg.brown.edu/exhibition/fashion/deco03.html [Accessed: 17 July, 2003].

Pile woven devoré textiles within both the Liberty of London archive and Tirocchi Shop archive at RISD, dating from this period, rely upon the contrast of dense weave and sheer weave to enhance the figured decoration. Furthermore, a lighter weight scaffold would have improved the overall drape of the textile and lightened the weight of any garment it was used within. Roberta Orsi Landini in her analysis of velvet for clothing makes reference to the manufacture of lightweight crêpe backings for velvets as the great innovation of the 1890's with crêpe fabrics made of chiffon to heavier crêpe marocain quickly becoming accepted, achieving their greatest level of popularity in the 1920's.[435]

As previously stated, fashion magazines of the time openly supported the move towards lighter weight pile fabrics for afternoon and evening wear. The contrast of sheer and dense weave of the Dreyfus devoré textile would have been further accentuated by the simplistic patterning fashionable at this time. Spots and geometrics were particularly strong during the latter part of the decade, and while the simplistic repeats were been favoured in the mid part of the decade, designs evolved to become considerably more decorative and elaborate. While the luxuriant fabric designs first adopted in the autumn 1925, as profiled within London Vogue, continued to be developed, the preferred fabric patterning of decorative dress textiles demonstrated abstract multi directional patterning or small scale motif in repeat. The Ducharne collection of Autumn 1927, a company that specialised in Jacquard woven dress silks, illustrated the trend for high shine glitzy textiles, and were accordingly applauded by Vogue editors for their lamés of 'infinite variety' which included voile lamé, damask lamé and cut velvet on a silver foundation, with the floral design formed by the lamé and not the velvet, see Fig. 34.[436] The Celanese devoré textile is thought to have been created as a novelty textile for both the commercial and home dress maker and to be employed within highly decorative dress such as evening coats, dresses, shawls, and possibly for trimmings.

The 'Celanese' brand of textile, once it began to be heavily advertised in the mid 1920's, was a demonstration of the move towards economical production of quality fibres by industrial factory methods. Advertised under the slogan of 'Celanese the Versatile', the Celanese textile was promoted as a product ostensibly to be worn by the

[435] De Marinis, ed. (1994) see Orsi Landini, Roberta. Luxury and practicality. The thousand faces of velvet for clothing. p.102.
[436] Vogue N. Y. (1927). The New Paris fabrics Have Gleaming Beauty. Vogue. September 1 1927. p.114.

bright and the young and was represented as such in full colour in magazines where black and white was the norm; a sensation for the reader of New York Vogue whose only other full colour page was the cover, see Fig. 35.[437] The Celanese product was promoted for its innovation, modern feel, cleanliness and moderate cost. By the mid 1920's textile manufacturers could purchase the fibre for half the price of raw silk, while in 1928 Hottenroth advised the poorer qualities of artificial silk were approximately a third of the cost of real silk.[438] The fibres when used in clothing often engendered affordable contemporary fabric designs, the marketing campaign was almost necessitated such fibres be retailed in modern design, while the eventual retail cost of the textile dependent upon how it was styled which was most likely to have been marketed as a figured textile' or displayed as 'Fancy Goods' a term used in association with the devoré samples sold in the Liberty of London store. Moreover, Dreyfus describes his devoré fabric as also being 'used under others for the manufacture of novelties and fancy articles in the dress trade.'

Essentially the price of a Celanese textile, though partially manufactured of acetate rayon and figured by devoré, could have retailed alongside real silk figured textiles, although it is probable the manufacturing cost of using an economical fibre and economical manufacturing process would have resulted in a widely affordable textile. Elizabeth Ewing writing about the 'start of modern fashion' identified reasonably priced 'artificial silk' fibre as having had a huge impact on the dress of the ordinary consumer. 'Rayon', a broad term that also included cellulose acetate 'came into general use in fashion in the 1920's, with America taking the lead and the rest of the world following rapidly. By the mid-twenties pretty, inexpensive, smart dresses with the look and some of the glamour of silk were being factory-made for the popular market on both sides of the Atlantic.'[439]

The increasing use of acetate rayon fabrics in dress was also reflected within magazines editorials of the day, partly because by the mid to late 1920's artificial silk velvets had considerably improved in both appearance and strength. The character of acetate rayon at this phase of its production was 'strong, supple and silky', and although not so lustrous as Chardonnet or Cuprammonium artificial silk, its appearance according to

[437] Vogue N.Y. (1927). Celanese advertisement. Vogue. November 1, 1927. p. between 32,33.
[438] A short history of manufactured fibres. (2002). [online]. Available from http://www.fibresource.com/f-tutor/history.htm. [Accessed: 26 April, 2002]; see: Hottenroth, V. (1928). p.403.
[439] See Ewing. (1974). p.88.

Foltzer (1928) was approaching that of 'good natural silk'.[440] Camille Dreyfus, commenting on the physical properties of acetate filament and threads, declared its softness, strength and elasticity could be modified and made to vary by incorporating softeners with the cellulose ester.[441]

The initial reservation shown by Camille Dreyfus towards his acetate rayon devoré technique did not deter the patenting of similar processes and the interest in the devoré applied solvent continued. Dreyfus, in conjunction with the British and American division of the Celanese Company, along with other independent textile engineers persevered with the development of the cellulose acetate printed devoré technique until the range of decorative devoré effects that could be used in conjunction with this fibre was as extensive as those used on natural or man-made fibres. Arthur Swallow (of Glasgow), voicing none of the concerns raised by Dreyfus, in an alliance with The Calico Printers' Association Limited (London)[442] registered a technique in 1926, whereby multi-coloured brocade effects could be created on fabrics composed of mixed fibres such as vegetable and animal or vegetable and acetyl cellulose (Cellulose acetate).[443]

The emphasis of this British Patent was the creation of figured woven textiles using a printed solvent, in accordance with the Dreyfus invention. However, Swallow envisaged a textile that was considerably more decorative in its design. Printed imagery first applied to the woven textile was then to be enhanced by the secondary removal of the unprinted background, in the spirit of Otto Timme's velvet soda print patent of 1902, with some similarity of manufacture to Müller's multicoloured devoré patent of 1926. Moreover, Swallow declared his patent to be an improvement on earlier soda printing of mixed fibre weaves where printed image and devoré had supposedly been accurately aligned stating 'Attempts have been made to produce multi-coloured brocade effects on such fabrics, involving the use of a blotch pattern as in what is known as the soda print process but the results have proved unsatisfactory.'[444]

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[440] See Foltzer, J. (1928).
[441] Softeners, such as 'oleic acid, acetylated castor oil, thymol, phenol, &c.' Dreyfus. (1924/1926). BP patent 263,355. l. 71-78.
[442] The CPA, Manchester 'An amalgamation of 46 British printing firms, several with spinning, weaving and dyeing plants, forming 85 per cent of the British Calico-printing industry. It was established in 1899.' Samuels, C. (2003). Art Deco Textiles. London: V&A Publications. p.141.
[443] Calico Printer's Association Ltd. and Arthur Swallow. (Application filed July 17, 1925, accepted November 17, 1926). Improvements relating to the Decorative Printing of Textile Fabrics. BP patent 261,448.
[444] Ibid.

To achieve a successful co-ordination of image and devoré Swallow recommended a multi coloured floral image should first be printed onto a woven fabric with 'chrome, mordant, basic and other colouring matters' or acid dyestuffs for animal fibres. The caustic soda paste (sodium hydroxide, or other caustic alkali) could then be printed in the areas around the floral image, referred to in the patent application as the 'blotch pattern'; where blotch is used as the common term for any relatively large area of uniform colour or printed background in a printed design.[445] The separation of floral print and caustic print was, Swallow declared, achieved by creating an area of 'bondage', an interval of fabric of sufficient width to prevent the creeping of printed colours and the chemicals used in the blotch pattern. Once printed, the fabric was dried and steamed to encourage the action of the sodium hydroxide but at the same time fixing the floral print, although this dual processing is only implied within the claim. The silk or 'artificial silk' fibres once fully decomposed were simply removed by washing, to reveal a net groundwork in the blotch area.

The registration of printed image and blotch pattern, because of this simultaneous printing technique, would have been relatively accurate. Moreover, taking into account Swallow's patent description, the intended appearance of the fabric would have been comparable to that of Liberty of London archive fabrics G12108-110, see Fig. 30. The design of these velvet pile fabrics, sold through Liberty's Regent Street store in the latter part of the 1920's, consists of graphic florals printed onto velvet pile with substantial areas of pile fibre removed by a printed caustic paste, in effect floral shaped pile designs floating on a lightweight sheer woven ground. Moreover, these particular Liberty of London samples appear to have an area of 'bondage', recognisable by its original blue colour and in this instance used as a shadow effect to the floral image. This careful blending of the fibre barrier within the design of the printed image suggests the signs of the fabrics' unique style of ornamentation were clearly meant to be imperceptible to the consumer.[446]

While no specific style of woven textile is preferred within this Swallow, CAP patent, it is evident that a range of woven textiles, whether pile, satin or plain weave, manufactured of mixed fibres would have been readily ornamented by the process. The

[445] Blotch pattern. See Anstey Weston. (1997);'The printed background to the design is commonly referred to as the blotch.'
[446] Liberty's of London archive. With thanks to Buruma A. (2003) [Archive review with Anna Buruma, 28 May, 2003]. Sample G12108-110. Catalogue of fancy goods, dated c. late 1920's.

emphasis of the invention was clearly the creation of mixed colour brocade effects, a general description now commonly used within woven devoré patents of the period. Why this devoré style of fabric manufacture was considered commercially viable by Swallow and the CAP is understood once the retail value of brocade styled textiles is seen in context. For the autumn season of 1927, Peter Robinson, Ltd. of Oxford/ Regent Street, London, advertised the latest in velvet brocade on georgette at 27/6 per yard, a printed multicoloured velvet brocade on 'ninon', (a lightweight plain weave made of silk or manufactured fibres with an open mesh-like appearance made of a high twist filament yarn), with an 'effective design on black ground' at 26/-, and a rich tinsel brocade for evening wear, with silver spots and a plain black ground printed with a coloured design of cerise, yellow and purple, also retailed for 27/6 per yard.[447]

These fabrics appear to have been relatively expensive to purchase, an opinion supported firstly by the fact of their advertisement in Vogue magazine, but also because to purchase an equivalent yardage in 2003, using the composite price index as a guide, a yard of this fabric if bought today would cost approximately £54.00, a figure calculated by comparing 1927 prices to the 2003 composite price index: annual percentage change: 1751 to 2003, therefore if the cost of a yard of fabric in 1927 was 27s and 6d, this would appear to equate to over £54.00 a yard in modern terms.[448] While it is likely the Swallow textile was manufactured to be cheaper than Peter Robinson's selection of brocades, it is plausible that the novelty value of such a textile would have also elevated the retail price. Furthermore, the marketing of acetate as a modern fibre should not be overlooked when evaluating the type of consumer who would have purchased a woven acetate devoré textile. The advertisements for the Celanese textile support the idea that the fibre was initially considered to be modern, innovative and exclusive by manufacturers and was marketed as such to Vogue magazine subscribers. The devoré textile suggested by the CPA and Swallow was thoroughly modern in its use of a new fibre, decorated with contemporary patterning by a novel process of textile finishing and in all probability sold under the label of novel or special goods.

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[447] Ninon: a lightweight plain weave. made of silk or manufactured fibres, with an open mesh-like appearance. Made of a high twist filament yarn, it has a crisp hand. Heavier than chiffon, its use includes evening wear and curtains; Vogue UK. (1927). Advertisement for Peter Robinson, silk and woollen fabrics. Vogue. October 19, 1927.

[448] O'Donoghue J, L. Goulding and G. Allen. (2004). Composite Price Index: annual percentage change: 1751 to 2003. [online]. Available from : http: www.statistics.gov.uk/cci/articles.asp?ID=726 , go to costs, prices inflation and then consumer price inflation since 1750. [Accessed 10 August, 2004]. Calculation composite $index_{2003}$/ Composite Price $Index_{1927}$/ $Price_{1927}$ = $Price_{2003}$

Concurrent to Swallow and the CPA's modern styled devoré textile René Clavel's historically imitative fabric while also employing the highly innovative cellulose acetate fibre in a devoré fabric thematically contradicted everything the previous invention favoured. In 1933 A. G. Lipscomb, in his review of the printing of acetate rayon briefly described Clavel's method of creating metallic effects on fabrics containing organic derivatives of cellulose.[449] Accordingly Clavel, who had previously devised processes with which to alter the physical and visual nature of cellulose acetate material (not to be confused with A. Clavel, dyeing), in this instance proposed treating a textile so it would closely resemble Venetian Metallic Tapestries of the Renaissance.[450] The registration of this fabric decoration technique in America in 1926, was in concordance with the trend for using distressed or antiqued fabrics within the interior. Schoeser and Rufey in their work on the English and American Interior (1989) observed that during the mid part of the decade 'The taste for old fabrics (real or reproduction) stimulated some textile manufacturers to create new fabrics that seemed to have acquired the patina of age. This was particularly true with regard to weave, which were made with strie (shaded) rounds, with silk warps and woollen wefts, on linen warps (exposed in areas to give the appearance of wear) and using slubbed yarns.'[451] To achieve an antique effect on woven fabrics Clavel suggested using mineral powders and dye stuffs to create variegated effects. Accordingly Clavel noted 'There are several different methods for obtaining metallic silver and gold effects on cloth known today.' The most frequently employed process being the printing of a combined gum and metallic powder onto a plain woven fabric.

The rationale of using devoré in this instance was to ensure the structure of the fabric was materially altered to create novel and 'unexpected effects', said by Clavel to resemble a thin breakable metallic film similar to old Venetian metallic tapestry. To achieve this decorative effect a paste containing a metallic mineral powder and a solvent were printed onto the fabric using a 'vertical doctor blade'.[452] According to Clavel the liquid was said to dissolve the cellulose acetate either partially or completely, while enabling the fixing of the metallic or mineral powder on the cloth. After treatment the

[449] Lipscomb. (1933). p.259.
[450] René Clavel, of Basel-Augst, Switzerland. (Application filed April 6, 1926 accepted December 11, 1928). Process of Obtaining Metallic Effects on Fabrics containing Organic Derivatives of Cellulose. US patent 1,694,466.
[451] Schoeser, & Rufey. (1989). p.76.
[452] Example one- 500g gum arabic dissolved in ½ a litre of water, and 5 litres of acetone added. Clavel, R. (1926/1928). US patent 1,694,466. p.1, line 56-58.

fabric could be dyed, and or calendered as appropriate, a process of fabric finishing where cloth is passed through a series of large pressure rollers some of which may be heated thus producing a smooth and lustrous appearance, and in this instance used to fix the powder on the fabric.[453]

Clavel suggested two fabric applications within the patent. The first describes a heavy crêpe constructed of cotton and cellulose acetate being treated with a combined acetone (solvent) and powdered gold substitute paste. The mixture was printed uniformly onto the surface of the fabric and then rapidly dried fixing the metallic powder. Once completely dried the fabric could be dyed (or cross dyed) between 80 to 100°C with dyestuffs for cotton or acetate or a combination of both.

Clavel declared 'The fabric at this stage presents a uniform solid and unbroken metallic surface due to the fixing of the metallic powder therein.'[454] Midgley, Technical Terms in the Textile Trade (1931/32) describes the cross dyeing of acetate to be of great importance, and because its dyeing affinity is different from other yarns, 'The combination of the two types of rayon or the combination of cellulose acetate with cotton, or viscose with wool or silk, has provided economic conditions for the production of an unlimited range of two-colour effects by piece dyeing.'[455] After washing, the coated fabric was put onto a stretching frame causing some of the partially or completely dissolved cellulose acetate threads to break, whereupon the remaining cotton weave of a different colour to the remaining cellulose acetate fibres was said to be revealed, 'that is to say the dyed portions of the fabric appear as a background to the metallic surface which is no longer a continuous solid mass but is broken up to a considerable degree. After the stretching treatment...the fabric may be calendered to give it a smoother appearance and feel.'[456]

Clavel's second application made use of a powdered gold and silver substitute, in a mixture of sericose, acetone ethyl alcohol and benzol. While suggested for use with the same heavy crêpe fabric, other fabric mixes such as wool and acetate, or silk and acetate, viscose and acetate were also proposed, with mineral powders such as ultra-marine, iron oxide, or insoluble dyestuff powders considered suitable for mixing with

[453] See Anstey Weston. (1997). Section F, Calendering.
[454] Clavel, R. (1926/1928). US patent 1,694,466. p.1, line 74-77.
[455] Midgley, E. (1931-1932). Technical Terms in the Textile Trade. Manchester: Emmott & Co. p.174.
[456] Clavel, R. (1926/1928). US patent 1,694,466. p.1, line 84-92.

any of the solvent mixtures, tinting the metallic to a blue or red shade. The depth of colour was to appear faded, almost antiqued with a possible highlight of strong colour in the areas of fibre disintegration.

This replica styled fabric was thought to have been marketed as a tapestry cloth, a generic term that Rathbone and Tarpley used to describe interior fabrics manufactured in imitation of early hand woven tapestries fabric.[457]
Of the substitute metallic powder printed fabrics of the period a Fortuny pile printed coat decorated with Persian styled patterning, circa 1920, gives some idea as to the nature of the metallic film that Clavel was aiming to create, see Fig. 36. Despite velvet fabric being used for this garment, the area of silver print is thought to resemble Clavel's fabric just prior to the stretching and snapping of the acetate fibres. While the rigidity of the metallic print in this instance formed a relief effect on the pile fabric, accordingly the same effect was almost certainly produced by the application of the devoré on the Clavel fabric.[458] A highly decorative Bianchini Férier figured pile fabric of shows how dramatic and showy the application of gold metallic printing could be during the period, see Fig. 37. This velvet textile shown within a Bianchini Férier catalogue dated 1920/1921, and held at the V&A's textile collection in London still retains it brilliance and is surprisingly modern in appearance, moreover, its elements of design, such as the amount of visible ground weave, linear gold pigment design on the pile fibres and the stylised nature of the patterning is noticeably similar to devoré textiles of the mid 1990's.[459]

George Holland Ellis, Henry Charles Olpin and Eric Eaton Walker considered velvets and 'plushes' to be the devoré fabrics of choice. Based in Spondon in Derby although working for The Celanese Corporation of America, their British patent filed in 1927 similarly advocated a "weakening agent", a solvent for cellulose acetate, be applied to the back of a pile fabric by stencilling or spraying to loosen the connection of acetate rayon pile fibre to its backing of silk, wool, cotton or artificial filament (though not a cellulose derivative).[460] Key to this Celanese patent was the creation of 'ornamental

[457] Rathbone and Tarpley. (1931). with reference to Curtains and Draperies. p.381.
[458] vintagetextile.com (2004) [online] Mariano Fortuny/ Venise Persian styled patterned velvet coat. Available from http://www.vintagetextile.com/new_page_207.htm. [Accessed: 4 April, 2004].
[459] Bianchini Férier sample book. Lyons. (1920-1921). Sample № 15205. Ruban Satin velour. 'Vendu': 30/5.
[460] George Holland Ellis, Henry Charles Olpin, and Eric Eaton Walker, of Spondon near Derby, England. Assignors to the Celanese Corporation of America, a Corporation of Delaware. (Application filed March 15, 1927. Patented Dec 2, 1930). *Treatments of Fabrics*. US Patent 1,783,608.

effects' by devoré. However, a fabric ornamented by this figurative treatment could be further enhanced by dyeing, cross dyeing, combined devoré and colour printing and mutli-colouration of pile fibre. The ornamentation of textiles in the manner of Ellis, Olpin and Walker's method, involved a fabric constructed of cellulose acetate pile being printed with an inert swelling agent on selected portions of the backing of the pile fabric to soften or weaken the loops by which the pile filaments were anchored. When duly softened and in a weakened state the pile fibres could be removed mechanically from the treated portions on the face of the fabric by plucking, brushing, carding or suction.

