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Technical Analysis of Textile Remains from a 17th-Century English Plantation at Ferryland, Newfoundland and Labrador, Canada

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A wide range of textiles was recovered from the archaeological excavation of a privy and elsewhere inside the palisade of Sir George Calvert's first English colony, established in 1621 in what is now Newfoundland and Labrador, Canada. These textile fragments were compared to those in museum collections in England and Canada. Many of the samples with higher thread counts (over 15 per cm either in the warp or weft) are finely woven silk and worsted wool representing the "New Draperies" of the period. These fine fabrics, at times coloured with expensive dyestuffs and including fancy trims, constituted high fashion in the 17th century. The moist and almost anaerobic environment of the privy allowed for the excellent preservation of protein-based fibres. Because these small finds were deemed useful for research, a minimal intervention approach to treatment was taken. A number of silk fabrics survived burial, including satin, damask, ribbon and velvet, but the majority of the surviving collection is wool. Dyestuffs have been identified on 26 of 59 samples analysed by high performance liquid chromatography (HPLC) and Fourier transform infrared spectroscopy (FTIR) and include madder (alizarin and purpurin), cochineal (carminic acid), logwood and weld (luteolin). Tannin components (ellagic acid and gallic acid) were detected in some samples. Scanning electron microscopy coupled with x-ray energy spectrometry (SEM/XES) was undertaken; the presence of chromium, aluminum and iron could not positively be attributed to their use as mordants. The identification of the "New Draperies" and expensive dyestuffs such as cochineal confirms the presence of a gentry class among the 17th-century English colonists in Ferryland.

Une grande variété d'artefacts textiles ont été mis au jour lors de la fouille archéologique d'une latrine et d'autres lieux faisant partie du site fortifié de Ferryland. Dirigée par Sir George Calvert, Ferryland fut la première colonie britannique au Nouveau-Monde, établie en 1621 dans l'actuelle province de Terre-Neuve et du Labrador, au Canada. Ces fragments textiles ont été comparés à des textiles conservés dans des musées en Angleterre et au Canada. Plusieurs textiles tissés serrés (c'est-à-dire ayant plus de 15 fils de chaîne ou 15 fils de trame par centimètre) faits de soie finement tissée ou de laine peignée furent découverts. Ces tissus de qualité, parfois teints au moyen de colorants dispendieux et garnis de bordures de fantaisie, sont typiques des «nouvelles étoffes» de l'époque et étaient très à la mode au XVII^e^ siècle. Les conditions humides et anaérobiques du sol ont favorisé la bonne préservation des fibres protéiques. Il était clair que ces vestiges avaient un bon potentiel pour la recherche, et par conséquent leur traitement a été minimisé. Parmi les textiles retrouvés, un certain nombre étaient en soie, dont des tissus en satin, en damas et en velours ainsi que des rubans; cependant la plupart étaient en laine. Il a été possible d'identifer les colorants de 26 des 59 échantillons analysés au moyen de la chromatographie en phase liquide et de la spectroscopie infrarouge à transformée de Fourier (IRTF), entre autres : la garance (alizarine et purpurine), la cochenille (acide carminique), le campêche et la gaude (lutéoline). Des tannins (acide ellagique et acide gallique) ont aussi été identifiés dans certains échantillons. L'analyse par microscopie électronique à balayage couplée à la spectrométrie des rayons X a révélé la présence de chrome, d'aluminium et de fer. Toutefois cela ne permet pas de conclure que ces éléments sont associés à des mordants puisque ces éléments étaient aussi présents dans le sol. L'identification, parmi ces vestiges textiles, de «nouvelles étoffes» et de teintures dispendieuses telles que la cochenille confirme la présence d'une petite noblesse parmi les colons anglais du XVII^e^ siècle à Ferryland.

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Introduction

Few pieces of costume have survived from the 17th century in this country. Much of what is represented in our collections illustrates the clothing of kings, queens and upper social classes. Documentary sources for the study of textiles include probate records, journals, household accounts and merchant records which are generally more plentiful than the textiles themselves.

Archaeological remains from the Ferryland site in Newfoundland, however, complement the written record relating to the textiles used by the 17th-century colonists. Each fragment has the potential to tell us about a complex trade network that began with the fibre producer who sold to a merchant who supervised the weaving, dyeing and finishing of fabrics, through their delivery to the port from which they were shipped to their final destination in the New World.

This paper provides technical analyses of textile finds from the 17th-century Ferryland site, Newfoundland, including fibre, yarn and weave, as well as dye and mordant analysis, and presents these data within their historical context. When possible, parallels are drawn to similar historical textiles housed in museum collections. The goal is to provide information and

insight toward a broader socio-economic understanding of this colonial site. The value of interdisciplinary research is demonstrated as the combined expertise of conservators, conservation scientists and archaeologists on this project has resulted in important information being garnered from the textile finds under investigation. This paper also demonstrates that the extraction and identification of dyestuffs from 17th-century archaeological textiles can be successful. Because the Ferryland site represents one of Canada's earliest historic settlements, producing one of the largest textile assemblages yet excavated in this country, these analyses prove that useful results can be obtained from some of this country's oldest historic textiles.

Historical Context

17th-century Ferryland

The settlement of Ferryland is situated on a small spit of land on the southeastern coast of Newfoundland 60 kilometres south of present-day St. John's. The site is protected from the Atlantic ocean, located on the inland end of the spit and facing a protective cove of land across a short run of water on its north face. At the time, this made an ideal spot for an inshore fishery, and as pleasant and temperate a location as Newfoundland could offer.

In 1621 Sir George Calvert (later the first Lord Baltimore) sent Captain Edward Wynne and a group of settlers from England to Ferryland with the intention of establishing a permanent settlement based on the lucrative inshore cod fishery.[1,2] What is known of George Calvert is that he was a "courtier, colonizer, capitalist and catholic."[3] Calvert had served as Secretary of State for James I of England from 1619 to 1625 during which time he accumulated considerable wealth. His investments included shares in both the Virginia Company of London and the East India Company.[3] Historical documents indicate that Calvert's colonists constructed a mansion house, brew house, salt works, forge, hen house, kitchen, fishing stores and other dwellings.[1,2] Lord Baltimore visited his colony in the summer of 1627 and returned with his family and an entourage of about forty people in 1628.[2] Perhaps because the climate didn't suit the Calverts, or because of a downturn in the fishery, they left within a year of their arrival. George Calvert did, however, leave the management of the growing colony in the hands of an overseer. It is unknown who this representative was after Calvert left in 1629, but we know that Captain William Hill was his representative when Sir David Kirke arrived in 1638 to take control of the colony, having been granted the island of Newfoundland in the previous year.[4] The Dutch attacked the area in 1673, inflicting a great deal of damage to several plantations, especially Ferryland. The colony recovered from this attack, but later the French captured and burned the settlement in 1696, after which the settlement moved from the "Pool" and spread out in a more dispersed manner on the mainland of Ferryland.[5]

The 17th-century English Textile Industry

From historical documents we know that finished cloth and items of clothing were shipped across the Atlantic early in the English colonial occupation of North America.[6,7] Some of these now show up in the archaeological record at Ferryland.

Essentially there were three basic types of weave in the 17th century from which clothing was made: the plain or tabby, the twill, and the satin weave.[8] Variations in these weaves produce the decorative pattern visible in the cloth. Fancier weaves included damask, velvet and taffeta.[9] During the 17th century, changes in manufacturing methods and materials led to the development of new types of fabric that were distinctly different from those traditionally available. The specific fibre types and combinations, new weave patterns, and the fineness of fibre that corresponded with a higher thread count are what define the "New Draperies."[10] Textiles of both silk and wool constitute the "New Draperies." The English export of "New Draperies" established an expanding market along the Iberian Peninsula, around the Mediterranean[11] and were also to find their way, across the Atlantic, to Ferryland.

Wool

The history of the English wool industry is well documented.[12-16] England's wool industry significantly influenced the country's economic growth from about the 12th to the 19th centuries.[17] The raw material was raised at home and was considered the best quality wool worldwide. Prior to the mid-16th century, the principal export was the raw wool. By the turn of the 17th century, however, there existed a profitable trade in the export of undyed and unfinished fine woollen English broadcloth to the Low Countries (present day Belgium and the Netherlands).[14,18] Woollen fabrics, manufactured from the short hair of the sheep, represented the first type of cloth production in Britain and are referred to as the "Old Draperies."[15] The warp and weft threads were coarse and when woven in a twill or tabby weave the fabric was warm, durable and somewhat water-resistant. Because of the coarseness of the fibres and the open weave structure, the "Old Draperies" were fulled.[19] The fulling of wool cloth produced a somewhat felted wool which was more water-repellent and warmer.

By the 17th century, production of a second type of woollen fabric, called worsted, became popular. These improved types of cloth were part of the "New Draperies." Worsted fabrics were made with long wool fibres that were combed instead of carded. The threads, made from these long fibres using a "Z" twist, had an increased tensile strength over that of shorter fibres, and could, therefore, be finer.[20] When twisted, the resulting yarn was strong and smooth and the woven fabric required no fulling, as a tight weave could be achieved. Traditional worsted yarns were spun in a single ply, while patterned worsteds, from the late 16th century onward, were manufactured using plied yarn.[10] The shot appearance, or changeable colours of these new fabrics, was produced by combining different threads. The warp and weft yarns of worsted fabrics could be made completely of worsted yarns of similar type or could be a combination of yarns of different fibres. Often wool yarns were mixed with silk yarns to produce a lightweight fabric with improved draping properties.[21]

Silk

The history of European silk production is also well documented.[22-25] The 17th-century silk industry was initially dominated by Spain and Italy. By the end of the century England had a silk industry, but it was never as successful as that of Spain, France or Italy. Spitalfields was the English production centre, and its success is generally attributed to the weaving skills of the Huguenot immigrants who settled in the area.[12,26,27] One important shift in production was the move away from ribbon weaving to a focus on broadloom silk weaving.

The three stages of silk production are: moriculture, sericulture, and cocoon processing.[28,29] James I attempted to develop the English silk industry by establishing orchards of mulberry trees in and around London, but despite all efforts sericulture, or the growing and harvesting of silk worms, was never successful in England, most likely because of the cool climate. Attempts were also made to establish sericulture in the colonies of Carolina, Virginia and Georgia. Although silk production did not supplant that of tobacco, which by this time was very successful, a small-scale silk industry did develop in Carolina and Georgia. By 1730 silk was exported to London from the American Colonies.[22] Although the production of silk did not become an important industry in England, this was offset by the manufacture of another of the "New Draperies," a lightweight finished cloth made with silk and wool yarns, that was also used to make silk hosiery.[10,12]

The production of fine silk fabrics in France contributed to its lead in the fashion industry by the 17th century.[30] Lyon was the silk weaving centre of France and gained recognition, in part, because of the local development of the drawloom weaving technique. This innovation meant that large and stylized symmetrical patterns could be woven in a variety of colours.[30] During the 1600s, the industry in Lyon annually released silk patterns and designs characterized by floral decoration. These styles dictated the standards to be followed in England and Holland.

Dyes and Mordants

The dyestuffs available in the 17th century included tannins, dyer's broom, kermes, madder, weld, indigo, cochineal and logwood.[31,32] Cochineal was an expensive dye, probably reserved for use on silk. Madder, indigo and weld were much cheaper and were used more commonly for dyeing wool as well as silk. Cunnington cites a reference to the wearing of blue at this time for the dress of apprentices and servants,[33] but undyed wool cloth was not uncommon.[12,14,18] It is also possible that the process of dyeing broadcloth was undertaken in the colonies. Flowing fresh water, an essential ingredient for the dyeing of cloth, was generally available and certainly was accessible to a potential cloth dyer at Ferryland.