The solvents suitable for use in this semi-destructive treatment of derivative cellulose fibres (cellulose esters not regenerated cellulose fibres) were 'organic liquids' such as lactic acid, formic acid, acetic acid, acetone, etc.[461] Though Ellis, Olpin and Walker pronounced 'Solutions of phenol in alcohol or benzol have proved to be particularly advantageous in the treatment of a pile fabric having a pile of cellulose acetate filaments.'[462] The destructive effect of the printed solvent could be further accelerated by heating, though Ellis, Olpin and Walker warned care must be taken not to allow undue evaporation of the weakening agent. To reduce any blurring of the pile and sharpen the outline of the pattern, a factor that was said to visually differentiate a devoré fabric from a woven figured fabric, the cellulose acetate fabric could be printed in its sized condition, or else a thicker printing paste could be employed which would prevent "running" and confine the solvent to the area of the print.

Undoubtedly the significance of this invention is the controlled effect of the devoré treatment, with the pile filaments easier to remove when in a substantially undissolved state. Furthermore, the potential for singeing or shrinking of the backing weave and delustring of the remaining cellulose acetate pile, both possibilities when heating and steaming was used, was eliminated. However, it was the variety of colouring effects that were suggested in this devoré invention that are of greatest interest. The fabric could be dyed prior to or after the devoré treatment. Mixed fibres could be cross-dyed partly before and partly after devoré, as cellulose acetate requires its own dye and is unaffected by those dyes required for wool and silk, while a dye for the backing

[461] also tetrachlorethane, chloroform ethylacetate, phenol and aniline.
[462] Phenol is acidic and forms metallic salts, therefore when it is used with cellulose fibres it instigates a loss of tensile strength. Whereas alcohol reacts with acids to give esters, which reacts as a solvent for cellulose acetate (an ester of cellulose) the rule of chemical solvents being that "like dissolves like". See Collier & Tortora (2001) p.57, effect of chemical solvents: 'Not all solvents will dissolve all solutes. An important consideration is the polarities of the solvent and solute. The rule to remember is that "like dissolves like".'

material could be combined with the 'weakening agent' and printed simultaneously. A two-colour pile effect was also suggested possible when dyestuffs giving contrasting colours were used on a fabric made of a mixed fibre pile, a process that would have facilitated the creation of a textile similar to that Peter Robinson's velvet brocade on georgette advertised in Vogue (October 1927), see Fig 38.[463]

To further demonstrate their claim Ellis, Olpin and Walker gave explanation as to how a plush fabric with a cotton backing and acetate pile could be ornamented by means of their devoré process. For instance, Example 1 recommended a basic mixture containing 10 parts by weight of phenol, 10 parts by weight of alcohol, and 20 parts by weight kaolin be stencilled onto the back of the fabric in sufficient quantity to weaken the loops without damaging the pile. The softened pile fibres were then removed by brushing or plucking while the material was still damp. Example 2, required a mixture containing 10 parts by weight of alcohol, and 10 parts by weight of phenol, sprayed through a stencil on to the back of the fabric. The pile could then be brushed or plucked out from the affected area as in Example 1. Finally Example 3, described the fabric in its sized condition being sprayed or stencilled with a mixture containing 10 parts by weight phenol, 10 parts by weight alcohol and 10 parts by weight of water containing a direct cotton colour. Once the pile was removed from the treated areas a clear cut figured effect was evident, with the ground weave coloured at the points of fibre removal. The fabric was then treated in an oven at 80°C for two hours in order to fix the dyestuff and 'volatilize' (evaporate) the phenol.

The range of colouring and designs that could be created by any one of these techniques was apparently wide-ranging. However, for these devoré textiles to have been constructed in this manner their structural style and the nature of patterning had to be commercially viable. The possible style of fabric created by this Ellis, Olpin and Walker technique was therefore dependant upon the exact nature of the pile fabric employed. When velvet was to be ornamented by the technique it is presumed the ground weave was lightweight or transparent in style with the pile patterning appearing etched or in relief on a light weight gauze. As regards the use of 'plush' the ultimate styling of the fabric may have been comparable to devoré velvet, though feathering of the unaffected

[463] Vogue UK. (1927). Advertisement for Peter Robinson, silk and woollen fabrics. Vogue October 19, 1927. With reference to velvet brocade on georgette. p.11.

pile would most likely be produced, with the edges of the exposed backing and pile remaining sharp.

As to its appearance Liberty of London samples G12145 and G12173 fittingly capture the feeling of devoré used on plush textiles, see Figs. 39 & 31 respectively.[464] The plain colouring of these samples is reflective of a trend that considered 'All-white and all-black' the smartest for new velvets, and the evening fabrics in general.[465] Plush, though a variant of velvet, has a less dense but deeper pile that lies along the surface of the fabric, which historically resulted in its habitually being employed in the simulation of fur fabrics.[466]

With 'shaved baby lamb' leading the trend in outer wear and 'fur sports coats' for winter 1927, and their being an 'abundance of furs', the feasibility of a devoré process such as Ellis, Olpin and Walker's being used in the manufacture of imitation figured fur fabrics should be considered. A Channel coat, for instance, of shaved baby lamb in a 'smart sport colour' of beige, imported into America by Thorn for the winter of 1927, has a pressed, almost etched feeling that would have been easily recreated by a printed devoré process; its ground weave possibly being simultaneously coloured to resemble the 'shaved' darker area of baby lamb skin, see Fig 40.[467] Bendure and Pfeiffer writing in 1946 on 'America's Fabrics' describe how rayon pile fabrics manufactured to imitate fur fabrics were woven in a pile weave and then dyed and finished to imitate fur fabrics, adding 'The pile may be long and straight, curled, or pressed down, according to the fur it is imitating'. [468] 'Lamb' was identified as just one of the numerous natural furs that pile fabrics were employed to replicate.

Although a theory that requires further investigation, the popular fabrics of autumn/ winter 1927 were particularly figured in their basis of design, and acetate rayon was becoming increasingly associated with innovative and modern woven textiles. Fabrics that the Ellis, Olpin and Walker devoré technique undoubtedly figured were transparent and chiffon velvets. The sensation of the autumn winter season 1927 these lightweight,

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[464] Liberty's of London archive. With thanks to Buruma A. (2003) [Archive review with Anna Buruma, 28 May, 2003]. Catalogue of fancy goods, dated c. late 1920's. Both white and appearing to have relatively long pile. In terms of their design the pile fibre is feathered. Some squashing has occurred in the catalogue so the pile appears somewhat messy. Liberty's of London fabric G12172. White devoré fabric.
[465] Vogue, N. Y. (1927). Vogue's Gallery of American Fabrics. Vogue. September 1, 1927. p.56.
[466] With reference to De' Marinis. (1994).
[467] Vogue N. Y. (1927). This costume was chosen because shaved baby lamb leads in fur sports coats. Vogue. November 1 1927. p.73.
[468] Bendure, Z. and Pfeiffer. G. (1946). p.210,211.

soft and delicate drape fabrics were used for both afternoon and evening dresses. Although evident in France in the early 1920's, and typically printed or dyed in a single colour, transparent velvet was initially expensive to purchase. Once introduced to America, its rise in popularity instigated cheaper methods of manufacture, including the incorporation of viscose and acetate rayon as a pile fibre. Using 'Modern' innovative fibres such as acetate rayon as the pile fibre in these weaves would have considerably reduced production costs. The association between the woven pile fabric and the devoré process was at its most cohesive during the latter part of the decade because of the rise in popularity of the lightweight velvet, but also because the inclusion of patterned velvet textiles within dress collections was a consistent trend from 1925 to the early 1930's. The editors of Vogue New York, September issue 1927 'Gallery of American Fabrics', were clearly taken by the revolution in pile fabric manufacture. They espoused the fabric declaring:

> 'Velvet, loveliest and most feminine of fabrics, has always been an accomplished actress and very versatile person—a bit heavy, perhaps for some parts, but with an innate distinction that has carried her far. This year, however, she has simply carried off the whole show. She plays in the afternoon. She plays at night, when she doubles in both frocks and wraps—in fact with her little sister, velveteen, who stars in the morning she rounds out the clock.
> The secret, of course, is that velvet has reduced—reduced unbelievably. She is no longer heavy, or within miles of it. She is so thin that you can see through her, so young that the débutante adores her. Wherefore no other fabric in the whole autumn and winter cast of the mode can touch her for popularity, and, as there has never been any other material half as flattering to the average woman, let us all praise Paris and applaud velvet.'[469]

This 'velvet epidemic' as it was described in the same edition of Vogue New York, was possibly a reaction to the couture houses of Paris that continued to dictate dress and fabric design of the affluent European and American women well into the late 1920's. As Parisian designers increased their use of velvets and other pile fabrics, notably during 1926 and 1927, it was inevitable that magazines such as Vogue and Harpers Bazaar were keen to chronicle this prevailing fabric style. Leading fashion retailers and department stores were eager to stock the latest Paris fashions for their wealthier clientele, and regularly advertised their importation of such articles. Those consumers unable to afford the imported Paris fashions were well catered for by large scale

[469] Vogue N. Y. (1927). Vogue's Gallery of American Fabrics. Vogue. September 1 1927. p.56,108,124.

manufacturers who adapted Paris couture lines to 'ready to wear'.[470] The production of fashions on a large scale positively transformed the price of clothing, but it was artificial silks such as cellulose acetate that allowed the 'girl of limited means' an opportunity to 'enjoy being in fashion to a degree hitherto impossible.'[471] The rise of the ready made clothing market in America was as a direct result of an increase in mass production and the rise of a new generation of working women who demanded fashionable clothing at moderate cost. As ready to wear clothing became easier to produce, large scale manufacture expanded and profitability increased as stock was distributed nation wide. Stores and dress shops across America responded to this burgeoning market by creating various ready to wear clothing departments.

American designers of ready made clothing were quick to establish themselves creating personality based identities for their goods using signature names as an identifiable brand or trademark for their collections. For instance, 'Barbara Lee' not only advertised the season's designs directly to readers of Vogue magazine, New York but also listed the eighteen stores in America where 'Barbara Lee costumes for women and misses are shown exclusively'. 'THIS FALL, EVERY WOMAN WEARS VELVET', declared the companies headline for September 1927, 'Since, according to the French "every woman is a beauty in velvet," this year we shall see only beauties! For velvet is everywhere.'[472] Of the four outfits presented in the Barbara Lee full page advertisement, in Vogue New York, outfits one, three and four were dark coloured lightly embellished velvet dresses. However, the second outfit was a two-piece model featuring 'an unusual fabric—velvet circles on georgette', available in rust, black and wine, in sizes 36 to 44, see Fig. 41. Strikingly designed and of moderate cost (only a nominal $39.50, equivalent to $139.00 in 2003, with reference to appendices for the CPI),[473] its price level and limited description suggests it may have been manufactured with an artificial silk fibre and ornamented by the devoré process. Accessorized with the latest clutch purse, the

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[470] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. The term was applied to off the peg clothing in America in the 1920's by the fashion industry and should not be confused with the concepts of Prêt a Porter of the 1960's.

[471] Ewing, E. (1974). p.88.

[472] Vogue, N. Y. (1927). Barbara Lee advertisement. This fall every woman wears velvet. Vogue. September 15 1927. p.6.

[473] Since 1934 the US Department of Labor has published the constituent elements of the CPI, including one for ladies dresses. The application of this index to the $39.50 original price gives a 2003 equivalent price of $139.00. If this value is escalated in line with the consumer price index (CPI), this price is equivalent to $420 in 2003 terms. However, it should be noted that the consumer price index incorporates a wide range of products and may not be representative of the true inflation of any constituent element. See U.S. Department of Labor. (2004). Consumer Price Index, All Urban Consumers (old series) Apparel and Upkeep. ID series MUUR0000SA3. [on line] Available from: http://data.bls.gov/servlet/Survey/OutputServlet. [Accessed 28 July, 2003).

season's trend in fox pelt and diamante bow clasp, this V-neck, low waisted, front pleated, below the knee figured velvet outfit was promoted as being both 'youthful' and 'striking' in appearance. This style of dress is possibly best illustrated by an American vintage dress constructed of a similar spotted pile fabric in blue indigo, c.1925-1929, see Fig. 42. Classified by its on-line vintage dress dealer as a 'cut-velvet' styled garment, this slight drop waisted, blouson style V-neck dress, is thought comparable to a devoré printed textile of the period, if not an actual devoré piece.[474]

The contrast between dull and shiny yarn within a woven fabric was another interesting trend reflected in designer-wear of the late 1920's. Accordingly Madeline Vionnet used dull surfaced 'velours de laine' and printed velvets, and The House of Channel, 'dull crêpes, satin, crêpe satin—using both the dull and shiny sides—, fulgurante, and velvet—plain, printed and cut', for afternoon dresses and evening wear.[475] A detail of Liberty of London's devoré samples G12144 and G12145, see Figs. 43 and 39, respectively, gives and indication as to the unique and dramatic feel of matt fibre pile textiles, although it should be noted these Liberty textile samples are not thought to have been constructed with an acetate rayon filament.[476] However, the combined effect of matt acetate rayon pile and shiny ground weave in a pile fabric devoré textile would have been equally striking, especially if the pile fibre was of a differing colour to the ground weave, black and white. George Rivat in association with Camille Dreyfus, in association with Celanese Corporation of America, patented a devoré process that proposed the manufacture of figurative patterned fabric that suggested just such an technique, whereby contrasting matt and shine were created on velvets, plushes or other pile fabrics manufactured of cellulose acetate (organic derivatives of cellulose) and a backing of silk, wool or other animal fibre.[477]

The basis of this woven acetate devoré technique was the printing of a carbonising paste made up of a thickener, an acidic compound and a solvent or softening agent for the cellulose acetate. The fabric once printed with the paste on the reverse side by engraved or embossed plates or stencils was heated to between 110° and 130° for 6 to 30 minutes,

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[474] Dress V914. (2003). [online] Available from: www.vintageous.com/v914.htm with reference to Unusual Indigo Cut Velvet 1920's dress Item V914. Price: $255. [Accessed: 28 July 2003].
[475] Vogue, N. Y. (1927). Daytime modes are varied: Madeline Vionnet Dress "5261". Vogue. October 15 1927. p.76. and Vogue, N. Y. (1927). Paris decrees: The House of Channel. Vogue. October 15 1927. p.144.
[476] Liberty's of London archive. With thanks to Buruma A. (2003) [Archive review with Anna Buruma, 28 May, 2003]. Catalogue of fancy goods, dated c. late 1920's.
[477] George Rivat and Camille Dreyfus for the Celanese Corporation of America. (Application filed December 16, 1927 accepted August 11, 1931). Process of Treating Fabrics. US patent 1,818,505.

followed by neutralisation in a solution of weak alkaline. As with the Ellis, Olpin and Walker technique, the 'attacked' pile was removed by brushing, plucking or suction, etc. At the end of the treatment the silk fabric ground weave developed a very soft handle and the beautiful pattern effect of the front of the textile stood out against the ground weave, moreover, Rivat and Dreyfus suggested the ground weave and pile fibre could be alternatively coloured, giving the area of etched ground weave and pile fabric the appearance of a perfectly matched colouration usually created by weaving. The creation of multi-coloured effects was also achieved by using mixed coloured yarns, or by cross dying (prior to or after devoré treatment) a process that exploited the fact that organic derivatives of cellulose behave differently towards many dyes than the silk or wool fibre.

The matt and shine effect on a pile fabric was achieved by means of boiling the entire fabric in an aqueous bath at 100°C. The pile was then partly or wholly delustred, consequently when areas of pile were removed by devoré a fabric with matt pile contrasting against the natural shine of the remaining silk ground weave remained. A. G. Lipscomb in his comprehensive review of cellulose acetate manufacture and its applications (1933) wrote in some detail of the alteration in acetate rayon lustre by the action of water and steam. While any prolonged treatment caused a woolly effect in the appearance of the acetate fibre, hot ironing using a damp cloth over the surface of the acetate was also noted as a technique of delustering as was the action of aqueous solutions of acids, alkali's, notably in hot solution.[478] Consequently all of the heated processes normally associated with woven devoré always produced a delustred effect on cellulose acetate fibre at this time.

The advantage of using a printed solvent in the destruction of pile fibre was the rapidity with which patterning could be updated, even during a specific season if required. Stylistically the patterning of the Liberty of London fabric samples G12144 and 45, see Figs 43 and 39, are thought to be consistent with the Rivat and Dreyfus technique, however, included within their application of 1927 is a customary sketch of the devoré treatment although intended to show the effect on an acetate and silk pile textile, see Fig. 44.[479] The ground weave would appear to have been of an open weave style, probably transparent although the patent image shows an etched effect the actual design

[478] See Lipscomb. (1933). p.192.
[479] Liberty's of London archive. With thanks to Buruma A. (2003) [Archive review with Anna Buruma, 28 May, 2003]. Catalogue of fancy goods, dated c. late 1920's.

was in all probability based upon the popular fabric structures of the period where the blotch background would have been devoréd thus creating pile floral, leaf or similar designs.

With regard to textile review of that period A. G. Lipscomb authoritatively summarized the printed 'ornamental effects' achievable on cellulose acetate textiles, making specific reference to this Rivat and Dreyfus devoré process. [480] Fabrics constructed of cellulose acetate filament were according to Lipscomb particularly suitable for the production of all kinds of decorative effects, and as a consequence acetate rayon by the time of his writing in 1930's could be found within 'woven and knitted fabrics of all kinds for dresses and underwear; hosiery, especially in admixture with other yarns; all classes of embroidery and knitting yarns; neckties; coat linings; and brocades and upholstery materials.'[481]

'Modern velvet', a term that represented a fabric manufactured of artificial silk, or a velvet with a lightweight transparent ground weave, or which exhibited both, was described by American Vogue as a Parisian material of choice in the autumn/ winter of 1927. Employed by Dœuillet's along with mixed woolen velvets, velvet Tircis, woven velvet, cut velvet on voile, English velvet and other plain and decorative velvets, it was a fabric highly recommended for daytime dress.[482] Concurrently, the most modern of the 1920's devoré velvets was manufactured with cellulose acetate pile and ornamented by a fibre destruction process that employed localised saponification.[483] For instance, a pile fabric woven of a mixture of cellulose acetate and natural silk, or wool, etc. could have contained areas of the cellulose derivative fibre converted into cellulose (as in cotton or viscose) whereupon the fabric was given a simple carbonisation treatment destroying the 'reconstituted' cellulose derivative 'thus producing many beautiful effects.'[484]

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[480] (BP. 302,592). See Lipscomb. (1933). p.236. With reference to: 'Ornamental effects' achieved on woven fabrics.
[481] Ibid. Lipscomb. (1933). See Uses of Acetate Rayon. p.240.
[482] Vogue N. Y. (1927). Paris Fashions. Vogue. October 15, 1927. p.71.
[483] Saponification: 'The act process, or result of soap making; conversion into soap; specifically (Chem.), the decomposition of fats and other ethereal salts by alkalies; as, the saponification of ethyl acetate. ←"ethereal salt"=ester→' with reference to Webster's Dictionary of 1913 http://humanities.uchicago.edu/cgi-bin/WEBSTER.sh?WORD=saponify. [31 May, 2002].
[484] Camille Dreyfus. N. Y. (Application filed December 16, 1927, accepted May 12, 1931). Ornamental Fabric containing Derivatives of Cellulose and Method of Producing the Same. US patent 1,804,529. p.1, line 27-28.