Madder, used as a red dye since antiquity, has a widespread geographical distribution and has been extensively cultivated.[32,34] Alizarin and purpurin are the major colorants of madder prepared from the roots of the madder plant, *Rubia tinctorum* and other species. Cochineal is a red dye obtained from a scale insect such as *Dactylopius coccus* native to Mexico. The dye's major chemical component is carminic acid. Cochineal was imported into Europe, following its discovery in the 16th century, because it was a superior dye to kermes, an insect dye prepared from *Kermes vermilio*.[10] Carminic acid is also found in Polish cochineal, which is derived from two other scale insects of relatively minor importance, *Porphyrophora polonica* and *Porphyrophora hamelii*.[34] Polish cochineal contains a small percentage of kermesic acid in addition to carminic acid. It can be very difficult, therefore, to distinguish the various types of cochineal in small samples. The chemical structures of the anthraquinones carminic acid, alizarin and purpurin can be found in the literature.[34,35]

Weld was historically the most important yellow dye in Europe.[34] It was frequently used in combination with indigo to provide a green coloration. Luteolin is the major component of the weld plant, *Reseda luteola* .[34] Weld also contains the flavone apigenin, which is difficult to detect in small samples because of its low concentration. Another yellow dye, dyer's broom, *Genista tinctoria*, contains the isoflavonoid genistein as well as luteolin. Genistein is present in a sufficiently high concentration in extracts of dyer's broom to be readily detected.

Prussian blue is a hydrated iron hexacyanoferrate complex that was first discovered in 1704. It was used as early as 1749 for dyeing fabrics, particularly silk. The process, developed in France by Macquer, involved producing Prussian blue directly in the fibre using a combination of ferrous salts and potassium ferrocyanide.[36,37] Prussian blue thus post-dates the Ferryland textiles. In the 17th century, a blue colour would have been produced using indigo.

Logwood produces a black dye, and is prepared from *Haematoxylon campechianum* native to South and Central America.[34] Logwood was first imported to Europe by the Spanish and was available in Spain early in the 16th century and shortly thereafter in other European countries. Because it was thought that the colours it produced were fugitive, its use was banned in England in 1580. The logwood prohibition laws were not repealed until nearly a century later.[38]

Tannins, found in galls, dead leaves and bark, were also used as dyestuffs. They produce a black dye and were mainly used with iron mordants.[31]

Historically, aluminium, iron and copper compounds were used as dye mordants. Chromium-containing compounds have also been used as mordants. A process for mordant dyeing using chromates was commercially developed in 1820.[39]

The Ferryland Archaeology Project

The Archaeological Site

The present Ferryland Project, under the direction of Dr. James

Tuck, began excavations in July, 1992. The site, its history and the artifacts excavated to date have been described by Gaulton and Tuck[2] and others.[5,40-50] Gaulton and Tuck have established that the area of excavation surrounding the present day sea-shore pool contains substantial material dating to the 17th century. The site itself is believed to cover an area of approximately 30,000 m^2. To date, a small fraction of the site measuring about 1,100 m^2 has been excavated and its parts designated as Areas A through G (**Figure 1**). The bulk of the textile collection was recovered from within Area C. Briefly described, the Areas represent the western edge of the colony (Area A); the houses of middle class planters (Areas B and D); a waterfront warehouse complex (Area C); defensive works (Area E); a high status house, possibly the

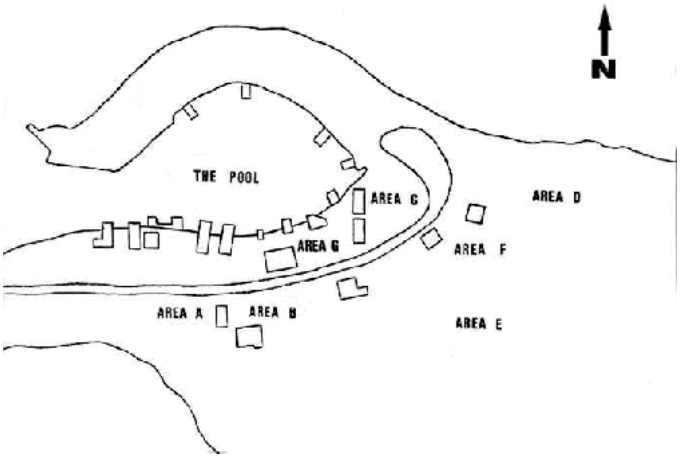

Figure 1. A schematic plan of the Ferryland site showing areas of excavation A through G.

Kirke residence (Area F); and another part of the waterfront with a late 17th to early 18th-century domestic structure (Area G). The colony's early forge was located in Area B.

Area C is located immediately adjacent to the existing pool. Along its northern boundary is a seawall which defines the 17th-century edge of the pool. Because of its close proximity to the sea, Area C floods each spring. The lowest stratigraphic sections next to the seawall remain wet all year round. Therefore, features that are adjacent to the seawall, such as the privy, are waterlogged all year (**Figures 2 and 3**). Several well-laid stone walls were uncovered during the excavation of Area C. The main warehouse structure contained both flagstone and cobblestone floors as well as an adjoining stone-built privy at its west end. This structure appears to have been destroyed or heavily damaged in the Dutch raid of 1673.[40]

The Ferryland Textile Collection

The Ferryland textile collection comprises 344 textile fragments. Approximately 89% were recovered from the warehouse privy in Area C. The other 11% were recovered outside the privy in Areas D, F and G.

Based on archaeological evidence, it appears that the drainage system, intended to remove waste from the pit, failed early in its use and the privy was subsequently filled with debris and human waste. Everything from wheelbarrow fragments to ceramics to foetal pigs was discarded there.[51] Many of the textile fragments recovered from the privy were folded and contained seed deposits and human parasites, indicating their use as toilet paper or "clouts" (**Figure 4**). The clouts are made from wool while the majority of off-cuts and trim, not used for hygiene purposes, are of silk.

The privy contains six distinct layers or Events (**Table I**). The following is based on the combined interpretation of archaeologists James Tuck and Barry Gauton, and of conservator Cathy Mathias, as they each contributed to the excavation. Event 114 is the bottom-most and earliest layer, dating to the 1620s, and consists mainly of small fragments of roof slate. These were likely used to raise the floor allowing continuous movement of water as the privy filled and flushed. The next Event, 170, contains some human waste. Some artifacts from this layer appear to correspond with Calvert's occupation of, and departure from, Ferryland starting in 1628 and ending in 1629. However this event could date up to the 1650s. These two lowest archaeological levels yielded 8% of the textiles found in the privy. Above these levels lies Event 116, a layer rich in textiles (22% of the textile finds from the privy) and human feces. This layer dates from after 1629 (Calvert's occupation), but before the Dutch raid of 1673. It most likely dates from the 1630s. Event 111 lies above this and is also rich in textiles (44% of the textile

Table I: Archaeological Layers Associated with the Privy (Area C)

Event Number	% Textile Finds	Date Range
114	8%	1620s
170		Calvert's occupation and departure from Ferryland, 1628-1629, but could date up to 1650s
116	22%	after 1629 but before the Dutch raid of 1673; most likely 1630s
111	44%	Later than event 116 but before 1673; most likely 1640s or 1650s
50	12%	Between 1650 and 1673
49	14%	1673

Figure 2. Excavation of the Area C privy; note the moist soil matrix.

Figure 4. Textile fragment with seed deposits on the surface indicating its reuse as a "clout" (112649).

Figure 5. A fragment of fulled wool of the "Old Draperies" (101202).

Figure 3. The privy was originally designed to flush with the rise and fall of the tide.

Figure 6. Fragment of silk damask showing leaf pattern (127294). This fragment tested positive for cochineal and madder.

Figure 7. A sample of cut velvet that tested positive for cochineal and madder (101147).

Figure 9. Silk trim dyed with cochineal (124936).

Figure 8. Silk trim dyed with weld (87101).

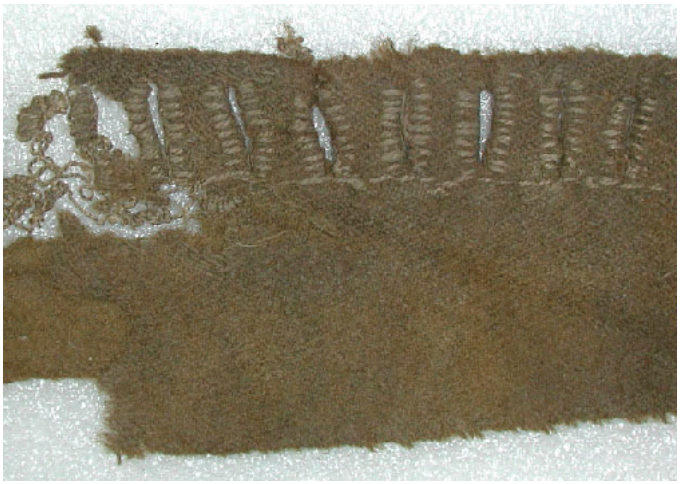

Figure 10. A wool doublet front section with buttonholes trimmed in silk threads (78130).

privy finds) and human feces. This layer dates later than Event 116, possibly from the 1640s or 1650s. The two uppermost Events represent the end of the third quarter of the 17th century. Event 50 was deposited on top of Event 111 sometime before 1673. It held 12% of the textile finds. The privy was capped by Event 49 which corresponds with the destruction of the waterfront warehouse in the Dutch raid of 1673. This last layer held 14% of the textile finds.

Treatment of the Textiles

Conservation of the Ferryland fragments included mechanical cleaning and freeze drying using standard methods. No attempts were made to unfold clouts or to remove seeds as it was considered important to maintain the historical integrity of each sample. Metal thread fragments were mechanically cleaned with tweezers to remove debris and air-dried. Preventive conservation methods required to preserve this collection included the construction of custom book mounts prior to storage in dedicated cabinets. This would prevent mechanical damage that can occur to objects in a mixed collection. Efforts were made to maintain a 45-55% relative humidity and temperature range of 19-21˚C in subsequent storage areas.

Technical Analyses of the Textiles

Fibre and Weave Analyses

The Ferryland assemblage comprises fragments that include woven cloth, yarns and metal threads. **Table II** presents the fibre and weave analyses for these finds. Of the 344 textile items excavated, 255 are woven fabrics. Of the woven fabrics, 237 are wool and 18 silk. There are 19 wool samples for which a weave cannot be identified because of felting.

Table II. Fibre and Weave Analyses and Frequency of Material Types in the Ferryland Textile Assemblage

Material	Construction	Quantity
woven wools	tabby weave	183
	twill weave	54
other wools	knitted	11
	yarn	43
	felted, matted and unidentified	19
woven silks	tabby weave	10
	velvet	2
	satin weave	4
	damask	2
other silks	braid	4
	edge binding	2
	yarn	2
metal threads	silk core	8
Total		344

The main difference between "Old" and "New Draperies" is the coarseness of their weave. Because of the coarseness of the fibres and the open weave structure, the "Old Draperies" were fulled (**Figure 5**). The "New Draperies" are of a lighter weight and tighter weave. The coarser woven wool cloth has a thread count of less than 15 threads per centimetre, while the fabrics believed to represent the "New Draperies" are finer, with more than 15 threads per centimetre for either the warp or the weft. For the purpose of this study, a thread count of 15 per cm or greater in either the warp or the weft indicates an example of the "New Draperies."