Where a fabric was constructed solely of cellulose acetate or in a mixture with cotton and linen was treated, hole effects were certainly created. Furthermore, various textile structures could be ornamented by the process, including knitted and netted fabrics, but also ordinary weaves where Broderie Anglais style patterning was thought to be created on woven fabrics comprised of saponified cellulose acetate, cellulose formate, etc. and ordinary cellulose fibres.[485] The localised saponification of the cellulose acetate was realized by printing the cellulose derivative with an extremely strong alkaline paste of sodium hydroxide, potassium hydroxide, sodium carbonate, etc. Once saponified the fabric was then subjected to a carbonising treatment where the fabric was passed through a bath containing an acid such as hydrochloric acid or an acid salt such as aluminium chloride or sodium bisulphate. Upon drying the cellulose acetate that had been saponified was removed leaving a 'beautiful print' in the remaining weave, or knit structure, etc.[486]

The decorative nature of this Camille Dreyfus devoré fabric was further enhanced by dyeing, either in solid colour, or by cross dyeing ' to accentuate the printed effect', taking advantage of the necessity for dual fibre content in the fabric configuration, and in line with similar devoré processes, such as Fulton (1905), Clavel (1926), and Ellis, Olpin and Walker (1927). Camille Dreyfus also registered drawings with this American specification providing a basic description of the fabrics processing, while ensuring full protection of the technique, see Fig. 45.[487] This style of devoré textile if used for dress was presumably employed as a decorative layered fabric, however, the possibly of it being created for lingerie must also be considered.

Cellulose acetate filament was highly regarded for women's underwear during this time. Its image as a clean hygienic textile made it a popular fabric choice, furthermore, the difficulties faced by British Celanese when dyeing acetate in the early years of its development resulted in the building of knitting and weaving plants which specialised in the production of soft dress, lingerie materials and furnishing fabrics.[488] Hottenroth

[485] Dreyfus. (1927/1931). US patent 1,804,529. Moreover: 'Examples of cellulose esters are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate. Mixtures of two or more of the above organic derivatives of cellulose may be used.'
[486] Ibid. p.2, line 21-22.
[487] Ibid. p.2, line 30-42. Note image one represents the fabric woven with cellulose acetate and natural silk yarn alternating in the warp and weft. Image two depicts the area of local saponification, while the third image shows the completed area of fibre carbonisation
[488] Handley, S. (1998). Cloth, Clothes & Chemistry Synthetics: Technology and Design in the 20th Century. Unpublished PhD Thesis. RCA. p.74.

(1928) in his review of artificial silks noted women's stockings, knitted underwear and jumpers were increasingly manufactured of pure artificial silk. While enormous quantities of the fibre was being used for these articles, said to be '50 per cent of the total artificial silk consumption in England and 60 per cent of that in the United States', with the heavier artificial silk yarns of 300 denier were for the products described, but also 'knitted ties, shawls, waistcoat slips, fabric gloves, and so forth,....produced wholly or partly of artificial silk in considerable quantities.'[489]

While the use of devoré fabrics for 1920's underwear requires definitive confirmation the devoré process was considered for use in association with Terylene and cotton lingerie in the late 1960's. In Fabric& Fashion Trends, a fabric-swatched report on fashion looks emerging for autumn 1967 'The Devorant process of burnt-out designs in Terylene and cotton' was said to give 'a new delicate look for lingerie', with Hollins and Thomson said to be producing a small experimental range, see Fig 46.[490] The role of the devoré process in lingerie design in light of this evidence clearly necessitates future examination.

Two years after registration of the Camille Dreyfus patent, Henry Dreyfus proposed a devoré process that promoted the destruction of cotton or other cellulosic fibre from a mixed fabric of cellulose acetate; silk or wool from a mixed fabric of cellulose acetate; or saponification of cellulose acetate from a mixed fabric of wool and cotton.[491] The manufacturing intention of this patent was the production of ornamental effects such as lace, brocade, or raised figuring on woven fabrics. The woven fabric could either be treated in a hot carbonising bath with a suitable chemical that would ensure fibre degradation, or the local removal of pile or plush was achieved by applying a reserve against the action of the baths acidic substances, and which rather interestingly could also be coloured to create tonal effects on the remaining fibres. The unreserved portions of the fabric once treated in the hot bath disintegrated and were then fully removed by washing or brushing. Henry Dreyfus also suggested using the saponification process

[489] Hottenroth. (1928). p.374.
[490] Fabric & Fashion Trends. A fabric-swatched report on fashion looks emerging for autumn 1967. Number 2, December 1966. London. (No publishing information: British Library shelf mark P445/10). Terylene and cotton fabric, with cotton devoré.
[491] Henry Dreyfus. London, England. (Application filed August 2, 1935, accepted May 21, 1935). Treatments of Fabrics. US Patent 2,002,083.

advocated by Camille Dreyfus, whereby preliminary local saponification was created in order to remove the cellulose acetate (or ester).

Although this Dreyfus patent apparently integrates all of the devoré and saponification processes previously registered during the 1920's, its use of a heated bath suggested a means by which highly decorative novelty devoré textiles such as those held within the Liberty of London archive could have been manufactured. These four beautifully patterned pile textile samples, see Fig. 47, in colour ways of light sky blue (G12271), navy (G12272), burgundy (G12273) and light green (G12274), were constructed of areas of shiny yarn and matt in a panné velvet style. The manner in which the yarn has been composed within the fabric was particularly precise. Essentially the shiny and matt part of the floral petals meet perfectly, small shiny flowers have precisely composed spotty matt centres and the larger flowers have also been reversed to show matt centres and shiny ends. To achieve such a co-ordinated design through random devoré printing would have been impossible. Furthermore, the sheer ground weave is the same colour tonally as the matt and shiny pile, suggesting three different fibres used within the construction but dyed with one colour, with each fibre taking up the colour slightly differently.

While examining this Henry Dreyfus technique a possible explanation as to how fabrics similar to these Liberty novelties could have been manufactured by devoré could have been achieved if a fabric was woven with a patterning of full pile in all areas, including the area of apparent devoré treatment. While it is supposed these four Liberty of London samples are silk in content if theoretically the shiny element of the leaf was woven of cellulose acetate, the matt part of the flower delustred acetate or cotton and the area of the pile where devoré would eventually expose the ground weave was woven with waste silk, and the whole fabric was passed through a carbonising bath with a suitable chemical for degradation, the waste silk would have been removed in the alkaline bath that was accordingly strong enough to destroy the silk but not saponify the cellulose acetate, as suggested by H. Dreyfus. Once the blotch pattern area was removed via the carbonising bath the whole fabric was dyed using a single colour, if each fibre was chemically different (or appeared to have a different lustre, etc.) three varying tones would have been created. Naturally the fibre content of the textile could have been

altered so that regenerated cellulose could have been removed by a devoré process, with any silk fibre remaining intact.[492]

By the early 1930's cellulose acetate devoré had become an acknowledged method of textile decoration within the artificial silk textiles industry, though a distinct name for the process or the fabric created by the technique was still lacking. A. G. Lipscomb when assessing the Rivat and Celanese technique of cellulose acetate devoré (BP 302,592) represents the process as a means of creating 'Ornamental effects' on woven fabric. Moreover, while the connection between printed devoré and carbonising devoré had been made via the development of printed solvents, the cellulose acetate devoré fabric treatment still appears to have been regarded as a novelty process used to create novelty patterned textiles with no specific title or distinctive trade name. Natalie Kneeland reviewing Hosiery, Knit underwear and Gloves (1924), observed the difficulty in categorising novelty textiles could be broadly applied to the rest of the textiles manufacturing industries, in that it was pointless to attempt to catalogue the trade names of novelty textiles as they 'cause great confusion because when a firm puts out a fabric with a special name, other companies at once produce cloth which practically duplicates it. Of course the same name cannot be used, but the different materials are almost exactly alike.'[493]

During an extensive search for woven devoré textiles of the 1920's and also the Art Deco period, a detailed canvassing of British, French and American textile and fashion archives revealed surprisingly few pieces. However, the historical development of devoré fabrics became increasingly intelligible, a further detailed search of specific archives was instigated with more success. A greater understanding of the devoré processes employment and the associated devoré fabric structures promoted during the decade resulted in key textile manufacturers being confirmed as leading designers of woven devoré textiles. An appointment at The Museum of The Fashion Institute of Technology in New York in 1999, proved to be the catalyst for future archive review, as devoré samples recently acquired by the Museum proved that the woven pile devoré textile manufacture was in operation during the 1920's and that devoré manufactured samples were still in circulation.

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[492] If these fabrics are all silk it is thought a low grade cellulose fibre would have been woven in and subsequently removed by carbonising.
[493] Kneeland, N. (1924). p. 88.

Pile woven devoré textiles

The Museum at The Fashion Institute of Technology, New York, N.Y.

The collection of pile woven devoré textiles examined at The Museum at the Fashion Institute of Technology in New York was attributed to the company of J.-B. Martin, the renowned velvet manufacturers, see Figs. 49 to 55. The J.-B. Martin Company founded by Jean Baptiste Martin (1801-1867) in 1841-1843 exported high quality velvets from the early part of the nineteenth century from its location in Tarare north west of Lyon in France. The company established its American manufacturing base in Connecticut in 1893, in accordance with other foreign companies that established mills in the USA in order to compete directly with American manufacturers, but also to avoid excessively high import duties set by the US Government on velvets and plush fabrics. In 1898 J.-B. Martin merged with E. Charbin et C^{IE}, C. Chavant and Crozier frères to form Manufacturers de velours et peluches, J.-B Martin. In 1950 the company relocated to South Carolina and its French mills closed in 1978. The company's connection with the Fashion Institute of Technology resulted in the establishment of a specially designed velvet room, as shown on the J.-B. Martin website, with support provided for exhibitions such as 'Extravagant Lengths. Velvet, Plush and Velveteen' in 1991.[494]

In discussing the history of the J.-B. Martin company with Joanne Carter Dolan, then Assistant Curator of Textiles at The Museum at F.I.T., it appeared the origin of these floral pile devoré textiles was provisional, being French or American, moreover, it was suggested these samples were likely to have been manufactured by a French textile company and only incorporated within the archive of J.-B. Martin during a later company merger.[495] Moreover, American companies customarily purchased French textile print designs during the early part of the twentieth century, although American designers and textile companies began to redress this trend during the 1920's. As to the possible date of manufacture of these devoré pile textiles, at the time of visiting The

[494] See J. B. Martin homepage. (2004). [online]. Available from http://www.jbmartin.com/home.html. [Accessed: 1 September, 2004]; See exhibition pamphlet Extravagant Lengths. Velvet, Plush and Velveteen. 1991. F. I. T. New York. From the Exhibition, November 19, 1991-January 11, 1992 with reference to J. B. Martin Company Inc.

[495] As discussed with Joanne Carter Dolan, Assistant Curator of Textiles. [Visit and archive review with Joanne Carter Dolan at The Museum at the Fashion Institute of Technology. New York. N.Y. 19th May, 1999].

Museum at F. I. T. visit in May 1999 these samples were newly obtained and unclassified.

Consequently an examination of the distinct patterning of the floral design initiated a search of The Museum at F. I. T. print archive, as these pile textiles were clearly printed by a devoré paste rather than treated by resists and carbonising and therefore similar motifs or style of mark or design composition may have been printed onto other dress textiles. Accordingly a printed sample donated by S. Silverman manufactured by Wager and Hirsch in 1928-1929 featured a close patterning style with similarities in drawing and linear style of the floral imagery, with comparable shadow design around leave shapes, and a sense of fluidity of line describing both petals and leaves respectively. The seemingly random placement of inch long curved dissecting lines was a shared and unusual stylistic feature, see Fig 48. A credible retail date for these J.-B. Martin samples is therefore thought to be between 1925 and 1931.

The colouring of the J.-B. Martin devoré samples tends towards dark chocolates, creams and black, however, the lustre of the fibre used in the pile also generates a bronze shimmer. Although the same image has been repeated on each sample there are in fact three colourways. The first devoré sample examined, measuring 39 cm drop by 92 cm wide, see Fig. 49, has a face of chocolate brown pile while on the reverse the devoré print is darker in its colouring, see Fig. 50. The dark printed floral images evident on all three samples measures approximately 11 cm in diameter, with linear spiky shapes the only other pattern interspersing the densely arranged floral figures.

It is incontrovertible that this particular fabric was dyed with a single colour, with the pile fibre dyeing lighter than the ground weave. The colouring of the fabric's selvedge also supports this theory, as fibre removal is also evident in the area of devoré printing. Clearly part of a roll end, the devoré print on the cream fabric appears to only have been partially successful in its fibre removal, while in some areas, and also evident in places on the reverse of the fabric, the image appears to have been misprinted and is shadowed marked supporting the hypothesis of the devoré paste being applied to the reverse of the fabric. Moreover, the devoré printing paste may have been coloured black or dark brown, although it is possible the action of heating caused the devoré print area to singe giving a burnt colour to the remaining ground weave. However, B. S. Hillman writing of devoré on viscose velvets in 1937 advised readers of the Rayon Textile monthly that

Dural Black B (Colour index 307), and Pharmacine brown R were suitable acid colours for combined carbonising and colouring of cellulose fibre based pile fabrics.[496]

The second J.-B. Martin devoré sample, measuring 35.5 cm drop by 91 cm wide, also employs devoré as its sole form of fabric patterning. The floral imagery was applied to the reverse of the pile fabric creating a clear area of fibre destruction, while the pile face appears soft and feathery. The selvedge of the fabric was also slightly destroyed in the area of devoré print. The scale of the repeat design measures approximately 20 cm drop by 54 cm across, yet the fabrics foremost design characteristic is its open and delicate plain woven ground visible in the area of devoré print, a feature counterbalanced by the feathery quality of the pile fibre, as in a plush fabric. As with the first chocolate brown sample, this second fabric is also restrained in its design. Dyed with a single light mushroom or cream colour, a request to have the face see Fig. 51, and the back see Fig. 52 magnified revealed the consequence of removing pile fibres by devoré, in that the remaining scaffold structure was unevenly distorted. Accordingly the fabrics pile face, see Fig. 53 and the samples reverse side, see Fig. 54, indicate the devoré print was not coloured or simply did not singe during heating.[497]

The third J.-B. Martin devoré sample, measuring 56 cm drop by 91 cm wide, was dyed a similar colour to the second sample, however, on the back of the fabric the area of devoré print is darkly coloured, see Fig. 55. The scale of the floral image suggests the fabric would have been used for coats or capes, requiring a similar weighted or lighter fabric lining, although the limited removal of pile fibre also suggest the fabric may have been used for dresses, skirts or tunics, all of which would have required a lining. The outstanding feature of these three beautiful samples is their simplicity of design, in that the colour palette is limited and no other form of embellishment has been added, further suggesting these fabrics were marketed for daywear or were test pieces.

The emerging trends in velvet and velveteen fabrics such as these J.-B. Martin samples was regularly featured in Fairchild's Bulletin. For example in the April 30th 1928 issue the publication advised its textile industry readership of 'Velveteens Demanded by America'. The view point of the London traders was that the sale of cotton velvets to American buyers was on the increase while 'Shipments of cotton velvets to America

[496] Hillman, B. S. Soda Prints on Pile Fabrics. Rayon Textile Monthly. February 1937. p. 54 (94).
[497] It should also be noted in order to photograph this particular sample a dark background was requested in order for the light ground weave to be clearly visible.

during the recent months have been composed mainly of plain materials, although certain demand is said to exist for printed goods, while the colours in favour for that market are stated to be black, red and brown.'[498] Furthermore, it is apparent that the J.-B. Martin devoré fabrics were dyed in colours popular with this period. The news from New York textiles merchants in October 1928, was that velvet as a dress fabric was according to the "Fairchild's Fabric and Color Analysis", said to be 'twice as strong as its nearest rival for the autumn season. While velveteen was considered important for suits, ensembles and formal daytime coats, shades of brown and beige were prevalent alongside blues which was written of as the colour that had become most used for dress colour. As for patterning 'The greatest importance is still attributed to prints.'[499]

These J.-B. Martin pile fabrics were manufactured in the colours used within dress fabric of the late 1920's, and importantly for the dating of these samples the use of beige and brown for daytime wear continued to be popular with Parisian fashion houses well into Spring 1929. The fibre content of these samples is thought to be either a mixture of natural fibres, such as cotton and silk, or a mixture of silk and reconstituted cellulose or viscose. In order for the devoré process to have worked successfully the ground weave and pile either had to be manufactured of different fibres, or manufactured of a single fibre with the ground weave fibre pre-treated with a protective resist. If a silk pile and cotton mix was used in this pile fabric Heberlein's (with Albert Bodmer) technique of alkaline printing dated December 1925 could have been used. Moreover, Arthur Swallow's process (with the CAP) of 1925 would also have worked effectively on this textile. However, it is the earlier 1895 patent of Wissel, Girard and Brunier, with velvet patterning created by means of a printed alkali or 'chemical remover' that this particular devoré fabric sample is indebted for its development.

Devoré textiles in The Tirrochi collection and The Museum of Art at RISD, Rhode Island, USA.

An American devoré textile of the 1920's was discovered at an online exhibition curated by The RISD Museum and The Brown University Scholarly Technology Group entitled the A & L Tirrochi Dressmakers Project 'From Paris to Providence.' Featured

[498] Fairchild's Bulletin. (1928). Velveteens Demanded by America. Fairchild's Bulletin. April 30, 1928. p.5

[499] Colour review and information regarding thoughts form various merchants see Fairchild's Bulletin. (1928).Velvet Sales Big in America. Fairchild's Bulletin. October 1, 1928. p.7

within its examination of 'Art Deco' textiles was a bold and distinctive devoré sample classified as 'Length with Ovals', thought to have been manufactured in America in about 1926, see Fig. 33. The discovery of this black silk plain weave treated by 'chemical burn out' brought about contact with The Museum of Art at RISD with the result that an ongoing discussion with Madelyn Shaw, Associate Curator of Costume and Textiles in the Museum of Art, Rhode Island School of Design, resulted in her taking a detailed look at the whole RISD textile collection in the hope of locating other examples of woven devoré textiles.

With regard to this sample discovered as part of the Tirocchi legacy, the background to the samples preservation has provided further evidence as to the nature of devoré manufacture and use within dress of the period. Accordingly, Anna Tirocchi, Italian trained dressmaker, together with younger sister Laura established an exclusive dressmaking shop, *A & L Tirrochi Gowns*, in Providence Rhode Island. Alongside garment alterations and adjustments, remodelling, repair and pressing, the sisters offered custom fitted designer dresses, a line of ready to wear (from 1927) and contemporary European styled accessories to the affluent women of Rhode Island, whose families were successfully involved in the textile, jewellery, machine parts, rubber and oil industries.[500] The Tirocchi's Providence clients were primarily interested in obtaining distinctive Parisian inspired clothing, constructed of high quality materials. In Anna Tirocchi they encountered a dressmaker conversant with the latest Paris trends and who used the latest French and American fabrics obtainable from American and European dress fabric suppliers.[501]

The existence of devoré fabric within this collection suggests its design and style was considered appropriate for use in the Tirocchi's bespoke and high quality clothing. Essentially, if such a style of fabric was worthy of Anna Tirocchi's attention, it was thought suitable fashionable for her clients. Susan Hay's Essay on Modernism in Fabric: Art and the Tirocchi Textiles, portrays Anna Tirocchi as a buyer who sought out the 'most luxurious and beautifully designed fabrics she could find from the font of all

[500] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. The term was applied to off the peg clothing in America in the 1920's by the fashion industry and should not be confused with the concepts of Prêt a Porter of the 1960's.
[501] Hay, S. Curator of Costume and Textiles. Museum of Art, Rhode Island School of Design. (2003). Essay entitled Modernism in Fabric: Art and the Tirocchi Textiles. [online]. Available from http;//tirrochi.stg.brown.edu/essays/hay_fabric_01.html [Accessed: 17th July 2003].

fashion.'[502] Accordingly, this plain weave silk textile appears to have been printed with an all over design of tumbling oval shapes, on the fabrics reverse side. Although simplistic in its design and manufacture it is a fun modernist styled print that would have worked well for dresses, coats and capes. Giesler's 1913 patented technique could have been easily been employed to create this fabric, so conceivably could Futon's plain weave process (1905), however, if the was constructed purely of silk, a resist and carbonising treatment may have been more suitable as the density of the weave would have allowed for full saturation of the resist.

The researching of other devoré fabrics held within the Costume and Textiles collection at the Museum of Art, at Rhode Island School of Design, also completed by Madelyn Shaw in July 2004, accordingly revealed a second devoré textile also part of the Tirocchi collection. Madelyn Shaw described the sample accordingly, "probably an American made fabric (the words "pure dye" appear in the selvedge every 30"). Off white silk chiffon ground (alternating S and Z yarns in ground) with woven design of flowers in plain and 5/1 twill weaves (the center of each flower head is in plain weave, the petals in twill, and a border around each petal in plain). Patterning yarns are rayon. It appears to have been printed with the burn out paste on the reverse." [503] The archive holds a full length of this sample; with its full selvedge it measures 2m in length, see Fig. 56.

The delicacy of this fabric is unlike any previous woven devoré fabrics discovered as part of this study. The fibre use, visual styling and weight of the fabric is similar to contemporary silk viscose satin devoré textiles, see Fig.74. The quality of the print and the subtle colouring shows the sophisticated level of devoré printing that was achievable during the late 1920's. This style of fabric was likely to have been used for light weight dresses or lingerie. Placed over a slip or created with a lining the hang of the chiffon would have created an elegant layering of textures.

The styling of this Tirrochi fabric is in marked contrast to two Bianchini-Férier pile devoré samples held within the archive. The first leaf design sample (51.328) is

[502] Parmel, P. A. Curator, Department of Textile and Fashion Arts. Museum of Fine Arts, Boston. (2003) Essay entitled Line, Color, Detail, Distinctions, Individuality: A & L Tirocchi, Providence Dressmakers.[Online]. Available from http://tirocchi.stg.brown.edu/essays/parmel_01.html. [Accessed: 17th July 2003].
[503] Shaw, M. Associate Curator, Costume and Textiles, The Museum of Art, RISD. (2004) [e-mail from Madelyn Shaw, mshaw@risd.edu, 26th July, 2004].

described by Madelyn Shaw as "an open weave semi sheer like chiffon, with silk warp and weft yarns alternate S and Z twist (VERY tightly twisted) giving a very slightly creped effect to the ground. The leaf print has also been overprinted on the ground, not lining up with the burnout design at all." The four selvedge fragments are 6" long, see Fig. 57-60b.[504] Preserved in four different colourways the leaf pattern is created by destroying the surrounding pile fibre, in a similar way to Liberty fabric Fig. 31, 32 and 39. The negative etching of the background has been enhanced by the printing of a discharge image on the reverse of the fabric. Using the same pattern but off set and over layering the pile leaf shapes a dense feeling of image is created. The use of a single dye on the fabric has created a two tone effect with the rayon and silk taking the colour differently. The discharging of the two colours has subsequently created a further two shades. This is particularly evident in sample 51.328.3, represented by Fig. 58 and 58b. Sample 51.328.1, see Fig 60 and 60b, dyed black and overprinted with a strong salmon orange colour discharge appears to have more of a tonal styling. The dark velvet pile sits on a soft charcoal chiffon ground and the colour print created a light shade on the ground and a darker pink on the remaining pile. The highly decorative patterning of this fabric and the quality of its manufacture suggests Bianchini-Férier were highly skilful at printing devoré on mixed fibre velvet fabric.

The second Bianchini-Férier devoré sample is described by Madelyn Shaw as a "black chiffon velvet with burn out design of spikes of flowers, overprinted with same design in different colors, not aligned with the burnout design; Chiffon type semi sheer ground is alternating S and Z twist yarns." The pile yarn was also made of rayon while the use of a crêpe yarn for the ground weave was highly popular during the winter season of 1925 and 1926, as previously stated, see Fig. 61 and 61b.[505]

The use of plain and colour discharge in the areas of devoré print is unusual. An enlargement of this sample, see Fig.61b, shows a detail of this mixed plain to blue printing and the area where the print repeat line is thought to occur. It is possible that the colour and plain discharge prints were applied to the back of the fabric and then steamed and over printed with the devoré. However, it is plausible that the devoré print was applied to the front of the pile fabric and the colour and plain discharge print to the reverse at the same time, as in duplex printing. What is clear from this fabric is that the

[504] Ibid.
[505] Vogue Fashion Bi-Monthly. USA (1925). Feminine, varied, supple, gorgeous. Vogue Fashion Bi-Monthly. (October-November 1925). Vol. 1- no.1. p.9.

devoré and discharge paste were not combined, as the edge of the devoré is considerable wider than the discharge print. The etched quality of this design is in contrast to the previous Bianchini-Férier sample. The floral design is created by the devoré chiffon ground, in a similar way to the J.-B. Martin pile fabrics.

The fashion critics take on Bianchini-Férier collections from 1925 to 1928 was always deferential. Vogue magazine regularly profiled the latest fibre and fabric developments made by this company and its designers.[506] Bianchini Férier were consistently noted for their 'evening scarfs' which were key to their collections and regularly used larger scale patterning, however, the company was highly inventive and manufactured an 'enormous collection of printed fabrics' and a diverse collection of woven textiles, for instance in one season daytime and evening lamés, cut velvets, printed velvets, velvets 'on metals, on gauze, on crêpe, and on georgette crêpe', ombré moiré, ombré velvets, satins, ribbed silks, and printed crêpes, were only a few of the total range available.[507]

By way of indication as to their client base, in London these fabrics were available at Harvey Nichols and Harrods. For Bianchini Férier to have experimented with devoré velvet designing makes perfect sense when the diversity of their fabric collections is recognised. The ease with which Bianchini Férier could have created velvet devoré textiles by printing should also be highlighted as they clearly had the manufacturing resources to trial and then produce such textiles.

Velvet lames and Tinsel brocades and devoré.

The popularity of printed velvets, cut out velvets and lamés was also reflected in the Liberty & Company Ltd. special goods catalogue dated late 1920's (after 1925) in which there are six thin strips of what may be devoré patterned tinsel brocades, each in a differing colourway, but all constructed with silver metal thread. The fabric's patterning is based around a fern leaf, which rests beside a larger silhouette leaf shapes reminiscent of a vine or other trailing plant. These six samples, slightly smaller in size than a British A4 envelope, show different sections of the fabrics patterning, but unfortunately fail to give an idea of the complete design and as a consequence there is

[506] Bianchini Férier was renowned for its large silk weaving mill in Lyons, which was established in 1888. In the 1920's they commissioned textile designs by artists including George Barbier, Robert Bonfils, Raoul Dufy and Paul Iribe, A. F. Lorenzi, and Charles Martin. See Jackson, L. (2002). p. 141.
[507] Vogue. (1927). Bianchini Férier Fabrics. Vogue. (September 7, 1927). p.59, 81.

little evidence of the size of the images repeat. Each fabric has clearly been dyed with a single colour after weaving, consequently the pile fibre taking on a rich deep hue and the tinsel or metal thread being tinted a softer and more silvery version. Accordingly, sample G12455 is a bright turquoise, G12456 is a rich burgundy red, G12457 is a fresh strong mint green, while G12458 is a plum or deep purple, G12459 a rich chocolate red shade and G12460 royal blue, see Fig. 62. If these are in fact devoré fabrics the areas of visible plain woven tinsel represents the area of devoré, while the remaining velvet weave, thought to be silk, appears unharmed by the devoré processing.

Manufacturers noted for such fabrics included Bianchini Férier who in September 1927 presented velvets on metal, using a combination of metallic and silk thread, they were particularly highlighted for their soft metal fabrics which were previewed in Vogue alongside silk and metal laces, transparent metal gauze and a breadth of velvets, including artificial, cut, printed, woven, transparent and plain. The Ducharne collection with its 'youthful attitude' and freshness of outlook' also heavily relied on metal materials during the winter season of 1927.[508]

Other manufacturers such as Coudurier, Fructus and Descher, Wiener, Rémond et Cie, Cheney and Haas were also involved in metal lamé and tinsel fabric production. These highly decorative and vibrant metal fabrics were popularly used for evening wraps and decorative dress. B. S. Hillman, in Rayon Textile Monthly noted in 1937, that tinsel and Cellophane novelty dress velvets differed from transparent velvets mainly in the nature of the pile, which was stiffer than ordinary viscose. Moreover, whether the pile was constructed partially or wholly of Cellophane or tinsel threads it's processing was said to be 'no different than for true transparent velvets.'[509]

Two examples of metallic styled "velour devoré" located within the Musée des tissus, Lyon, attributed to Coudurier-Fructus-Descher and Hurel (part of the Lapidus collection) respectively, supports the hypothesis that tinsel velvets, such as these Liberty samples, could be manufactured by devoré processes. The CFD sample, dated 1929, is a bold abstract floral and leaf design in navy blue velvet with gold ground weave, see Fig 63. The second devoré textile is attributed to Hurel and has been employed as a pull down top, see Fig. 64. Its design and use of metal thread has resulted in an incredibly

[508] Vogue. (1927) The Ducharne Collection. Vogue. (7th September 1927). p.58.
[509] Hillman, B. S. (1937). Rayon Textile Monthly. (January 1937). p. 55. (23).

ostentatious fabric perfectly in keeping with late 1920's evening wear fabric trends and other cut velvets manufactured with metallic threads.[510] Liberty samples G11959-G11962 are also important to highlight at this point. These four matching samples in varying colourways exhibit a beautiful simplistic patterning formed by areas of gold thread interspersed within the weft. Where visible this decorative scaffold sits back from and contrasts against the richly coloured pile fibre, which in this instance is used as plain relief to the gold thread design. The abstract and floral patterning has a strong etched devoré feel in its styling, see Fig. 65. Accordingly, the similarity between this Liberty sample and a Ducharne cut velvet silver lamé shown within Vogue, in September 1927 should be recognised. Both samples use the exposed lamé to form the flower patterning, see Fig 66.

As a result of the research conducted into these metal thread velvets some future investigation into metallic pile devoré textiles and the connection to the manufacturers and designers of metallic thread cut velvets would clearly be of some interest. The possibility of other metallic pile fabrics decorated by devoré still being in existence is highly likely, with samples held within Lyon factories catalogues as yet not inventoried is also thought probable.[511] Furthermore, the chance discovery of a highly decorative Chinese styled velvet metal thread devoré textile used for an evening coat, discovered during a visit to an exhibition entitled 1920's: The Decade that changed London (October 2003- July 2004) at The Museum of London, further emphasised the research potential of this seemingly neglected area of textile design and manufacturing. Constructed from pale gold silk devoré velvet with gold lamé in an abstract 'chinese architectural' pattern, this woman's evening coat is knee length and has artic fox fur around the neck and shoulders, see Fig. 67. [512]

The lining of the coat is of apricot silk velvet and has an embroidered dressmaker's label of W. W. Reville-Terry of 50 Grosvenor Street, London, see Fig 68. The use of the metallic thread in the weave is clearly evident and appears to be used as a supplementary weft yarn, see Fig 69. The metallic thread creates a greater feeling of shimmer when seen under low lighting, see Fig. 70. The etched patterning effect is

[510] Guelton, M.H., Musée de tissus, Lyon, France (2003) [e-mail from Marie-Hélène Guelton, guelton@lyon.cci.fr. 26th July, 2003].
[511] Ibid. With reference to an e-mail sent by Marie-Hélène Guelton.
[512] Museum of London catalogue. ID number 68.23/1/ gift, 1968-03-04. Permanent collection Made by W.W. Reville Terry of 50 Grosvenor Street. Worn by Lady McCorquerdale of Cotswold Park, Cirencester, Gloucestershire.

thought to have been created by a printed devoré process, which would have destroyed the pile fibre loops on the reverse of the textile. Remarkably the front left panel of the coat is designed to be an exact copy of the right but in negative, moreover, the top patterned section of the coat from the shoulder seam to the horizontal geometric strip is identical on both sides but mirrored. A coat design with similar fabric patterning and fur trimming was shown in Vogue London in late September 1927, q.v. Fig. 71. Reviewed under the heading of 'New Autumn Patterns have a Special Distinction', Evening wrap No S3155 also employed metal cloth and velvet and was designed for sizes 16 to 20 years and 34 to 44. [513] The Museum of London coat has been dated at 1930, with its owner the Honourable Daisy Yoskyl Consuelo Pearson-Churchill (b. 1906) daughter of the 2nd Viscount Cowdray and Agnes Beryl Spencer-Churchill, said to be unmarried at the time of its being first worn.[518] Undoubtedly this coat requires further study, with its fashion house a strong lead with which to begin an investigation of the fabric's manufacturer and location.

Summary and conclusion.

- The increase in decorative textile manufacturing in the early 1920's considerably influenced woven devoré textile development. With the process adapted to reflect printed patterning and weaving tends of the period.

- The fibre and fabric trends of the period were also evident in the styling of woven devoré fabric. Innovative combinations of metallic threads, tinsel, lame and cellulose acetate were used alongside pre First World War woven devoré fibres and processes.

- Natural fibre devoré remained an important aspect of the technique. With open work and natural fibre devoré techniques employed within furnishing fabrics and upholstery.

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[513] Vogue. London. (1927). These New Patterns Have a Special Distinction. Vogue. September 21, 1927. p.85.

[518] See www.thepeerage.com/p2023.htm~i20228; for Hon. Daisy Yoskyl Consuelo Pearson/ Churchill. The first of her three marriages wasn't until 1932.

- Cellulose acetate devoré was the principal woven devoré fibre within patent registrations. The woven devoré process was once again adapted to suit innovation in fibre development.

- Consequently influential companies and recognised textile engineers adapted the woven devoré process to suit innovations in both regenerated cellulose and derivative of cellulose fibres.

- The influence of the chemist on the woven devoré designing was evident within the manufacturing technology used to both create and decorate textiles.

- The development of the ready made clothing collections stimulated the development of the woven devoré process. The extent of woven devoré textile manufacture was at its greatest during the mid to late 1920's.

- The woven devoré textile could be as exclusive as any other highly patterned fabric, the process was employed to create bold and dramatic patterning on a wide range of woven textiles.

The decorative woven devoré textile continued to be developed for some time during the early years of the 1930's however, the effects of the world economic crisis of 1929 – 1933 was to drastically influence its design and manufacture. In America, the seasonal fabric and dress trends dictated by Paris were losing influence with the consumer, the ready to wear collections were allowing home grown designers the chance to establish their own designs.[514] The collapse in international commerce caused in part by the recalling of loans by America meant the textile industries were hit hard on the export front. Raw silk processes declined, and a protectionist atmosphere prevailed. The woven textile manufacturers faced by economic depression adapted their products and continued to invent original textiles by the devoré method, however, the atmosphere of economy prevailed from this point onwards, with the end of the 1930's seeing a time of gradual decline in the processes development.

[514] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. The term was applied to off the peg clothing in America in the 1920's by the fashion industry and should not be confused with the concepts of Prêt a Porter of the 1960's.

Chapter 5

Economic depression and design innovation.

Chapter 5

Economy and design innovation.

Anna H. Rutt a commentator on American Home Furnishing writing about 'Recent Developments in the Twentieth-Century Style' described two distinct phases of the 'modern movement'. The first phase consisted of 'produced forms that were very individual. They were often eccentric, over-adorned and very costly to produce', losing favour at the close of the Paris Exposition of Modern Decorative Arts in 1925. The second stage of the movement, well advanced by the time of her writing in 1935, was focused on the opportunities provided as part of the machine age, 'The aim of the designers is now to create simple, beautiful, functional things, suitable for mass production by machinery, at such low cost as to be available to all.'[515] However, the 1930's interior whether modern or traditional in design, remained predisposed towards the display of beautiful woven fabrics. The use of plain woven sheer curtaining was one example of how woven textiles were adapted to impart lighter, less fussy elements within the home. Sheer and semi-sheer lightweight fabrics, including plain and coloured voiles and muslins, were affordable because of the use of modern fibres such as regenerated cellulose and acetates. Consequently a popular and long lasting trend in using these fabrics was established. Woven devoré manufacturers also modified their processes to take advantage of such fabric trends. Devoré when used in association with plain woven textiles created sheer and lightweight opaque patterned fabrics.

The use of pile fabric within upholstery was also on the increase, with reference to B. S. Hillman. Although many types of novelty plush were available, mohair pile had become widely used within upholstery fabrics. Accordingly, imitation Jacquard mohair plush was classed as the most popular devoré fabric during this period.[516] In the dress textile market an increase in the use of velvets in the early 1930's was regarded as a consequence of the development of crush resistant velvets. Meanwhile other popular novelty dress velvets such as tinsel velvets, "Cellophane" velvets and glass velvet were also in existence prior to 1936.[517] The pile devoré textiles manufactured in the mid 1930's were still regarded as novelty textiles, with their style of decoration classified as

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[515] Rutt, A.H. (1935). Home Furnishing. London: Chapman and Hall. New York: John Wiley and Sons. Inc. Ltd. p.146.
[516] Hillman, B. S. Rayon and Melliand Textile Monthly. June, 1936 p.46. (364).
[517] Hillman, B. S. Rayon and Melliand Textile Monthly. February, 1936. P.71. (107). Note Cellophane fibre was manufactured in much the same way as viscose.

a fancy or special despite the process delivering a diverse breadth of patterning that didn't conform to any one particular style.[518]

The designers and manufacturers of devoré textiles throughout the inter war period saw growth and economic depression in the textiles market. The latter half of the 1920's had seen considerable investment from America into Europe, in part to aid in the modernisation of a range of manufacturing industries. However, the infrastructure built to deal with this economic disbursement was not particularly successful, and after the crash of the New York stock market in October 1929 and the worry over poor returns, American investors withdrew. After 1930 Europe received little American investment, with the great depression from 1929 to 1933 indiscriminately destroying industries worldwide. Teed (1992) states 'Farmers could not sell crops; factories and industrial concerns could not borrow and had to close; workers were thrown out of work; retail shops went bankrupt; and governments could not afford to continue unemployment benefits, even when these had been available....Unemployment in Germany rose to 6 million, in Britain to 3 million, and to 14 million in the USA, where by 1932 nearly every bank was closed.'[519] Quotas, tariffs and manufacturing protectionism, introduced to relieve the impact of price competition, protected the textile trade and in consequence boosted home and export markets. H. James (1996) in his assessment of the fall and rise of the European Economy in the Twentieth Century notes 'The effects of the depression were felt until the outbreak of the Second World War, as in most countries, even though production recovered, unemployment remained at high levels.'[520]

The impact of world economics on the manufacturer and consumer of woven textiles, and textiles goods in general, was also reflected in the development of woven devoré techniques registered during the 1930's. Cellulose acetate remained a popular fibre on which to base woven devoré techniques as it had considerably reduced in cost, with the printing of destructive pastes rather than the dissolution of fibres seemingly much preferred as the chemical expenditure was significantly cheaper. The development of more unusual fibres and woven textile products intended to be economical, hard wearing and generally functional, such as those made of rubber, were also created by means of woven devoré manufacture during this period. The velvet devoré innovator

[518] Ibid. (June 1936). p.46. (364)
[519] Teed. P. (1992). Dictionary of Twentieth Century History. Oxford: OUP. p.121.
[520] Blanning. T. C. ed. (1996). The Oxford Illustrated History of Modern Europe. Oxford: OUP. see James, H. The Fall and Rise of the European Economy in the Twentieth Century. p.185.