Analyses of Dyes and Mordants

Sampling

Of the 344 items, 59 samples were further analysed for dyestuffs. Of these, 36 were classified as "New Draperies", 14 "Old Draperies" with 4 samples of trim and 4 of threads. Of the samples studied, 38 were wool and 21 were silk. These samples are described in **Table III**, with the "New" and "Old Draperies" distinguished by different shades of grey. The selection of samples for analysis was based on the quality of the fabric (those with a thread count greater than 15 per centimetre, in the case of the "New Draperies"), the visible appearance of a colour in the sample, and the material. In the latter case it was expected that most of the silk samples would have been dyed as they represented high fashion. Initially, only silk samples were examined, but as research progressed, it was observed that fine worsted wool fabrics also represented the "New Draperies." These fabrics were usually sold as finished and dyed cloth.[12, 14]

Experimental Methods

To identify the dyes, samples were analysed by high performance liquid chromatography (HPLC) following acid hydrolysis. Fibre samples 5 to 10 mm in length were heated in a 1:2 mixture of 3N hydrochloric acid and methanol at approximately 70˚C for 45 to 120 minutes. Following separation of the solution from the fibres, plus evaporation and treatment with water, the nonvolatile residue was dissolved in 100 µL methanol and filtered through a 0.2 mm filter into a 150 µL conical glass vial insert placed in a glass shell vial. The vial was positioned in the autosampler and the sample injected into the column. Samples (50 µL) were analysed on a reverse phase µBondapak C18 column (3.9 x 300 mm) using a Waters HPLC system equipped with two Model 510 pumps, a Model 717 autosampler with a Model 996 photodiode array detector (PDA range: 220 - 550 nm, monitoring at 254 nm) using gradient elution (solvent A: water, 0.02% phosphoric acid; solvent B: methanol, 0.02% phosphoric acid) with a column temperature of 35˚C; a method adapted from the literature by one of the authors (E.M.). The analysis was qualitative and the detection limit for each dye was not determined. The dye compounds used for comparison were both chemical standards obtained from commercial sources and extracts from dyed yarns. The analytical method used separates genistein and luteolin, allowing weld to be distinguished from dyer's broom. While logwood, anthraquinone (e.g. madder, cochineal, kermes) and hydroxyflavone dyes (e.g., weld and dyer's broom) would be detected using this technique, dyes such as indigo and Prussian blue would not.

Identification of blue dye components, such as indigo, was undertaken using Fourier transform infrared spectroscopy (FTIR) on samples that appeared blue, green and green-brown in colour, including both the fibres themselves and the solvent extract residues remaining after evaporation of the solvent. The extracts were prepared by heating the fibre samples in pyridine in order to extract any indigo present. For analysis by FTIR, the sample was positioned on a diamond anvil microsample cell and was analysed using a Spectra-Tech IR-Plan microscope interfaced to a Bomem Michelson MB-120 spectrometer. Compounds were identified by comparing their infrared spectra to reference spectra.

X-ray microanalysis was undertaken to determine the presence of elements that could be indicative of mordants. Fibres with as little adherent particulate matter as possible were selected for analysis. The analysis was carried out using an Hitachi S-530 scanning electron microscope equipped with a Noran Instruments X-ray detector and Voyager II X-ray microanalysis system. Using X-ray microanalysis, elemental analysis of small volumes, down to a few cubic micrometres, can be obtained for elements from boron to uranium with a sensitivity of about one percent.

Results

(a) Dyes

Overall, compounds indicative of tannins or colorants were identified in 52 of 59 samples. **Table III** presents the dye results, with the "Old" and "New Draperies" identified with highlights. Ellagic acid, a tannin component, was present in 49 samples. It was the only compound identified in 25 samples, while additional dye components were detected in 24 others. Only 2 samples (97640 and 248639), in which dye components were identified, did not contain ellagic acid. It was also not detected in a wool sample (148251) that was coloured by a red iron-containing accretion. Gallic acid, another component of tannins, was detected in 3 samples (124936, 126459 and 127320), all of which also contained ellagic acid and dye components. The presence of ellagic acid on such a large number of samples suggests contamination by the burial environment. Dyestuffs were conclusively identified in 26 samples: 14 had compounds indicative of red dyes, i.e., the anthraquinones such as carminic acid, alizarin and purpurin; 7 had the hydroxyflavone luteolin, indicative of a yellow dye; 1 had logwood, indicative of a black dye; 1 had logwood and alizarin, indicative of a purple dye; and 2 contained an unidentified coloured compound. Prussian blue was identified on wool sample 248639 by FTIR analysis. This item was excavated from an uncertain archaeological context. Given that Prussian blue did not come into use until the 18th century, sample 248639 could not have been deposited in the 17th century and is not discussed further.[36]

(b) Mordants

The analytical results for the mordants are also presented in **Table III**. Utilizing SEM/XES, the inorganic components identified in most of the samples included: aluminum, magnesium, silicon, phosphorus, calcium, iron, and occasionally sodium, potassium, chromium and titanium. These elements probably represent soil contamination; however, aluminum, iron and chromium could also be indicative of mordants.[52] The average soil chromium concentration on site was determined to be relatively high at 55 ppm.[53] Minor or trace amounts of chromium were detected in seven of the samples.

X-ray microanalysis of the textile fragments revealed that the major elements detected in the fibre samples were oxygen, sulfur and carbon, attributable mainly to the protein of the silk or wool fibres.

Comparisons to Other Textile Collections and to Historic Records

An examination of the Ferryland assemblage would not be complete without some comparison to extant costumes, archaeological finds and documentary records from the period.

Examination of Museum Textile Collections

The purposes for comparing the Ferryland collection with complete textile remains from the 17th century are as follows: to confirm assigned dates; to look for fabric matches; to identify uses of trim and colour; to identify how different types of fabric were used and for what purpose; and to gain information regarding the provenance of fabrics. Because the Ferryland collection is derived from an English colony, textile collections identified as English were the focus for comparison. By the 17th century, however, the movement of trade goods was far-reaching and it is possible, therefore, that part of the Ferryland assemblage was produced outside of England.

Examinations of textile artifacts from other collections were carried out by one of the authors (C.M.) during visits from 2002 to 2004 and included the following items: 12 costume pieces dating from the 1620s to the 1670s, as well as a collection of flat textiles from the 1600s from the Victoria and Albert Museum (V&A), London[54]; 19 pieces of costume dated from early to mid-17th century from the Museum of Costume, Bath[55]; 21 costume pieces dating to the 17th century from the Gallery of Costume, Manchester[56]; and 6 costume pieces from the 17th century from the Royal Ontario Museum (ROM), Toronto.[57] The vast majority of the items examined were silk and wool fabrics used in the manufacture of high fashion costume, and are considered examples of the "New Draperies", although there were a few examples of "Old Draperies."[58]

The survey confirmed that the majority of the silks preserved from the 17th century are either damask or brocade, made using a drawloom. Several items examined during the surveys were of particular interest for this study. Most notably, from the V&A Museum: a man's costume with yellow doublet and breeches, dating to the 1620s, in which the trim appeared to match a yellow silk trim fragment from Ferryland, 87101; a woman's yellow bodice, dating to the 1660s, with silk trim also similar to 87101; a red velvet mule dating to the 1650s; and a gown of cut and uncut velvet dating to the first half of the 17th century that matched in colour the burgundy red velvet sample, 101147 from Ferryland. From the ROM, the most interesting item was a silk damask sample (934.4.437) from the 17th century, identified as of French origin, that bore a floral pattern similar to the Ferryland damask samples 124974 and 127294. The Ferryland damasks are also similar in pattern to silk fragments identified as French in the flat textile collection of the V&A (C47 1178-1877).

Many of the objects at the Museum of Costume and the Gallery of Costume were made of linen with silk embroidery and metal spangles for decoration. Because the burial environment was unsuitable for the preservation of cellulose, costume components made of linen are absent from the Ferryland collection. The Bath and Manchester collections, therefore, allowed an examination of linen items missing from the Ferryland collection that would, plausibly, have been used during the period. Because the museum items were highly decorated garments, these collections provided examples of the ways in which braid, edge bindings, metal and silk threads, found at Ferryland, were used on costume.

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Table III. Dye Compounds Identified on All Textiles Analysed

Light grey highlighting of samples indicates a "New Drapery"; **darker grey** indicates "Old Draperies"; no highlighting indicates that the type of Drapery ("Old" or "New") could not be identified. The black highlighted row indicates an 18th century sample. Thread count is indicated as warp/weft.

Colour of dye	Sample Description	Thread Count	Sample	Elements Detected*	Compounds Identified	
					Tannin Components	Dye
Red	brown wool, tabby	38697	101202	S, C, O, Mg, Al, Si, P Ca, Fe (K)	ellagic acid	alizarin, purpurin
	brown wool, twill	38697	109020	**S, O**, C, Mg, Al, Si, Ca (P, Fe)	ellagic acid	alizarin
	light brown wool, twill	38695	124990	**S**, C, O, Ca (Al, Si, P, Fe)	ellagic acid	alizarin, purpurin
	green and red wool, twill	14/14	124995	**S**, C, O, Si, Ca (Al, P, Fe)	ellagic acid	alizarin, purpurin
	dark red brown wool, twill	38634	127320	**S**, C, O (Al, Si, Ca, Fe)	ellagic acid, gallic acid	purpurin
	burgundy silk,velvet	18/18	101147	**O, S**, C, Mg, Al, Si, P, Ca (K?, Fe?)	ellagic acid	carminic acid, alizarin, purpurin
	brown wool, twill	14/16	101991	**O, S**, C (Mg, Al, Si, P, Ca, Fe)	ellagic acid	alizarin, purpurin
	green wool, tabby	18/18	109810	**O, S**, C (Mg, Al, Si, P? Ca, Fe?)	ellagic acid	purpurin
	brown wool, twill	17/17	112648	**O, Si, S**, C, Mg, Al, Ca (P, K, Fe)	ellagic acid	alizarin, purpurin
	green brown wool, twill	18/14	124957	**S**, C, O, Si, Ca (Mg, Al, P, K, Fe)	ellagic acid	alizarin, purpurin
	burgundy silk, damask	50/50	124974	**O**, C, Al, Si, P, S, Ca (Na, Mg, Fe)	ellagic acid	carminic acid, alizarin, purpurin
	brown silk, satin	30/20	126469	**O, S, Cl, Ca**, C, Na, Mg, Al (Si, P, Fe)	ellagic acid	alizarin, purpurin
	burgundy silk, damask	50/50	127294	**O, C**, S, Ca (Al, Si, P, Fe)	ellagic acid	carminic acid
	burgundy silk, trim		124936	**O,** C (Mg, Al, Si, S, Ca, Fe)	ellagic acid, gallic acid	carminic acid
Yellow	brown wool, twill	30/20	67517	**S**, O, C, Ca (Mg, Al, Si, P, Ca, Fe)	ellagic acid	luteolin
	brown wool, twill	38639	78130a	**O, Al, Si**, C, S, K, Ca, Cr, Fe (Na, Mg, P, Ti)	ellagic acid	luteolin
	yellow brown wool, twill	20/20	124994	**O, S**, C (Mg, Al, Si, Ca)	ellagic acid	trace luteolin
	brown wool, twill	20/17	148115	**O, S**, C (Mg, Al, Si, K, Ca)	ellagic acid	luteolin
	green silk thread		78130b	**O**, C, Al, Si, P, S, Ca (Mg, Fe)	ellagic acid	luteolin
	green silk trim		87101	**O**, C, Si, S, Ca (Mg, Al, P, K, Fe)	ellagic acid	luteolin
	light green silk, trim		124904	**O**, C, Al, Si, P, S, Ca (Mg, Fe)	ellagic acid	luteolin
Black	black wool, tabby	20/20	230445	**O, Si, S**, Al, P, Ca, Cr, Fe (C, Na, Mg, K)	ellagic acid	logwood
Purple	black wool, twill	24/20	97640	**O, Si, S**, C, Al (P, C, Ca, Cr, Fe)		logwood, alizarin
Blue	wool, twill and tabby	38634	248639	**O, Al, Si,** S, C, P, Fe (C, Na, Mg, Ti, Cr)		Prussian blue
Dye/dye colour not identified	brown wool, tabby	38478	75004	**S**, O, C, (Mg, Al, Si, P, Ca)		
	light brown wool, twill	14/14	75969	**O, S**, C (Mg, Al, Si, Ca, Fe)		
	brown wool, tabby	38571	88796	**O, S**, C, Mg (Al, Si, P, Ca, Fe)	ellagic acid	
	brown wool, 2/2 twill	38695	97366	**Si, S**, C, Al, Ca, Fe (Mg, P, K)	ellagic acid	
	yellow brown wool, twill	38695	124787	**S**, O, C (Mg, Al, Si, Ca)	ellagic acid	
	brown wool, tabby	38571	124947	**O, S**, C, Si (Mg, Al, Ca, Fe)	ellagic acid	