Carl Theodore Pastor, operating prior to the First World War, envisaged rubber thread being formed into woven or knitted textiles, to create partially elastic and non-elastic textiles suitable for belts and bandages which importantly retained their manufactured form. Why these textiles came into being was a reflection of the innovation required but also triggered by periods of mass economic recession. M.S. Woolman writing during the economic recession after the First World War noted rubber was considered a worthy substitute for leather and was accordingly used for 'many practical purposes in dress, among which are waterproof coats, hats, rubber shoes, rubber heels and soles, dress shields, bibs, aprons, and gloves.[521]

The woven devoré process, at the beginning of the 1930's, clearly underwent a resurgence of development. A time of relative stability had given textile inventors an opportunity to take advantage of new fibres and mixed fibre fabrics. For the most part woven devoré manufacture during the mid 1930's remained orientated towards the production of textiles that were considered purely ornamental in purpose. Moreover, the manner of their production was to be further enhanced by the establishment of hand screen-printing fabric methods. This process developed during the 1920's and 1930's, presented an expressive and rapid means by which to create prints with a variety of colours and on a range of woven fabrics. Used primarily in conjunction with 'art silks' such as viscose and acetate rayons, Storey notes of its development that 'a process was required which would print, easily and less expensively, greater yardages than could be managed by the slow hand blocked method, and yet not so great as were needed for economic roller printing.'[522]

Generally it was the couture fashion designer who found this new printing process to be incredibly versatile as it allowed for the creation of smaller fabric runs that were essentially more exclusive in their manufacture. Moreover, screen printing fabrics provided a means of counterbalancing the mass production and standardisation of interior and dress textiles. For the producers of woven devoré fabrics, the screen-printing process was found to work equally well with a range of chemical disintegrating pastes. The designing of woven devoré textiles, in line with other woven textile

[521] Woolman Mary S. (1920). Clothing Choice Care Cost. Philadelphia/ London: Lippincotts Family Life Series/ JB Lippincott Company. p.80

[522] Storey, J. (1992). The Thames and Hudson Manual of Textile Printing. London: Thames and Hudson. Page 108. Note the roller printing method was often associated with low quality prints, often of few colours and sometimes poorly registered. It manufactured huge runs of fabrics, which were unviable during these times of economic instability.

printing, was to become heavily reliant upon this revolutionary printing process for initial design sampling.

Towards the end of the 1930's woven devoré was still utilised in the generation of new textile products. However, it was the design and manipulation of fibres including new techniques of colouration and chemical treatments that clearly interested the majority of its innovators. This change in emphasis was to radically alter the nature of its employment well into the 1950's. For a time the development of soluble alginate (seaweed based) support fibres in 1941 reduced the prominence of fibre devoré. These alginate fibres adhered themselves to previously unworkable materials in the spirit of Louis Chaux's process of 1883, and countered the issue of waste that the destruction of support fibres created. By using alginate support threads a whole range of fabrics were supposedly created in aid of the war effort. [523] However, the impact of the Second World War once more interrupted the continuance of woven devoré manufacturing. Although devoré was designed to be a process that could be employed in the creation of economical textiles, the destructive nature of its approach meant in times of true shortage it was materially expensive in its use of raw fibre, while even the use of alginate support fibres became prohibitive during the most critical period of the war years. [524]

Woven devoré in the early 1930's.

In 1937 E. Lewis noted the largest producer of Rayon was the United States followed by Japan. The Courtaulds Factory in England manufactured 20% of the world's output, while the styles of rayon accounted for 87.5 % viscose rayon, 9.7 % acetate rayon and 2.8% cuprammonium and nitrocellulose.[525] A year previously, the world depression had engendered the rapid development of the industry in Europe, Asia and America. From the decade's initial development, which had slowed in 1930 and 1931, a marked increase of 120 to 140% over 1929 saw 1935 as the highest period of production.[526]

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[523] Bertram Pusey Ridge. I.C.I. (Accepted August 19, 1952; BP March 17, 1948) Production of close woven cellulose fabrics by dissolving Terylene support yarn. US patent 2,607,656.
[524] Ibid. the use of alginic threads is thoroughly discussed and the following stated: 'A further disadvantage is the large quantity of alginic yarn or filament which is dissolved away and the resultant high cost of such a process'.
[525] Lewis, E. (1937). The Romance of Textiles. The Story of design in weaving. New York: The Macmillan Company. P.325.
[526] Rayon Publishing Corporation. (1936). Greatest Expansion in Rayon Production Centers in Japan. The Rayon and Melliand Textile Monthly. (March 1936). P.67 (171).

While the degree of the artificial fibre use in woven devoré textiles slowed during the 1930's the development of new ways of utilising it to create new fabrics was seemingly continuous. The reasonable cost of viscose to the textiles manufacturer meant it was popular with consumers, with the world's production of rayon exceeding that of silk by 7 times in 1934. [527] Acetate Rayon filament although clearly not as widely manufactured as viscose, was distinctive for its less than 1% waste in manufacturing, however, it should be noted that by 1937 the chemicals employed in its manufacture were disproportionate to any material savings.[528]

Without doubt the woven cellulose acetate devoré processes developed during the 1930's were primarily used to decorative fabric. However, an exception to this customary employment was a devoré technique proposed by William Mendel, which advocated the creation of delicate and stylish braids or ribbons for decorating hat crowns. While equally innovative in its manufacturing processes as the previous decades cellulose acetate devoré processes, its treatment was limited to a smaller ribbon textile, widely used during this period to enhance otherwise unvarying outfits. The patent drawing that accompanied this particular specification shows a beautiful open weave ribbon created on a braiding machine, see Fig. 72. Mendel also suggested the technique be used in the creation of patterned knits whether flat or tubular in form, or other similar cross weave fabrics. The breadth of design was possible because of the combining of an insoluble artificial cellulosic filament pattern on a soluble artificial cellulosic warp frame, with the soluble filaments cellulose acetate or cellulose nitrate and the insoluble viscose. The warp frame after being dissolved out formed a residual weft patterning. The combined use of cellulose acetate and viscose was notable because of the decision to retain the viscose fibre. This suggests either the quality of the cellulose acetate fibre was not as superior as the viscose, or the cellulose acetate was cheaper to destroy than the viscose possibly being reclaimed during processing. [529]

Ribbons when applied to hats or other accessories helped co-ordinated a garment, they provided a sense of novelty or modernity to an otherwise relatively unvarying outfit, see Fig. 73. The scale of this textile product was an indication of the time in which its

[527] Reich, E. & Siegler, C. J. (1937). Consumer goods. How to use them. New York: American Book Company. P.139.
[528] Ibid.p.142.
[529] It should be noted that both filaments were easier to obtain than natural silk or cotton fibres.

process of manufacture was registered. The early years of the 1930's saw mass unemployment in America, with 1930 to 1932 the very worst years of the great depression. The implementation of tariffs by America to protect its manufacturing base resulted in counter restrictive measures, including quotas and tariffs set by other countries. With the further introduction of mass production techniques during the previous decade the manufacture of more and more goods at cheaper prices had occurred. The consequence of this over production and swamping of markets with textiles goods resulted in many manufacturers ultimately facing bankruptcy.

During the early years of the decade the inequity between consumers supplied by the mass produced textiles manufacturers and those looking to the couture designs of Paris became progressively evident within contemporary fashion magazines. The wealthy were offered the chance to adopt a new femininity within dress, suggesting women should feel attractive, even pretty, with the body enhanced by subtle curving lines within dress, in contradiction to the gamine chic of the tubular dress in the previous decade.

This new styling was accordingly reflected in new Parisian couture textiles. For evening dress skirts lengthened and fabric use increased, a move slammed by the majority of commentators conscious of the harsh economic situation faced by the many in America and Europe. In due course the growing economic difficulties faced by manufacturers and dressmakers gave rise to the reassignment of daywear fabrics to the evening, with wools and cottons used in response to the changing market and the obligatory tariffs placed on the importation of textile goods. James Laver in Costume and Fashion, theorised the depression brought dress, and presumably the fabric, of the varying classes closer together.[530]

While the increasing use of artificial silks fabrics within textiles transformed the wardrobe of the working and middle class woman, the further use of the bright and glitzy artificial silk fabric within dress for the cinema engendered a sense of the modern and sophisticated. Consumers past reliance on the fashion magazine to provide fabric direction for the approaching season, and the latest Parisian dress trends was gradually supplanted by the immediacy of seeing the fashions of the screen actresses. Rathbone and Tarpley writing in 1931 noted 'If a fashion starts in New York, it spreads over the

[530] Laver, J. (1996). Costume and Fashion. London: Thames and Hudson. p.245.

country rapidly through such means as magazines, newspapers, radio talks, and the travelling public.'[531]

With the changes in dress imposing a softer curving appearance, lighter underwear was developed using softer fabrics. With cellulose acetate was regarded as a clean and hygienic textile suitable for lingerie it was increasingly mixed with other fibres to add strength and lustre to dress and interior fabrics, significantly effecting an economy in material costs. The extent of its use within devoré textiles was comparable to that of its employment within other woven textiles. By the mid 1930's artificial silks had attained the reputation as being highly adaptable fibres. Soft lightweight weaves, with textured, delustred and shiny effect yarns were increasingly present within every day constructed textiles.

The continued development of solvent based devoré was noticeably evident within the textile patent record. As previously highlighted in Chapter One, q.v. Carbonising and fibre reclamation, Dickie and Hill's wool and cellulose acetate pile fabric process of 1930, recorded the varying methods of fibre removal classed under the term "carbonizing processes", greatly aiding the chemical framework of this research. As an alternative to the well known wool and cotton devoré fabrics previously mentioned, Dickie and Hill (1930) assigned to the Celanese Corporation of America, pronounced wool and cellulose acetate constructed as part of a woven pile fabric could be treated with an inorganic liquid and an inorganic salt having a solvent or latent solvent action on the cellulose. The cellulose acetate pile when destroyed in selected areas revealed an undamaged cotton scaffold. Towards the end of the decade and working in association with Wainwright and Allan, Dickie further improved upon the treatment of cellulose acetate and other cellulose derivatives by once again using devoré.

The aim of this second, 1937 specification, was the creation of 'lace-like' effects on a viscose crêpe fabric constructed with a cellulose acetate satin back. Such a crepe back satin or satin back crepe, as the fabric is reversible and has a lustrous satin on one side and a crinkled crepe fabric on the other, was created by weaving alternatively hard twisted weft yarns, first a right handed twist and then a left handed twisted yarn.[532] Bendure and Pfeiffer suggested it had the appearance of a crepe meteor, a fabric

[531] Rathbone & Tarpley. (1931). Introduction.
[532] Bendure and Pfeiffer. (1946). p.649.

described as being a lightweight satin material with a crepe back and lustrous face, and which is woven with crêpe yarns in twill weave.[533] The physical appearance of this 1937 devoré fabric is thought to be similar to a viscose satin fabric currently used within a wide range of dress textiles, and which is evident within day and evening dress on the high street, see Fig. 74. The use of 'lace like effect' as a descriptive term was in this instance found to describe the effect caused by the exposure of the woven ground (gauze) in the areas of fibre removal. The breadth of novelty fabrics achievable using this technique is thought to be considerable, with Kneeland describing crepe meteor also being employed in petticoats because of its soft, pliable and serviceable character.[534]

A further example of the application of crêpe yarn within devoré fabrics was also evident in 1934, when Edwin Golding proposed hand drawn and Jacquard effects could be achieved by means of a crêpe yarn and selective rayon fibre destruction.[535] Colouration and fibre removal were said to be achieved simultaneously by combining the devoré agent and a dye, however, Golding's primary objective was the creation of a fabric that was finished alike on both sides by locking in position the loose ends normally created as a result of carbonisation.

A crêpe yarn was employed for both the warp and the weft by alternating the yarns in both, between a right twist and a left twist. A 'composite' yarn that dissolved or disappeared when subjected to a special chemical treatment was also included in both the warp and the weft, see Fig. 75 and Golding's Fig. 3. The crêpe yarn was constructed using three strands of appropriate denier silk, for instance 14 denier. Shown as number 30 in Golding's Fig. 3. Once twisted together to a high twist, for instance 65 turns to the inch the yarn was steamed, thus creating a single thread shown as number 32 in Golding's Fig. 3. The single rayon thread, shown as number 34 in Golding's Fig. 3, was for instance a one hundred denier twisted 50 times to the inch and also been set by steam. Yarn 32 (silk) and 34 (for instance viscose) were accordingly twisted together ten times to the inch. Golding subsequently referred to this silk and rayon composite yarn as yarn 36. The composite yarn shown within the drawing had a left twist, or clockwise twist, and was to be employed with an identical but right twisted yarn. In Golding's Fig. 1., a simple weave was constructed of yarn 36 in both the warp and weft,

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[533] Kneeland. (1924). p.89
[534] Ibid. p.89.
[535] E. I Golding. New York. N.Y. (Application filed January 10, 1934, accepted April 17, 1934). Fabric. US patent 1,955,582.

with the composite yarn alternated between a right twist and a left twist, producing what Golding described as a double crêpe fabric. Accordingly the fabric was said to be symmetrically constructed throughout, with no visible distinction between the warp and weft except in the selvedge. Unlimited pattern effects were possible, as with 'printing patterns on a sheet of paper.'

The creation of contrast within the textile was a further objective, with regard to both the structural and textural qualities of the fabric, but also in terms of varying its colouration. A printed chemical suitable for the rayon, was used to partially destroy the viscose composite yarn, see Golding's figures 1 and 2 point 12. The colouring matter was meant to react directly with the silk, otherwise the silk could be made sensitive to the dye by mordanting. The previously recognised complexity in achieving colour and devoré registration was solved in this instance by combining the colour and devoré in the same treatment. However, the colour did not have to match the devoré areas, and could be applied to smaller sections, with reference to Golding's Fig. 1, and 40, or to full areas of the fabric as in Golding's fig 1 and 2 point 42. The accompanying patent image shows a devoré abstract floral design, with a smaller colour print at the centre, see Golding's figs 1 and 2 point 40.

Golding's objective of stopping floating ends of the rayon being apparent in the fabric was cleverly achieved as a result of using crêpe and the composite yarn. By employing water absorptive threads that shrink during the boil off, a process described by Golding as the treatment of fabrics by boiling water so as to remove soluble constituents such as sericin from the threads of silk, an enhanced creping effect could be achieved. [536] The high twist given to the threads resulted in the silk and viscose shrinking in the same direction, this also resulted in the fibres locking together. So when any part of the constituent thread was destroyed the remaining silk thread prevented the viscose thread from unravelling at the margin of the patterned area, q.v. Golding's fig.1. Within the textile the printed devoré design created a sense of the transparent against the full solid background, as if resembling 'hand-drawn or Jacquard effects.'

The desire to create a quick and simple printed devoré technique for cellulose acetate fibres was clearly required by manufacturers during the early part of the decade. The

[536] Sericin, See Anstey Weston, protein in silk fibre cementing the two fibroin filaments (brins) in the bave.

Société pour la Fabrication de la Soie Artificielle "Rhodiaseta", was one of a few manufacturers cognisant of the potential in creating printed cellulose acetate devoré textiles.[537] The process outlined within their 1934 patent proposed the manufacture of a composite yarn, four velvets and a voile while reducing the wasteful and complex solvent use required by cellulose acetate devoré manufacture by switching to a simple peroxide printed carbonisation technique. Significantly their patent introduction declared devoré or 'carbonising' effects of cellulose acetate had until their invention rarely been obtained in a satisfactory manner, as the solvent based process had resulted in 'either the formation of a collodion-like solution very difficult to eliminate from the material, or in a considerable alteration in strength of the animal or vegetable fibres.'

The elimination of cellulose acetate fibres from a mixed fabric had previously only been effected by the aid of a solvent 'which necessitated the use of complex apparatus and generally led to a serious loss of the solvent by entrainment of the latter.'[538] This statement clearly questions the economic viability of the earlier solvent based acetate cellulose devoré processes, however, similar comments regarding the improvement of supposedly wasteful or uneconomic practice were repeatedly incorporated within American woven devoré patent registrations, as if a prerequisite to the successful establishment of a new devoré invention.

The elimination of a solvent for the cellulose acetate clearly instigated a reworking of pile and plain woven textile techniques developed during the previous decade. The varying procedures of devoré outlined within this Société Rhodiaseta patent included the construction of a yarn with cotton, silk and cellulose acetate, subsequently treated by a paste to remove the cellulose acetate once in fabric form. Of the woven fabrics listed a single colour velvet could accordingly be manufactured of a silk and cotton ground and a cellulose acetate pile printed on the back with a benzoyl peroxide devoré paste, dried, steamed and brushed resulting in areas of pile removal. While a second velvet constructed of a silk and cotton foundation and a nap of cellulose acetate, dyed with dischargeable dyestuffs, was printed with both a devoré paste and a discharge agent for

[537] Société Rhodiaseta had used a cellulose acetate manufacturing process very successfully since 1922-23. In 1927 the German Acetate-Kustseiden A.G. "Rhodiaseta" was established by German, French and Swiss Industrialists in Freiburg. The company produced cellulose acetate by the Société Rhodiaseta process. [online] Available from http://www.german-hoisey-museum.de [Accessed 11 September, 2004].
[538] Société pour la Fabrication de la Soie Artificielle Rhodiaseta, Paris. (Application date August 20, 1934, accepted November 29, 1935). Process for obtaining Effects or Designs on Yarns, Threads, or fabrics composed of or containing Cellulose Esters or Ethers.

the dye. The focus of the design was the creation of a co-ordinated discharge and devoré print contrasting against the unaltered colour of the pile fibre.[539] The breadth of multicoloured printed fabrics made possible by this process was thought considerable by its designers. The colour trends of the period suggest a vibrant coloured effect may have been preferred for dress fabrics, a market which this velvet fabric clearly was aimed toward.

The variation in fibre effects was also considered within the patent. A lightweight patterned, multicoloured, lightly figured fabric could be manufactured if a voile made of a warp and/ or weft of regenerated cellulose and cellulose acetate threads was printed in separate areas with either an aluminium chloride gum for the regenerated cellulose or a devoré paste containing benzoyl peroxide for the cellulose acetate. The subtle variation in design of the fabric created by the dual devoré would have been further enhanced by either cross dyeing the fibres, or by simultaneously applying colour or discharge as part of the devoré paste.

The applications of a voile fabric, as described by Kneeland in 1924, included 'chemises, gowns and so forth', however, blouses, neckwear, children's clothes, curtains and bedspreads were also familiar articles for voile fabric usage.[540] Prior to the 1930's voile was manufactured of highly twisted yarns in plain open weave and generally made of cotton, silk or wool, with cotton voile used primarily in underwear. Its clear surface produced a soft handle, although wool voile made of worsted yarns could feel wiry. With viscose and cellulose acetate apparently being employed as a substitute for cotton in this instance, this highly coloured devoré voile was most likely created for lingerie or dress fabrics.

Notably the Société Rhodiaseta patent also presents a devoré mixture suitable for use in both roller printing and hand printing (thought to be screen printing), in conjunction with a velvet fabric made with a silk ground weave and cellulose acetate pile. While the suggested use of roller printing within the patent initially implies the mass manufacture of such a textile, the idea should also be taken at face value, as any roller created for the printing of other pile textiles could have been reused without any alteration necessary for devoré printing of a pile textile, with no extra expense incurred on the part of the

[539] Benzoyl peroxide 250 parts, diethylene glycol 200, soluble zinc formaldehyde sulphoxylate 100, and 50% gum solution.
[540] Kneeland. (1924). p.94.

manufacturer, with reference to Hillman. Hand manufacturing or screen printing, suggests a smaller production and a more considered process of manufacturing. However, the ability of the manufacturer to vary the patterning of the devoré pattern was key to the extent of the fabrics manufacture.

Of the various procedures of devoré printing included within this patent a three-motif devoré design should be highlighted as the most decorative. On a velvet manufactured with a ground weave of silk and a pile of both cellulose acetate and regenerated cellulose, the first motif print was engineered to remove the cellulose acetate pile fibres, leaving the regenerated cellulose and natural silk intact. In the application of the second motif only the regenerated cellulose was removed. In the third motif both the cellulose acetate and the regenerated cellulose were fully removed to reveal the ground weave. The visual effect of the fabric if coloured devoré pastes were used, as suggested, was a highly decorative design with between four or five colourways.

B. S. Hillman and the finishing of pile fabrics.

The breadth of velvet devoré manufacturing evident during the early to mid 1930's was initially difficult to establish from any conventional sources. However, an industrial view of the process was described by B. S. Hillman, who in a year long review of the finishing of pile fabrics concluded his series of articles by writing a final piece on 'Soda Prints on Pile Fabrics.' Published within the American periodical Rayon Textile Monthly in 1937, Hillman outlined key terminology that was applied to pile woven devoré, but also analysed current manufacturing practices.[541] Moreover, Hillman should be regarded as the first known analyst of velvet and pile fabric devoré to connect together terminology such as *'Soda print, Damasse, Jacqueline, Cut-Out Printing, etc.'* [542] As to the nature of the textiles created by the process, Hillman also declared transparent velvet the most common soda printed fabric. While cut-out prints on silk pile with a cotton back were less frequently seen, with upholstery fabrics having a cotton back and a mohair pile were also said to have been 'damassed', a term relating to the fabric appearing as if woven like damask, although this term was usually associated with fabrics constructed of linen (damasse). The reference to mohair upholstery devoré fabrics is considered to be a direct link to Flory's wool devoré process of 1925/ 1928.