Colour of dye	Sample Description	Thread Count	Sample	Elements Detected*	Compounds Identified	
					Tannin Components	Dye
Dye/dye colour not identified	green brown wool, twill	38697	124970	**S**, C, O, Ca (Mg, Al, Si, Fe)	ellagic acid	
	brown wool, twill	14/14	124971	**S**, C, O, Ca (Mg, Al, Si, Fe)	ellagic acid	
	brown wool, twill	18/14	43914	**S**, C, O, Al, Si, Fe (Mg, P, K, Ca)		
	brown wool, twill	26/20	67959	**O, Si, S**, C, Al, Fe (Na, Mg, P, K, Ca)	ellagic acid	
	brown silk, satin	52/36	75184a	**O**, C, Al, Si, P, S, Ca, Fe (Mg, K)	ellagic acid	
	brown silk, tabby	52/36	75184b	**O, Si**, C, Mg, Al, P, S, K, Ca, Fe (Na)	ellagic acid	
	dark brown wool, tabby	17/17	75970	**S**, O, C, Si (Na, Mg, Al, P, K, Ca, Fe)		
	green silk, velvet	20/50	90000a	**O**, C, Mg, P, S (Al, Si, Ca, Fe)	ellagic acid	
	green silk thread on velvet		90000b	**O**, C, Mg, S (Al, Si, P, Ca, Fe)	ellagic acid	
	dark green wool, twill	25/20	97654	**O, Si**, C, Al, S, Fe (Na, Mg, K, Ca, Cr, Fe)		
	yellow brown silk, tabby	60/40	101068	**O**, C (Na, Al, S, Cl, Ca)	ellagic acid	
	brown wool, twill	16/18	101148	**O, S**, C, Mg, Ca (Al, Si, P, Fe)	ellagic acid	
	brown wool, tabby	26/16	101994	**O, S**, C, Mg, Al, Si, P, Ca (Na, K, Fe)	ellagic acid	
	brown wool, tabby	25/17	106585	**C, O**, **S** (Mg, Al, Si, Ca, Fe?)		
	brown wool, tabby	16/16	109809	**S, O**, C (Al, Si, P, Ca, Fe, K?)	ellagic acid	
	green wool, tabby	17/28	109942	**O, Si, S**, C, Mg, Al, P, Ca, Fe (Na, K)	ellagic acid	
	green wool, twill	20/20	124991	**S**, C, O, Si, Ca (Al, Fe)	ellagic acid	
	green brown silk, tabby	50/20	126182	**O, S**, C, Al, Si, Ca, Fe (Mg, P)	ellagic acid	
	green brown silk, tabby	50/20	126395	**O**, C, S, Ca (Al, Si, Fe)	ellagic acid	
	brown silk, satin	46/36	126420	**O**, C, Al, Si, P, Ca, Fe	ellagic acid	unidentified coloured component
	burgundy green silk, tabby	22/22	133115	**O, S**, C, Al, Si, Ca, Fe (Mg, P, K)	ellagic acid	
	brown silk, tabby	50/20	148251	accretion: **O, Si, Fe**, Al, S (C, Na, P, K)		unidentified (red iron-containing accretion)
	light brown wool, twill	24/24	255018	**O, Al, Si, S**, K, Cr, Fe (C, Na, Mg, P, Ca, Ti)		
	brown wool, satin	15/4	304202	**O**, C, Al, Si, S, Cr, Fe (Na, Mg, K, Ca)	ellagic acid	
	yellow brown silk, tabby	60/30	371218	**O**, C, Al, Si (P, S, Ca Fe)	ellagic acid	
	brown wool, knitted		75377	**O, S**, C (Mg, Al, Si, P, Ca, Fe)	ellagic acid	
	brown silk lace with silver point		90255	**O**, C, P, S, Ca, Fe (Mg, Al, Si)	ellagic acid	
	dark green silk, thread		126459	**O**, C, Mg, Al, P, S, Ca, Fe (Na, Mg, Si)	ellagic acid, gallic acid	unidentified coloured component
	light green silk, thread		127977	**O**, C (Al, Si, P, S, Ca, Fe)	ellagic acid	

*Elements present in major amounts are in bold, those present in minor quantities are in normal type and those present in trace amounts are in parentheses.