[541] Hillman, B.S. (1936/1937). Rayon and Melliand Textile Monthly and Rayon Textile Monthly. January 1936 to February 1937.
[542] Hillman, B. S. Soda Prints on Pile Fabrics. Rayon Textile Monthly. February 1937. p. 54 (94).

Other key points raised by Hillman include manufacturing advice on ways to achieve successful devoré printing. Firstly it was essential for the print to be applied to the reverse of the pile fabric, so that the chemical in the paste could eat away at the pile loop making the redundant pile easy to remove by washing, boil off or brushing. Devoré printing on the face of the pile fabric was said to result in 'ragged looking finished piece of velvet', as the pile fibre tended to protect the loops from the required chemical saturation at the fabric's base, but also because short ends of jagged fibres were found to project from the reverse of the fabric. In contrast, colour printing of the pile fabric was advisedly performed on the front of the fabric as the pile fibres prevented full penetration of the colour to the pile face. The simultaneous soda printing and 'application printing' customarily required the use of a duplex print machine, where the colour was applied on the face of the fabric and the fibre corroding chemical on the reverse if an attempt to match the two designs was made.[543] However, Hillman noted 'such machines are not available in the majority of print works', and as most printing machine used for velvets were no different from that used for broad goods, an ordinary print machine could be converted to a practical duplex machine.[544]

A textile manufactured in this manner had a 'cut-out design' in which the remaining pile appeared to be printed. This is thought to have appeared similar to the creation of blotch printed style of devoré fabric, with reference to Timme (1901/1902), and Swallow's (1925/1926) pile devoré patents, q.v. Chapter Two and Three, respectively. In regard to the nature of velvet devoré patterning and how the etching process enhanced the textiles design Hillman stated 'A typical pattern for this type of work is a floral design in which the outlined foliage is printed in bright realistic colors. If the cut-out pattern and the application print are printed separately, as necessary on the usual print machine, the pattern is almost sure to overlap the remaining pile into the cut-out pattern. This would cause the cloth to lose the desired effect of raised flowers on colored background.'[545] It is apparent that the alignment of both print and the devoré blotch pattern was difficult to achieve, see Liberty samples such as Figs. 30-32. Whether this affected the price of the textile is unknown however, the use of a coloured devoré paste may have been sufficient for the majority of manufacturers.

[543] Duplex or double sided fabric printing machine was used when long runs of fabric were printed with the same design. The colour was applied on the pile face and the carbonising print on the reverse.
[544] Broad goods,
[545] Hillman, B. S. Soda Prints on Pile Fabrics. Rayon Textile Monthly. February 1937. p. 54 (94).

In light of where this article was published, the two preferred chemicals for carbonising vegetable pile fibre, i.e. cotton, or regenerated cellulose such as viscose, aluminium sulphate, aluminium chloride were clearly the preferred carbonising agents. While the latter was considered the easiest to handle being purchased in crystalline form or in solution. Accordingly aluminium chloride solution 32° Baumé was said to be cheaper and more convenient to use because it was not likely to vary in strength as readily as the hygroscopic aluminium chloride crystals.[546] With regard to the 'cutting' of animal fibres sodium hydroxide was favoured, with manufacturers commonly using commercial caustic soda flakes.

The combined use of colour and caustic agent was also given consideration by Hillman. Firstly, the dye colour had to withstand the destructive effects of the chemical, as colours were often reduced. Therefore the selection of dyestuffs was limited to those able to withstand the caustic agent and steaming without loss of colour. Vat dyes and naphthol colours accordingly 'stood up best', while a few sulphur colours in deeper shades were considered 'impervious enough to the caustic treatment to be of use.' The shades that were achievable included blues, green, yellow, orange, red, and black. Acid colours were not generally able to endure the carbonising chemical, although two outstanding acid colours recommended by Hillman were Dural Black B (Colour index 307), and Pharmacine brown R.[547] The shading of these colours once the fabric was processed are thought to have been similar to the colour of the J.-B. Martin pile fabrics, see Chapter Four, and Fig. 55.

When applied in a combined colour and carbonising paste the application of these colours on the reverse of a heavier weight pile fabric was said to result in patchy or uneven colouration of the pile surface. As complete saturation of the pile face with colour was a priority for the manufacturer, Hillman consequently advised the fabric be dyed first, unless the grey goods were to be union dyed at a later point. Moreover, because the caustic print created a slight mercerisation in the area of the printed weave, the fibres affinity to cotton dyestuffs was increased. Boiled off transparent velvets were frequently printed with a combined colour and fibre carbonising chemical. After

[546] Hygroscopic- substances absorb water from the moist air and form a moist solid or solution.
[547] Hillman stated 'As a class the chrome colours are probably the best type.'

processing a differently coloured background was evident in the area of carbonized print, as with J.-B Martin sample, see fig. 55.[548]

The finishing of these velvet fabrics involved heating at between 290°-310° for several minutes. Steaming was only required if a colour had been added to the cut out paste. An extract from this Hillman entitled 'Finishing Operations' can be found within appendix 5. While extraction was clearly essential during processing to contain excess acid fumes given off by the paste, other health and safety issues were referred to by Hillman. For instance the manner in which the carbonized pile was removed considered to be an important issue to the health of the devoré worker. Accordingly, in 1937 the extent of the exposure to pile fibre debris was dependent upon the nature of the pile fabric and the manner of its finishing. For instance, transparent velvets carbonized in the greige state were advisedly rinsed in a weak ammoniacal solution before boil off, a process that simultaneously neutralised the devoré chemical and washed out the carbonized rayon fibres. Any residual carbonized fibres were removed by brushing and carding, a processing that reduced the possibility of shirring the fabric, a possibility with machine brushing. Velvets dyed prior to devoré printing were brushed using a stiff wire card. This was said to result in 'a great deal of dust (carbonized rayon, aluminium oxide, etc.) flying around' during the process.[549] Hillman advised the brushing machine should have an exhaust fan and hood over the brushes to remove the majority of the dust, although some of the fine grey brown dust was said to still coat everything in the room. It is unlikely that workers were protected from such light dust exposure.

As machine brushing was regarded as unsuitable for carbonized rayon pile fibre, calendering was preferred. The fabric was said to finish up being cleaner and less shirred. A temporary doctor blade could be attached to remove the excess dust which was said to rapidly collect on the roll. While the cleaning of the machine was recommended every night as the build up of the acid could quickly cause rusting, an issue also raised in the patents of embroidery laces manufactured on chemically pre-treated woven grounds where the needles were discovered to rapidly corrode due to the effects of the chemical. The only draw back to calendering for the velvet manufacturer, despite it being faster and cleaner than carding machines was 'its use is somewhat

[548] See Anstey Weston. Boiled Off (degumming). The removal of a natural gum previously applied to the fabric by treatment with a mild alkali.
[549] Hillman (February 1937). P.56 (96).

limited due to the fact that most velvet mills do not have any calendering equipment.'[550] In the case of printed dyed goods neutralised with acetic acid prior to their final rinsing, the carbonized pile dropped out during washing, carding or beating. This was a safer way in which to contain the dust produced as a result of the carbonising, although the pile fibres suspended in the washing liquid would have also required disposal, as even the smallest area of velvet devoré creates a substantial amount of fibre residue.

Clearly Hillman's review of pile woven devoré processing raises other issues, for instance determining the extent to which the process was actually employed by manufacturers. From the various articles Hillman published during 1936 it is evident the pile devoré textiles were regarded as novelties rather than imitative fabrics. As regards the problem of matching colour and the devoré ground, this issue was raised within most devoré patent specifications and was in fact the main issue devoré manufacturers aimed to overcome by developing alternative methods of colour and devoré co-ordination, for instance in the case of carbonising by means of a chemical bath the need for a printing machine to specifically apply the devoré chemical devoré was eliminated, moreover, cross dyeing fibres to create the same effect reduced the need for colour and devoré co-ordination, and colour resists and colour devoré were all aimed at surmounting the difficulty of registration. Moreover, the practical advice given to the 1930's rayon pile fabric manufacturer, as regards the conversion of familiar printing equipment points to the operation and the use of ordinary pile printing machinery clearly refers to earlier pile devoré processes, such as Timme's roller printed technique of 1901, previously reviewed as part of this research.

Rubber thread and elastic textiles.

A third devoré patent registered in 1934 was textile engineer C. T. Pastor's rubber thread process. Based in Crefeld (Krefeld) Germany, a region renowned for its velvet manufacturing, Pastor had formerly registered a velvet devoré patent at the British patent office in 1912.[551] The basis of this earlier process, as outlined in the provisional

[550] Hillman. (February 1937) p. 56 (96). Calendering, a machine finishing operation using a number of large pressure rollers, would have squashed pile fabrics. It was normally used to flatten the yarn of cloth in open width, closing up the woven fabric giving the cloth smoothness and lustre, with reference to Anstey Weston. In this instance Hillman states that because the pile was brushed flat prior to calendering, no harm was caused to the fabric.

[551] Carl Theodore Paster, No 7 Bismarckplatz, Crefeld, Germany, Engineer. (Complete specification left 4th October 1912 (provisional 4th April 1912), Accepted 3rd April, 1913). Improvements in Pile Fabrics and Method for Producing the same. GB 8231.

specification was the decoration of a cotton pile fabric by printing with a carbonising paste, however, at the submission of the complete specification the fibre acid treatment had been removed and replaced with a process of selected fibre protection and pile removal by singeing. A year earlier Fritz Pastor, also of Krefeld, also registered the heat technique in America.[552] The basis of the Pastor's rubber thread process was significantly different from the velvet process in that the use of solvent treatment was employed in the manufacture of a rubber thread. In this instance a guide thread was dipped into a rubber compound, described as a watery rubber dispersion, which was allowed to adhere to the fibre, dry and then vulcanised. The guide was then either removed after the making of the thread or after the rubber threads construction within a textile, whether woven, knitted, crocheted, braided or similar fancy goods.

If the guide thread was made of 'celanese' (acetyl cellulose) acetone was employed as the solvent, acting on the cellulose acetate by swelling the guide thread to double or triple its size causing the rubber coating to expand. When the swelling reached a point where the cellulose acetate thread had dissolved the expanded rubber thread then permitted the dissolved inner thread to ooze out through its pores.[553] The removal of a guide thread could also be achieved by carbonisation if a viscose thread were employed. In this instance the thread was first treated with a carbonising agent, such as sulphuric or 'muriatic acid' (hydrochloric acid), that allowed its destruction at 100°C. The reduced thread was then removed with an alcohol or acetone solution.

The greatest advantage of the process, as indicated by Pastor, was that the thread could be made fully or semi-elastic, 'thereby opening up entirely new possibilities for its manufacture into finished goods.' If the yarn was made up into fabric, whether knitted or woven, the thread or textile could be dipped into the solvent, partially removing parts of the guide thread creating areas of elasticity. Moreover, once the fabric was manufactured a protective resist of gelatine glue or British gum could be printed onto the fabric. The solvent then only removed the unprotected areas of guide thread from its rubber coating creating areas of elasticity. Whether a patterning effect was envisaged for this process requires further investigation, however, such a procedure was clearly feasible.

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[552] Fritz Pastor, pf Krefeld, Germany. (Application filed April 1, 1912, accepted September 10, 1912). Method of Figuring Velvet. US patent 1037975.

[553] This was performed by spraying the acetone onto the thread, in an enclosed extractor, and then dipping in an acetone bath with added age protector.

Pastor's rubber thread could also be combined with any other thread when within a woven textile, however, by keeping the guide thread intact during fabric manufacturing stretching of the rubber thread was reduced thereby holding its form. A further adaptation of the process envisaged a rubber thread having a thread of silk, cotton, or wool or artificial silk twisted around it, although it had to be immune to the effects of the guide thread solvent. Accordingly, bandages or belts could be manufactured to be partially elastic or non-elastic. The process as a result of the rubber thread concept of manufacture allowed for the construction of an even or flat weave with a warp and weft of pure rubber being elastic in all directions.

In Rubber and Textiles (1927), published by The Rubber Growers Association Inc., the vulcanisation of rubber was said to be the key discovery in the further advancement of manufacturing rubber products. 'That rubber should still be to many somewhat of an enigma is perhaps not surprising when we consider the varied forms in which it is encountered.'[554] The latex film when heated in combination with a sulphur accelerator and heat caused the cross linking of the rubber, giving elasticity and strength to the film. In its natural condition rubber was used for the familiar crepe rubber sole, while prolonged vulcanisation converted the tough black material to ebonite, as used in wireless sets. By adding other ingredients followed by vulcanising, elastic threads in surgical bandages were possible as was a 'tough product almost indistinguishable from leather employed for the manufacture of rubber belts and braces.'[555] Its elasticity and strength combined with a resistance to moisture also made it an attractive product to a range of clothing manufacturers. The viewpoint of the Rubber Growers Association in regard to its use in clothing and textiles was that it was a product "par excellence", especially when blended with other textile materials.

While C. T. Pastor's invention was one amongst many rubber an elastic processes registered during the 1930's that aimed to manufacture new rubber thread or fabric materials, the bringing together of carbonising, and dissolution processes with rubber thread and textile manufacture was distinctive for its combined processing, bringing a new group of fibre inventors into woven and knitted devoré development. While the dissolution of cellulose acetate in the manufacture of rubber thread appears to have first been proposed by Pastor, the uniting of fibre destruction and rubber in the creation of

[554] The Rubber Growers Association. (1927) Rubber and Textiles. London. Ec3. The Rubber Growers Association. Inc. Introduction. p. 3.
[555] Ibid. p. 4.

elasticated threads was just one method of creating elasticated threads amongst a number of elastic manufacturing processes developed during the mid to latter part of the 1930's. For instance a knitted fabric manufactured of rubber yarns was proposed by H. T. Gammons assignor to Scott and Williams in 1935.[556] Gammons claimed that before his invention the use of a 'stretch limiting thread' combined with a rubber thread during fabric manufacture could only be destroyed by stretching the inelastic thread to the point of snapping leaving unsightly ends within the fabric. His invention, supported by extensive patent drawings, see Fig. 76, recommended a composite thread of silk, cotton or wire and rubber thread be wrapped with another thread stretch limiting thread, later removed by carbonising, with reference to Gammons Fig. 7, which shows a knitted structure exerting a 'strong contractive effort such as is desirable in constrictive garments.' The manufactured textile was intentionally light weight and appeared to be sheer in style.

Similarly, Schwartz and Chavannes, Paris 1937, also experimented with elasticated fabric and devoré manufacture.[557] Soluble (wool) and insoluble (cotton) threads were constructed as part of a woven or knitted textile, which was then sprayed on one side with a fine layer of latex, so as to allow for the removal of the woollen threads by caustic soda. Extensive elasticity was required in the direction of the fabric vacated by the woollen threads, see Fig 77. Elastic fabrics allowed for firm figure control, with boneless firm foundation garments popularly worn with the backless dresses. However, other style of new wool and elastic fabrics were intermittently reported by Fairchild's Bulletin. For instance in 1929, the newest rubber and wool fabrics shown in London were said to be made from a combination of rubber and wool 'described as grained reptile leatherette cloths', and produced by a Glasgow manufacturer.[558] The development of these textiles was reportedly to meet the growing demand for 'novelty waterproof coats' at an affordable price.

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[556] Herman T. Gammons, Natick , Mass., assignor to Scott and Williams Inc. New York. (Application filed October 3, 1935 accepted September 1, 1936) Textile Manufacture. US patent 2052875. Scott and Gammons were responsible for the development of the overlock machine.
[557] F. F. Schwartz and Marc Chavannes, Paris. France. Assignors to American Ecla Corp. Dover, Del. (Application filed August 5, 1937 accepted October 10, 1929). US patent 2175733.
[558] Fairchild's Bulletin. (1929) New Rubber and Wool Fabrics. Fairchild's Bulletin. September 16, 1929. p.3.

Summary and conclusion.

- The employment of devoré as a decorative technique was limited by the economic downturn of the late 1920's and early 1930's.

- The process was adapted to suit small scale textile production, with economy of materials a significant factor in the processes development throughout the decade.

- The gradual move away from highly decorative woven devoré processes toward the making of practical utilitarian textiles reflected the impact of economic depression on the textiles industries.

- The making of stretch and elasticated textiles was directly influenced by innovation in lingerie and underwear.

- The woven devoré process was known throughout the manufacturing industries by the end of the 1930's. Its demise prior to the Second World War was in line with similar textiles whose manufacturing included some form of fibre destruction.

By the end of the decade the woven devoré processes that we employ today in conjunction with natural and regenerated cellulose fibres had been firmly established. The patterning techniques of negative and positive etching achievable using the woven devoré process were to remain popular throughout the following sixty years. Woven devoré development in the 1930's shifted from highly decorative designing in the early part of the decade to more functional practical application in the latter. The economic pressures faced by the textile manufacturing industry engendered innovative textiles that used devoré technology and carbonising as their form of manufacture. The complexity of woven devoré processes increased throughout the decade as more ingenious methods of fibre and fabric engineering were attempted. The invention of alginic fibres only temporarily disrupted woven devoré adaptation, with the woven devoré process being intermittently used during the war years and revived in the mid to late 1950's for use with a new class of man made fibres.

Conclusion

Conclusion

This study of woven devoré brings to the historical textile record a new understanding of chemical textile development. It is the first comprehensive review of the creative evolution of woven devoré and its diverse processes of manufacturing. The study highlights the interdependence of technological and design innovation, while aiming to identify the societal and economic factors that influenced the manufacture and decoration of woven devoré textiles during the period 1880 to 1939.

The interdisciplinary nature of the study and the different research methodologies employed have led to a new interpretation of woven devoré design and manufacture. A reassessment of patent material has added to the discourse surrounding woven devoré textile development, proven a correlation of manufacturing between chemical lace, chemical embroidery, woven devoré and knitted devoré practices, and more broadly augmented the knowledge of manufactured fibres and how they were employed in decorative woven devoré fabrics intended for middle market and ready to wear fashion of the 1920's and 1930's.[559]

The recognition of the transition from natural fibre usage to manufactured fibre use within woven devoré textile manufacturing during the early twentieth century has been a primary objective of this study. Consequently, the examination of woven devoré manufacturing patents, specifically from 1900 to 1939, has identified a unique connection between the woven devoré process and the pioneers and commercial manufacturers of regenerated cellulose and derivatives of cellulose fibres. In a broader context the formation of a chronological developmental history for woven devoré has also revealed the relationship between the textile manufacturer and the woven devoré process to have consistently engendered innovative fabric designs.

That the hundred years manufacturing development of woven devoré has remained relatively unknown although recurrently associated with pioneering textile invention is also of significance to the field of design management, in particular how knowledge of woven devoré textile design innovation has largely remained hidden within the textile

[559] Ready to wear in this instance relates to ready made clothing of the 1920's and 1930's. The term was applied to off the peg clothing in America in the 1920's by the fashion industry and should not be confused with the concepts of Prêt a Porter of the 1960's.

manufacturing industry. The analysis presented within this thesis of the way in which early woven devoré processes were shaped by fabric designers and manufacturers to suit specific manufacturing technologies and complement individual company's traditional expertise and technical know how has added to the debate surrounding the impact of technological innovation on the aesthetic aspects of fabric design.[560]

The perception of the woven devoré fabric belonging to a group of fabrics whose identity was associated with low grade materials and inferior patterning and colouring can now be challenged. The woven devoré process, from its modest beginnings as a method of manufacturing staple fibre fabrics to a technique of ornamenting luxuriant fabrics, is remarkable for its diversity and breadth of practice. Constant adaptation of the woven devoré process reflected changes in the broader dress and interior fabric industries. Accordingly the woven devoré textiles reputation as a novelty fabric employed intermittently at times of economic depression contradicts the evidence uncovered in both the historical patent record and in popular fashion periodicals. The linking of woven devoré patents with surviving examples of woven devoré textiles has undoubtedly shown the woven devoré manufacturing process to have developed on a global level, involving textiles industries in America, France and England, thus marking this study as a significant addition to the international historical textile record.

The identification herein of woven devoré textiles from archives in America, France and England, and their subsequent linking to carbonising and applied devoré practices, uncovered as part of this study's patent review, is seemingly original to this thesis. Moreover, the conventional belief that pile woven textiles are the original woven devoré textile, and that the velvet and pile textile industry was the source of all woven and knitted devoré, is repudiated by this study.

This investigation of woven devoré textile design has also added to the debate surrounding the importance of preserving mass market manufactured textiles and ready to wear fashions of the 1920's and 1930's. The possibility of the woven devoré textile being used for clothing or interior fabrics that had mass appeal were affordable but also highly decorative, has to my knowledge never previously been raised within the field of

[560] With reference to King, B and Spring, M. (2001) The design process in its regional/national context: A knowledge management approach. The Design Journal. (2001) Volume 4. Issue 3. p.7.

textile research. This study represents the first step in an ongoing endeavour to catalogue and collect early twentieth century woven devoré textiles.

The extensive span of this research has dictated its apparent limitations. In mitigation, I would argue that this was inevitable given the subject's complex and comprehensive development across a breath of theoretical disciplines. Moreover, it was never the express intention of this thesis to offer a comprehensive review of woven devoré from its inception in the 1880's to the present day, but instead signpost the significant aspects of early woven devoré practice and mark out the most significant period.

The challenge of researching a subject so diverse inevitably impacted upon the structure of this study. The creation of a historical analysis was primarily in response to the research not being positioned in any one discipline. The difficulty experienced in locating material and surviving examples of woven devoré textiles also reflected the fragmentary nature of devoré documentation. The subsequent reliance upon patent evidence was both demanding and rewarding. Although, in hindsight, it may have diverted the research away from a broader design focused examination; however, the knowledge gained of woven textile manufacturing has informed my academic delivery of printed textile technology, which has in turn has stimulated a new group of woven devoré practitioners and designers.

The use of woven devoré fabrics within contemporary women's and men's wear and accessories is extensive. The woven devoré textile, and to some extent knitted devoré, has been positioned across all levels of the market place, from low end high street to couture. However, unlike other decorative fabrics the widespread employment of the woven devoré textile has not outwardly affected its popularity with the consumer. Moreover, it is the ever-increasing application of woven devoré textiles within contemporary men's and women's wear, and the interior that apparently fuels the continuing development of the process and the creation of innovative woven devoré patterns and structures.

The introduction of modern technology, for instance digital printing, in the patterning of woven and knitted devoré textiles has brought about an increase in woven and knitted devoré being employed within the modern interior, and not only for traditional decorative textile products but also lighting, window dressing, room dividers and wall

coverings. This combining of new decorative textile techniques with a process that has evolved over a hundred year period is typical of the manner in which the woven devoré textile has been adapted by each new wave of devoré practitioners. Furthermore, the image of woven devoré as being inherently sophisticated has not been eroded by this shift in fabric designing. Modern woven devoré fabrics remain seductively tactile and seemingly impart an air of exclusivity whatever market level they are targeted at supplying.

The increase in the manufacture of bespoke patterned devoré fabrics now made practicable by digital printing is being led by a new breed of technology aware designer crafts maker. The adoption of the devoré technique by both printed fabric designers and craft led makers reflects the blurring of the traditional divisions between craft and technology. Moreover, the making of one off or limited runs of devoré fabrics has become viable to all textile designer makers interested in using the technique to support their personal activities.

It is my intention to pursue and document other surviving examples of woven devoré textiles. After attending a study day at Moda in November 2004, it emerged a limited number of French devoré textiles are now held within a manufacturers catalogue archived in the Museo del Tessuto. The formation of an illustrated catalogue or published work containing woven devoré textiles is a primary objective for post graduate research, this would hopefully provide a new source of reference for archives and other textile researchers who have requested such information during the study. The continuation of archive visits will hopefully include The Museum at Rhode Island School of Design in order to view woven devoré dresses from the Art Deco period, and a return visit to F. I. T. in New York.

A further objective is to discuss the findings of this research on a more formal level within the academic community, particularly in America. The continuation of the investigation of woven devoré development will also be focused towards discussion through conferences and within journals. It is my intention to concentrate more upon Art Deco styled devoré, presenting lost processes and analysing the significance of the devoré technique to early twentieth century textile manufacturing. Aspects of textiles preservation raised by the study, for instance the conservation of mass manufactured, fancy goods and novelty textiles are of particular interest to me at this time.

Accordingly I have an opportunity to present my research and views on the collecting of woven devoré textiles at The Future of the Twentieth Century-Collecting, Interpreting and Conserving Modern Materials conference to be held at the AHRB Research Centre for Textile Conservation and Textile Studies, University of Southampton, in Winchester in July 2005.

Presenting the history of the woven devoré textile within the public domain is a primary goal of this study. Although I have been extensively involved in woven devoré designing and production throughout the period of research, the creation of a new body of work based on the combining of past and contemporary devoré processes is planned for the autumn of 2005. The proposed exhibiting of such woven devoré work in 2006/ 2007 would facilitate the repositioning of the technique within the historical textile record and revise the narrow classification of the textile as a novelty product.

Appendices

Appendix 1

Fibre and Fabric Chemical carbonising and devoré fabric development: Patent chronology 1860-1911.					
Origin & product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
England. Middx. & Surrey **Wool reclamation.**	June 11, 1855	1855 **GB 1330**	E. V. Gardner J. H. Walker	Improvements in separating cotton, flax, hemp jute, and other vegetable substances from manufactured fabrics containing wool, and preparing the wool for remanufacture.	Carbonising of vegetable fibres. Drying. **Cellulose fibre removal.**
USA New York **Wool reclamation, from mixed fabrics**	April 3, 1863	September 8, 1863 **US 39, 828**	J. G. Perzél	Improved process of recovering wool from mixed fabrics.	Destroying cotton in old mixed woolen goods. Chloride of zinc, alone or with sulphuric acid. **Cellulose contaminant removal.**
USA Mass. **Burring wool.**		December 8, 1863 **US 40, 832**	J. Fullen	Improved process for removing burrs from wool.	Sulphuric acid- steep the wool, a picker, an alkaline solution, a solution of Irish moss. States not new to remove burrs in this way. **Cellulose contaminant removal.**
USA New York. **Burring wool.**	April 29, 1864	July 26, 1864 **US 43, 647**	F. M. Ruschhaupt J. G. Perzèl.	Improvement in cleaning wool.	Separating wool from vegetable matters. Subjecting raw wool to a chemical process. Chloride of zinc, and dilute sulphuric acid, and then heated, carbonization of the burrs. Removal by wool picking machine. **Cellulose contaminant removal.**
USA New York **Burring wool.**		July 12, 1864 **US 43, 547**	J. Fullen	Improved method of treating wool for removal from burrs, &c.	The treating of wool with two acid solutions (both sulphuric acid) of different densities, preparatory to its being subjected to soda ash and Irish moss. **Cellulose contaminant removal.**

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA New York **wool and woollen goods.**	April 12, 1865	July 10, 1866. **US 56, 291**	W. Sykes	Improved process for removing vegetable matter from wool.	The speedy removal of vegetable matters from wool. Sulphuric acid solution, steep or soak wool for 8-48 hrs. Warm or cold acid solution, warm is quicker, soak in saturated lime for a short time then drying. Superior to soda ash treatment **Cellulose contaminant removal.**
France. Paris **Burring wool in raw or fabric state.**	August 17, 1874	October 13, 1874 **US 155, 802**	F. R. Joly	Improvement in processes of destroying vegetable matter sin wool and woolen fabrics.	To obtain chemically the incineration of vegetable matter in wool either raw or in a fabric, without altering the colour and without damaging or altering the wool fibre. Advocates use of aluminium chloride. **Cellulose contaminant removal.**
Burring wool.		March 5, 1877 **GB 886.**	O. Low	Burring wool.	Tank filled with an acid. **Cellulose contaminant removal.**
Silk extraction/ waste silk collection.		May 12, 1877 **GB 1856**	G. Rydill	Yarns and threads.	Silk waste converted into yarns for knitting and lace machines.
Cellulose contaminant removal.		February 8, 1878 **GB 523**	H. Simon A Frank	Carbonizing fibres	Wool, wool waste soaked in magnesium chloride, dried and passed through carbonizing chamber. 30-90 mins carbonization is effected. Neutralised in manganese with hydrochloric acid. **Cellulose contaminant removal.**
"burl" removal from dyed woven fabric		March 21, 1878 **GB 1129**	A Browne C. J. A Leclerq	Carbonizing fabrics	Dyed animal fabrics, to remove the "burl", acids in the state of vapour and mixed with air employed instead of acid solution. **Cellulose contaminant removal.**

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA Maryland. **Animal fibre reclamation.**	April 23, 1878	April 30, 1878 **US 203,230**	J. Wilkins	Improvements in separating animal from vegetable fiber.	Rags. Disintegration of vegetable fibre with mineral acids such as sulphuric, nitric or hydrochloric. Inclusion of a mordant to reduce colour loss.
Vegetable removal including fibre		May 2, 1878. **GB 1761**	H. J. Hadden	Carbonizing	Currents of compressed air charged with acids or gases, are used. Wool, fleece or silk or textile fabrics are agitated in closed chambers. After carbonization acids are restored and neutralised by alkaline gases. **Cellulose fibre removal.**
USA Mass. **Wool reclamation.**	July 5, 1878	January 7, 1879 **US 211,109**	G. M. Rice A. L. Rice	Improvement in Separating Animal from Vegetable fibres	Recovery of animal fibres. Chlorine bath, consisting of chlorine gas held by or dissolved in water, a saturated solution. Heated in a sealed chamber. **Cellulose fibre removal.**
		July 8, 1878 **GB 2732**	T. J. Smith	Carbonizing fabrics.	Acidulated bath, with sulphuric acid. **Cellulose fibre removal**
	August 3, 1878	Provisional **GB 3081**	A Daniel A Lessieux	Carbonizing rags.	Dry pure gaseous chlorine heated to 70-100°C. Then thrashed. Applies to wool, hair, silk feathers threads or fabrics. **Cellulose fibre removal.**
Cellulose debris and cellulose fibre removal.		June 26, 1879 **GB 2561**	G. Rydill	Carbonizing fibres, rags and fabrics.	Destroying cellulose contaminants or fibres from a wide range of textile goods. Using dilute hydrochloric acid or sulphuric acid, acid gases, aluminium chloride, dil. nitric acid, or in nitrate of soda, potash dissolved in sulphuric or hydrochloric acid. Packed in hot sand to enable heating! **Cellulose debris removal.**
Cotton Embroidery.		September 26, 1881. **GB 4143**	J. Renals J. Steiger	Embroidery with ground fabric destroyed.	The production of Guipure embroidery, and embroidery on loose or open fabrics, such as net. Dissolving of animal fibres by a solution of caustic soda or potash. **Silk backing removal.**

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Saxony		1881	Robert Neubauer		
Switzerland. St Gall **Cotton Embroidery.**	November 29, 1882 **USP**	June 26, 1883 **280,094**	Frederick Suter Assignor to The Wetter Bros. St Gall	Process of Producing Open-Work Effect.	Cotton embroidery, continuous design in cotton on a silk ground. Carbonising treatment, fabric is immersed in chloride of lime until the silk is dissolved, the vegetable fibres resistant to the treatment. **Silk backing removal.**
France Paris **Wool woven fabric.**		May 11, 1883 France **143, 061**	Louis Chaux	Art of Manufacturing Woolen fabrics from Short-Staple Fiber.	Method of mixing cotton with a common, short-fiber wool to serve as a provisional support, and enable the wool to be spun into fine yarn and woven. After weaving the cotton is entirely removed by means of an incinerating bath (hydrochloric acid) – whereby a fine wool fabric remains composed entirely of common wools. **Cotton Fibre removal.**
		May 15, 1883 Belgium **61,386**			
		May 18, 1883 England **2,496**			
	June 13, 1883 **USP**	November 6 1883 **288,015**			
USA Philadelphia **Wool woven fabric.**	May 5, 1884. **USP**	May 3 1887. **362,317**	Edward Scheppers & Emile Scheppers	Art of Making Fabrics from Coarse Long-Staple Wool or Hair.	Fine spun threads of wool or hair are twisted with threads of cotton or other vegetable fiber and then these compound threads in the production of worsted fabric by weaving, in both warp and weft, etc. then vegetable fiber destroyed by action of sulphuric acid which attacks and destroys vegetable and not the wool leaving a fabric composed entirely of fine worsted threads. **Cellulose fibre removal.**
		October 7, 1884 BELGIUM **B 65,523** ENGLAND **GB 13,274** FRANCE **FR 164,648**			

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Switzerland Fribourg **Flax, cotton, wool or silk embroidered lace.**	May 24, 1884 **USP**	April 14, 1885 **315, 589**	David Wuillemin	Lace and the Art of Making the Same.	Manufacture of Lace made by an embroidery-machine with thread of any kind upon a ground adapted to be removed after the embroidery is applied by use of a solvent. Also uses a dissolvable paper. **Paper or fabric removal.**
USA Philadelphia **Wool woven fabric.**	June 20, 1884. **USP**	May 3, 1887. **362,318** October 7, 1884 **B 65,523** **GB 13,274** **FR 164, 648**	Edward Scheppers & Emile Scheppers	Manufacture of Textile Fabrics.	Producing textile fabrics, consisting in spinning a strand of wool or other animal fibre, then doubling the same with a strand of cotton or other vegetable fibre by a reverse twist which wholly or partially untwists the wool strand, then producing a fabric containing such compound thread, and finally subjecting fabric to action of an agent which will destroy the vegetable fibre, leaving intact the untwisted or slightly twisted strand of animal fibre. **Cellulose fibre removal.**
USA New York. **Wool & Cotton mix woven fabric**	November 13, 1884 **USP**	May 18, 1886. **341,927** January 20th 1885. **GB 821**	Emile Maertens. A. M. Clarke and E. Maertens.	Art of Making Textile Fabrics. Carbonized Fabrics. (Raised or sunken effects can be created).	In a single ply fabric create the effects of a double ply fabric or one woven with two sets of threads. Destroying agent is in liquid form it is printed onto the fabric, or may be treated with an impermeable size prior to subjection of the whole piece to the destruction agent, or may be sprayed onto the fabric to create a spotted effect. **Cellulose fibre removal.**
Switzerland St Gall **Cotton, linen wool, or metal thread embroidery lace.**	**GB** US July 8, 1885	June 30, 1885 **7931** March 9, 1886 **337, 687**	John Krüsi	GB: Lace US: Process of Making Embroidery-Laces.	Pre treated chemical backing fabric, after embroidery the fabric is destroyed by heating. Destroys the base without injuring the animal or vegetable threads or the threads covered with metal (fine gold or silver wire) that form the pattern. Cotton fabric dipped in sulphuric acid. Stitches have to support each other after the backings removal. **Cellulose fibre removal.**

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Paris France. **Lace**	June 10, 1886 **USP**	February 22, 1887 **358,156**	Frederick Juncker	Foundation fro Embroidered Lace, &c.	New kind of lace, galloon, guipure, and similar, on a soluble continuous sheet of soluble gum. Animal, vegetable or metallic threads. Destruction of the gutta-percha in a bath of sulphured of carbon or benzine or other dissolvent. **Gum sheet removal.**
Silk embroidery / lace?		August 9, 1888. **GB 11,478**	F. H. Bowman	Carbonized fabrics	Silk design embroidered on a ground of cotton, which is afterwards destroyed by the action of acids and heat. **Cellulose fibre removal.**
Woollen Lace		November 10, 1888. **GB 16,420.**	F. H. Bowman	Carbonized fabrics	Wool and other similar animal fibres (excluding silk) are embroidered or woven in a suitable pattern upon a ground of cotton, or other vegetable fibre, the groundwork is destroyed by the action of an acid and heat. **Cellulose fibre removal.**
Silk, wool or other animal fibre in a woven, knitted or lace fabric.		November 28, 1888. **GB 17,283**	F. H. Bowman	Carbonized Fabrics.	In the manufacture of woven, knitted, or lace fabrics of silk wool, or other animal fibre, "draw threads" of cotton, linen, or other vegetable fibre are introduced and afterwards removed to form peculiarities in the pattern. Acid or acid gas. **Cellulose fibre removal.**
USA New York **Coloured silk or metal embroidery.**	July 15, 1892 **USP**	September 11, 1894 **525,738**	Gottfried Hauser Assignor of two thirds to Rudolf Spiess and Emil Kreis.	Process of Removing Background from Embroidery	Removal of fabric background in a bath consisting of aluminium chloride and a suitable acid such as sulphuric. Product then dried and at 100°C, the cotton backing falls away while silk gauze and embroidery remain. Aluminium chloride is used as a mordant to fixing and retaining colours. **Cellulose fibre removal.**

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
France Neuville Sur-Saône. **Cotton or silk velvet devoré.**	November 18, 1895. **USP**	March 24, 1896. **556,794**	Auguste Wissel, Louis Girard, Joseph Brunier, trading as Wissel et Cie.	Ornamentation of Velvet.	Pile removal. Performed by plates, platens or rollers cut in relief. The chemical remover for silks and wool being a basic alkaline product and for cotton and a mixture of oxalic and sulphuric acids. **Silk or cotton removal.**
USA New York. **Figured Pile fabrics with a cotton or silk pile.**	December 4, 1901 **USP**	July 29, 1902. **705,977**	Otto Timme	Method of Producing Figured Pile Fabric.	To closely imitate a jacquard-produced pile fabric. Subjecting a portion of the pile of a plain woven pile fabric to the action of colors according to a pre-determined design and subjecting the remaining portions of the pile to the action of a pile-destroying medium, then steaming the fabric to fix the color and to aid in the destruction of the pile. **Silk or cotton removal.**
		August 1, 1902 17,070	B Dalichow	Carbonized fabrics	
Switzerland, Herisau **Trapped tinsel ornament in fabric.**	May 5, 1903. **USA**	October 13, 1903. **741,302**	Ernest Ulrich Buff	Ornamented Embroidery and Process of Manufacturing Same. Images	The embroidery is made upon a corrodible substance or material capable of being removed by suitable etching or corroding agents. Behind the embroidery a fabric is applied between the embroidery and the tinsel ornaments are inserted. The tinsel ornament and fabric are fastened to the embroidery, after which the corrodible material is removed by etching and the applied fabric is removed by cutting away around the tinsel ornaments.

Origin & Product	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Scotland Paisley **Wool and cotton paisley style fabric.**	August 7, 1905. **USP**	March 3, 1908. **880, 983**	Charles William Fulton.	Production of Patterns, Designs, or other Similar Markings in Fabrics.	Parts of the fabric are chemically treated to remove or destroy parts of some of the threads or fibres. Wool and cotton fabric with destruction of the cotton fibres. Gauze like open work effects. **Cellulose fibre removal.**
Germany, Rodewisch **Cellulose fibre embroidery.**	February 21, 1907 **USA**	September 10, 1907. **865,640**	Hermann Häberer.	Method of Manufacturing Embroidery.	The embroidery is arranged on a specially prepared groundwork, later corroded with soda or the like. Using 'bourette threads' – spun of waste silk to give the groundwork greater firmness and prevent distortion of the embroidery. **Silk fibre removal.**
Germany Leipzig/ Plauen **Cotton embroidery lace.**	October 7, 1908. **USP**	April 6, 1909. **917, 402**	Rüdolf Bauer assigner of one half to Rudolf Schiller (Plauen)	Corrodible Groundwork for Lace.	Replace expensive woollen groundwork with a cheaper cotton. Since lace is made of cotton the corrodible cotton groundwork is prepared prior to the embroidery but without destroying the cotton lace. The cotton ground is impregnated with 'neutral non-hygroscopic sulfates' capable of being thermolytically dissociated' (with aluminium sulphate, etc.) **Cellulose fibre removal.**
England Bradford **Artificial silk woven fabric.**	March 23, 1911 **USP**	March 26, 1912 **1,021,712**	Joe Wilkinson & The Bradford Dyers' Association, Bradford England.	Manufacture of Textile Fabrics.	Animal threads twisted with artificial silk threads to form the warp of a woven fabric. Afterwards destroying the animal fibre leaving the warp threads of artificial silk only. Wool destruction to aid in the manufacture of a delicate fabric composed of artificial silk treads. **Protein fibre removal.**

Appendix 2

Appendix 2.

'Table: Burn-out agents and fibre materials'. Rouette. H. K. (2001). The Encyclopedia of Textile Finishing. Berlin; London: Springer.

	aluminium sulphate	sodium hydrogen phosphate	caustic soda	benzoic peroxide
cotton	+	+	-	-
viscose	+	+	-	-
linen	+	+	-	-
polyester	-	(-)	(-)	-
polyamide	-	+	(-)	-
triacetate	-	+	(-)	+
acetate	-	+	(-)	+
wool	-	-	+	-
silk	-	-	+	-

Fibre is: + destructible, -resistant, (-) and partially resistant

Appendix 3

Woven devoré patent chronology 1900-1914					
Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA New York	December 4, 1901 **USP**	July 29, 1902. **705,977**	Otto Timme	Method of Producing Figured Pile Fabric. Images	To closely imitate a jacquard-produced pile fabric. A new, improved method of producing figured pile fabric in a simple and economical manner. Subjecting a portion of the pile of a plain woven pile fabric to the action of colors according to a pre-determined design and subjecting the remaining portions of the pile to the action of a pile-destroying medium, then steaming the fabric to fix the color and to aid in the destruction of the pile.
Scotland Paisley	August 7, 1905. **USP**	March 3, 1908. **880, 983**	Charles William Fulton.	Production of Patterns, Designs, or other Similar Markings in Fabrics. Images	Parts of the fabric are chemically treated to remove or destroy parts of some of the threads or fibres thus leaving the parts so treated more open or wider in mesh than the main body of the fabric. The chemical employed may also change the colour of the threads it does not destroy, or it may be combined with a substance for changing the colour of the remaining threads and constituting the body of the pattern. Wool and cotton fabric with destruction of the cotton fibres. Gauze like open work effects.
England Bradford	March 23, 1911 **USP**	March 26, 1912 **1,021,712**	Joe Wilkinson & The Bradford Dyers' Association, Bradford England.	Manufacture of Textile Fabrics.	Animal threads twisted with artificial silk threads to form the warp of a woven fabric. Afterwards destroying the animal fibre leaving the warp threads of artificial silk only.

Belgium Brussels	November 17, 1913 Belgium		Henry Giesler		Open work effects on a woollen foundation, etc in imitation of embroidery. A voile cotton cloth, and a satin cloth made out of worsted warp and weft with a yarn of artificial silk. A reverse process whereby a mixed fabric is passed through an acid bath and then immediately dried at a low temperature. The design is then printed with a neutralising alkaline solution. The fabric is passed through a heated chamber to produce carbonisation at the places not protected.
	May 2, 1914 **GB**	November 25, 1915 **10,867**		Improvements in or Relating to Processes for the Decoration of Woven Fabrics.	
	November 10, 1914 **USP**	August 15, 1922. **1,425,520**		Process for Producing Patterned Textile fabrics and the Resulting Product.	

Stitched devoré patent chronology 1900-1914					
Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Switzerland, Herisau	May 5, 1903. **USA**	October 13, 1903. **741,302**	Ernest Ulrich Buff	Ornamented Embroidery and Process of Manufacturing Same. Images	The embroidery is made upon a corrodible substance or material capable of being removed by suitable etching or corroding agents. Behind the embroidery a fabric is applied between the embroidery and the tinsel ornaments are inserted. The tinsel ornament and fabric are fastened to the embroidery, after which the corrodible material is removed by etching and the applied fabric is removed by cutting away around the tinsel ornaments.
Germany, Rodewisch	February 21, 1907 **USA**	September 10, 1907. **865,640**	Hermann Häberer.	Method of Manufacturing Embroidery. Images	The embroidery is arranged on a specially prepared groundwork, the embroidery afterwards being liberated from the ground-work by the later being corroded with soda or the like. Using 'bourette threads' – spun of waste silk to give the groundwork greater firmness and prevent distortion of the embroidery. Silk fibre destruction.

Germany Leipzig/ Plauen	October 7, 1908. **USA**	April 6, 1909. **917,402**	Rüdolf Bauer assigner of one half to Rudolf Schiller (Plauen)	Corrodible Groundwork for Lace. Small image.	Replace expensive woollen groundwork with a cheaper cotton. Since lace is made of cotton the corrodible cotton groundwork is prepared prior to the embroidery but without destroying the cotton lace. The cotton ground is impregnated with 'neutral non-hygroscopic sulfates' capable of being thermolytically dissociated' (with aluminium sulphate, etc.) Heated after embroidery and then brushed or beaten to remove ground. The prepared cotton can be preserved for months without losing durability also resistant to damp.
Germany, Plauen.	February 4, 1913. **USA**	July 15, 1913. **1,067,605**	Julius Groetschel.	Process for the Production of Embroideries.	Shuttle embroidering machines. One row of needles with dischargeable (discharge (burn out) embroideries) thread and the other with non-dischargeable threads. Embroidered onto a backing of dischargeable threads. 'Beautiful embroideries that cause astonishment'.
Associated chemical fibre treatments 1900-1914					
Origin	**Application date**	**Acceptance date**	**Inventor/ Company**	**Specification Title**	**Specification Abstract**
GB Chester	March 24, 1903 **GB**	October 18, 1904. **772,598**	John Yates	Treating Cloth %c.	'The method of dividing, perforating and similarly treating cloth and other fabrics which consists in applying an acid or equivalent corrosive substance to a printing-surface containing an engraved or otherwise produced pattern, then impressing said printing surface upon the cloth and finally separating the fabric along the lines of the impressed pattern.

Appendix 4

Woven devoré patent chronology 1920-1929.					
Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification abstract
USA New Jersey	February 15, 1924. **USP**	October 28, 1924. **1,513,370**	**Ernest Cadgène & Jules Jeandros.**	Soda-Print Process	To produce a new and improved soda printing process by means of which all of the reserved figured effects may be secured and in addition desired colour effects may be produced upon the reserved figures. **Printed** colour onto the face of the fabric and mixing with the colours, a **resist composition** which is colourless, and which will prevent the chemical used from attacking or reacting with the threads of the portions to be reserved. The resist composition may either forma protective coating on the reserved portions or may react with the soda print chemical so as to neutralise the effect. The entire face or back of the goods is then coated with the **soda printing** chemical. The unreserved threads are destroyed
	June 4, 1924. **GB**	July 23, 1925. **229,241**		Improvements relating to the Production of Brocaded Effects on Fabrics.	
Switzerland Wattwil.	July 29, 1924. GER.		**Georges Heberlein.**	Figured Fabric and Method of Producing the Same.	Solvent for cellulose acetate silk- printed reserve, steamed, carbonization, conversion of the cellulose ester into cellulose hydrate, which is insoluble.
	July 27, 1925 **USP**	May 1, 1928. **1,667,892**			
	July 28, 1925 **GB**	April 8, 1926. **237,909**		Production of Pattern Effects on Woven Fabrics.	
USA New York	August 27, 1924. USA		**Samuel Eliot Creasey & Sidney Blumenthal & Co. Inc**		When desired we remove all the pile in the peripheral outline by singeing or applying chemicals to the back of the cloth, eating the pile out of the back of the goods, the pile then falling out in the peripheral outline.
	February 11, 1925. **GB**	August 13, 1925. **238,139**		Improvement in Pile Fabrics to Simulate Fur Blankets and in the Method of Producing the Same.	

Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA New York	September 20, 1924. **USP**	June 15, 1926. **1,588,951**	**Camille Dreyfus & American Cellulose & Chemical Manufacturing Co. Ltd N.Y.**	Printing of Fabrics and Articles.	**Printed removal** of cellulose acetate then heat.
	March 12, 1926. GB **GB**	December 30, 1926. **263,355**		Improvements in or relating to the Printing of Fabrics and Articles Made of or Containing Cellulose Esters or Ethers.	
(N) Ireland Co. Tyrone	March 28, 1925 **GB**	October 1, 1925 **240, 378**	**Robert Stevenson & William Wakefield**	Improved Method of Manufacturing Decorated and Mercerised Woven Fabric.	**Plain woven fabrics.** Ornamental patterns of the open-work type and mercerisation of the vegetable threads. Woven fabric composed of animal and vegetable threads, is treated in a bath containing an alkaline solution at such a temperature that not only are the animal threads removed but the vegetable threads are mercerised, the combined actions being simultaneously performed. Alkaline bath
GB Lancashire/ London	July 17, 1925. **GB**	November 17, 1926. **261,448**	**Arthur Swallow & The Calico Printers' Association Ltd.**	Improvements relating to the Decorative printing of Textile Fabrics.	Multi coloured brocade effects, animal, veg and acetyl cellulose fibres. caustic soda- animal or artificial silk fibres- blotch pattern is **printed?**
USA New Jersey	October 9, 1925. **USP**	January 10, 1928. **1,655,414**	**Henry Flory**	Method and Chemical Mixture for Producing Brocaded Textiles.	Applied **printed nitration/ burning mixture** (intaglio plate or roller) then steamed. Wool devoré. Making a brocade from a textile having a cotton back and a pile face of wool which comprises impregnating designed portions of the pile face with a mixture comprising a water solution of caustic soda solution and sulphuric acid and a carrier. Steamed after printing.

Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Switzerland Watwill	December 5, 1925. GER		**Albert Bodmer & Heberlein and Co. A.G.**		Interwoven **nitrated threads (vegetable)** Solution, (or less successful) denitration paste printed onto fabric and then passed through alkali solution. Producing pattern effects, which consists in weaving a fabric with unnitrated threads and nitrated vegetable threads and decomposing and removing portions of the nitrated threads according to a predetermined design. Printing upon the fabric a reagent, which will either decompose the nitrated threads or neutralise (denitrating) the threads upon contact. Applied (printed) alkali solution (caustic soda) on various spots (pattern) where contact dissolves or decomposes threads- dry heat or steaming. Localised **alkali is printed**. Also can print alkali and then pass through alkali.
	November 27, 1926. **USP**	October 23, 1928. **1,688,798**		Fabric Making	
	December 6, 1926. **GB**	March 17, 1927. **262,477**		Process for Producing Patterned Weaving Effects.	
Switzerland Watwill	December 5, 1925. GER		**Albert Bodmer & Heberlein and Co. A.G.**		**Nitrated threads, without carbonisation of the threads.** The alkali dissolves or decomposes the nitrated threads, which are removed by washing. 'According to the method of prior patent, it has been found that practical commercial difficulties arise in practices resulting in a loss of yarn unless great caries taken. Under that process the yarns were dried at low temperature in an endeavor to reduce loss, this is due to the fact that the yarns when treated with sulphuric acid are partially destroyed while drying.'
	July 14, 1928 **USP**	October 23, 1928. **1,688,799**		Fabric Making A division of US patent **1,688,798**	
Switzerland	January 20, 1926. GER		**Herman Müller & Cilander, A.G.**		**Plain woven fabric &printed alkaline** Producing pattern effects in the texture of fabrics which consists in printing a pattern on a mixed fabric of warp and weft threads only composed of animal and vegetable fibres by means of an alkaline pasteproducing the same pattern on both sides of the fabric in the original weave.
	February 26, 1926. **USP**	February 21, 1928. **1,660,042**		Method for Producing Pattern Effects in Fabrics.	

Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Switzerland Basel-Augst.	April 6, 1926. **USP**	December 11, 1928. **1,694,466**	**René Clavel.**	Process of Obtaining Metallic Effects on fabrics Containing Organic Derivatives of Cellulose.	**Solvent printed** the organic derivatives of cellulose forming part of the fabric- the liquid dissolves the organic derivatives of cellulose.
GB Derby	September 12, 1927. **GB**		**George Ellis, Henry Olpin, Eric Walker &Celanese Corporation Of America.**		Substance applied to back of the pile fabric to soften or weaken loops – mechanically removed – **printing, spraying, blocking, stencilling**, etc.
	March 15, 1928. **USP**	December 2, 1930. **1,783,608.**		Treatment of Fabrics	
USA New York	December 16, 1927 **USP**		**British Celanese Ltd.**	Improvements in or relating to the Treatment of Fabrics Containing Cellulose Derivatives. **Addition to GB patent 274,074.**	Woven, knitted, netted. Woven ordinary weave or pile fabrics, consisting of either entirely cellulose esters or mixed fabrics with cotton, linen, silk, wool, etc. Ornamental effects on fabrics made of or containing cellulose esters. By removing part of the cellulose ester made possible by a local treatment of the fabric with a saponifying agent whereby the cellulose ester is converted into regenerated cellulose fibre and is then susceptible to the carbonising treatment of bath containing hydrochloric acid or other carbonising acid or acid salt, and then dried at an elevated temperature.
	December 14, 1928 **GB**	January 10, 1929 **302,363**			
USA New York	December 16, 1927. **USP**	May 12, 1931. **1,804,529**	**Camille Dreyfus.**	Ornamental Fabric obtaining Derivatives of Cellulose and Method of Producing the same.	Fabric totally made of cellulose acetate. **Printed** with a paste containing a saponifying agent for cellulose derivative- converted into cellulose where applied- then **carbonized (acid bath)**- destroying reconstituted cellulose but original cellulose derivative is unaffected.

Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA New Jersey/ New York	December 16, 1927. **USP**	August 11, 1931. **1,818,505**	**George Rivat & Camille Dreyfus for Celanese Corporation of America.**	Process of Treating Fabrics.	**Printed paste** acid or acid salt and a solvent, swelling agent – heated and brushed then delustering of cellulose acetate – engraved or embossed plates or stencils.
USA New York & Maryland	May 3, 1928. **USP**	December 1, 1931. **1,834,339**	**Camille Dreyfus, Robert Dort, Herbert Platt & Celanese Corp.**	Treatment of Textile Materials Containing Carbonizable Fibres and Product thereof.	Creation of **short staple cellulose acetate thread** - preparation of "spun yarns" of organic derivatives of cellulose with cheap cotton vegetable fibre, etc. **carbonization treatment**. Lace effects – jacquard fabric **carbonization**. mixed fabric with a **printed paste** – heating
as above	October 26, 1929. **USP**	December 1, 1931. **1,834,388**	**Camille Dreyfus, Robert Dort, Herbert Platt & Celanese Corp.**	Treatment of textile materials containing Carbonizable Fibres and product thereof. **Division of US patent 1,834,339 (above)**	**Division of above patent** – just creation of **short staple cellulose acetate thread** -preparation of "spun yarns" of organic derivatives of cellulose with cheap cotton vegetable fibre, etc.
GB London	August 2, 1929. **USP**	May 21, 1935. **2,002,083**	**Henry Dreyfus.**	Treatment of Fabrics.	**Printed reserve – hot bath** containing acidic substances unreserved portions disintegrate and are removed. Also delustring in hot bath.

Stitched devoré patent chronology 1920-1929

Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
New York Yonkers	March 24, 1925. **USP**	December 8, 1931. **1,835,866**	Joseph F.X. Harold.	Lace Making	Nitration of the cotton ground for the embroidery, the treatment renders the fabric relatively soluble, while providing enough strength for the embroidery.
USA New York	May 27, 1925. **USP**	February 25, 1930. **1,748,608**	Vaman R. Kokatnur.	Manufacture of Embroidery Lace and Similar Artistic Products.	Treatment of cotton thread used to create the embroidery, rather than the ground fabric. Usually expensive silk, wool or rubber used as the ground fabric and is often higher costing than the cotton embroidery.

Lace devoré patent chronology 1920-1929 Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
USA New York	January 19, 1926. **USP**	April 10, 1928. **1,665,230**	John Spalding & Albert T. Otto & Sons New York.	Lace Web and Process of Making the Same.	Instead of hand removing draw strings from manufactured fabrics, the draw strings are manufactured from an alternative fibre which is dissolved to liquid. Dissolve in an organic solvent or mixture of organic solvents. For instance cellulose acetate fibres which are soluble in acetone, or any treatment which does not affect the ordinary cotton threads of the lace. Bath.
Associated chemical fibre treatments 1920-1929 Origin	Application date	Acceptance date	Inventor/ Company	Specification Title	Specification Abstract
Germany Berlin	May 11, 1926 GER		Wilhelm Sponholz		Threads of artificial silk are woven near to the edge of bandages so that when they are moistened with a solvent they become sticky and remain in position and become firmly connected with the fabric. This is top fraying of the edge of strips of fabric. The thread has to be soluble in organic solvents, being adherent to the body of the fabric and each other.
	November 23, 1926. **USP**	April 23, 1929. **1,709,887**		Textile Fabric and Method of Making Same.	

Appendix 5

Hillman. B. S. Soda Prints on Pile Fabrics. Rayon Textile Monthly. February 1937.

Finishing Operations

After printing cut out velvets pass up through a drying tower where they are heated for several minutes at 290°-310°. The tower is usually provided with an exhaust fan to remove the excess acid fumes generated. Steam ageing is unnecessary unless color has been added to the cut out paste. Animal fibers printed with caustic are first dried at a fairly low temperature so as not to yellow the mohair or worsted pile. They are next transferred to a cottage steamer and steamed for about 30 minutes. With dry steam at five pounds pressure.

Transparent velvets carbonized in the greige state are given a short rinse in a weak ammoniacal solution before boil-off. This will neutralize the excess carbonizing chemical. The carbonized rayon will fall out during the subsequent boil-off. Any residual bits of carbonized rayon will be removed by the brushing and carding which takes place during the finishing process. Dyed velvets or boiled-off velvets which are later carbonized cannot be handled in this way. Such fabrics are usually brushed several times using a fairly stiff wire card. As there is a great deal of dust (carbonized rayon, aluminium oxide, etc.) flying around during this process, the brushing machine is provided with an exhaust fan and hood over the revolving brushes. This removes practically all the dust. However, there is always a small residual amount of fine greyish brown dust which escapes the exhaust flue and gradually coats everything in the room.

Machine brushing does not result in a clean cut job of removing the carbonized rayon residue. Any attempt to remove all the carbonized rayon loops and pile usually ends up with a badly shirred piece of transparent velvet. The small residue left after machine brushing is usually removed by careful hand brushing using a small stiff hair brush. At best there is often a slight amount of shirring. It is possible t remove all the carbonized pile without shifting any of the silk threads in the filling or in the ground warp by using an ordinary three (2 paper—1 steel) silk calender. At first thought, this method might be expected to crush the remaining pile. However, as the pile is carefully brushed flat before printing no harm is done to the remaining rayon. The carbonized portion being very brittle falls out in the form of fine greyish brown powder. Calendered pieces always finish up cleaner and with less shirring than brushed pieces. A makeshift doctor blade is usually rigged up on the steel roll of the calender to remove the excess dust which quickly collects on this roll. It is also important that the machine be cleaned every night after using. Otherwise the acid dust will cause it to rust badly in a very short time. Calendering is considerably cheaper and at the same time does a faster and cleaner job than the usual wire carding machines. However, its use is somewhat limited due to the fact that most velvet mills do not have any calendering equipment.

Caustic treated mohair-pile cotton back plush is not handled like transparent velvets after printing. Printed grey goods are handled no differently than ordinary grey goods except that the first rinse is always dumped sooner than usual. Printed dyed goods are rinsed cold and afterwards they are carefully neutralized with acetic acid before a final rinse. The causticized pile always falls out during the rinsing and subsequent finishing operations—beating, carding, etc.

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