Examination of Textiles from New World Archaeological Sites

A survey of textiles from similar archaeological sites of the same period as the colony at Ferryland was also conducted for comparison. Archaeological textiles from the period, or information published about them, turned out to be scarce. The St. Mary's City site, Maryland, produced only silk taffeta ribbons found within burial coffins. No examples of textiles survived at Jamestown, Virginia.[59] A privy from Boston, Massachusetts, Nanny privy from the Cross Street Back Lot Site, dating to the late 17th century provides much information[60] but falls outside the date range of the Ferryland privy. The Boston collection (stored at the Massachusetts Archive in Boston), however, contains types of silk textiles similar to those at Ferryland, such as damask and taffeta. The remains from the Boston site support the suggestion that a variety of fancy textiles were being shipped to the colonies by the end of the 17th century.[60] By the end of the century not only were fishing crews being supplied, but also a growing permanent population.

Historical Records

Apart from the archaeological evidence of the clothing available to 17th-century colonists, information on this subject can be derived from historic records. Ledgers of goods coming into Newfoundland suggest that colonists could purchase cloth and clothing items typically worn by mariners and craftsmen in England including, "coats and breeches, waistcoates, hats, shirts, neckcloths, shoes, stockings, buckles, mittens and gloves."[6] As an example of what might have been worn by a fisher at Ferryland, here follows an account of clothes and other necessities for a fishing servant from Richmond Island, Maine, circa 1639:

> 2 pair of shoes, 3 pair of stockings, 1 suit of canvas, 1 suit of kersey, 1 waistcoat, 1 calf skin for a barvel [a large leather apron], 1 pair of boots, 400 sparables [wedge-shaped nails used in the heels of shoes and boots], cape (white merino or mohair), cloth used to make a pair of mittens, 8 thongs, 1 pound of six ounce leather for 2 pairs of hauling hands, list [selvedge edge of cloth] for lining the leather hand protectors, thread, 1 coverlet, cape cloth to make a pair of boot breeches, 2 shirts, 1 knife.[61]

Discussion

Dyes

Dyes were identified in 26 of the 59 textile fragments that were selected for analysis. Except for one anomaly (Prussian blue), the dyes identified were common to the 17th century and thus support the archaeological dates for the layers (Events). The most frequently identified dye compounds are carminic acid, alizarin, purpurin and luteolin. Madder and weld were identified on both wool and silk. Cochineal, an expensive dye, was identified only on silk fragments. One of these was a tablet woven trim, an interesting combination of a "cottage industry" fabric with an expensive dyestuff. There were 2 occurrences of logwood, identified only on wool samples that dated to the late 17th-century.

Carminic acid was identified on 3 of the woven "New Draperies," 2 silk damask samples and 1 silk velvet. Carminic acid was also identified on 1 silk trim sample. All of these would be considered examples of fancy silk and all were dyed using an expensive dyestuff. Carminic acid was mixed with alizarin and purpurin on 1 of the silk damask samples and on the velvet sample.

Alizarin and purpurin were found in combination on 6 of the "New Draperies," and 3 of the "Old Draperies." Alizarin was found by itself on 1 of the "Old Draperies" and combined with logwood on 1 of the "New Draperies." The latter combination probably produced a purple colour. Purpurin was found by itself on 1 of the "New Draperies" and 1 of the "Old Draperies."

Luteolin was detected in 7 samples, 4 of which were twill woven "New Draperies" of wool, 2 were silk trim fragments and 1 a silk thread. Since no genistein, a component of dyer's broom, was detected in the Ferryland samples, the most likely source of the luteolin is weld.

From outside the privy, 44 samples represent Areas D, F and G. Dye analysis was performed on 2 samples from the Area D house dating from the last quarter of the 17th century and 5 from Area F, which dates from the early to late 17th century. Ellagic acid was identified on the only silk sample of this group (371218). No dyes were detected on the wool samples from an early 17th-century context; however, ellagic acid was found on some of these. Logwood was identified on two samples of black wool having a twill weave, both considered "New Draperies." They originated from a mixed context (230445 and 97640). Prussian blue was identified on a sample from an 18th-century context (248639). These results may indicate that only dyes on fabrics dating after the 1670s have been preserved in areas outside the privy burial environment.

As mentioned in the section on the Dye Results, tannins, but no other dye compounds, were detected on 14 wool and 11 silk samples. Walton and Taylor report that ellagic acid was occasionally found in samples of dyed archaeological textiles that were analysed by thin layer chromatography, but pyrogallol (1,2,3-trihydroxybenzene) was the most commonly identified tannin component.[31] While tannins have been used as dyestuffs, mainly with iron mordants, they could also be contaminants in the samples, as a result of tannin-containing materials (dead leaves, bark, etc.) at the site. Given the high frequency of occurrence of ellagic acid, in 83% of the samples tested, it is considered to be a contaminant. It was observed that 7 samples, representing different time periods and areas of excavation, have no tannins while other samples found near them contain these compounds. The reason for this has not been determined.

No tannins or dyes were detected on 7 wool samples. Three of these samples, 43914, 75969 and 75970, were excavated from the privy's late period; 2 samples, 75004 and 106858, from the

privy's mid period; and 2 samples were excavated outside of the privy, 97652 from the house in Area D and 255018 from the Kirke house in Area F. Undyed wool was not uncommon at this time. Negative test results could also indicate the leaching of dyestuffs in the burial environment.

Although it is assumed that any cloth imported to Ferryland would have been pre-dyed, there is archival evidence that George Calvert, while Secretary of State for James I, was charged with the mission of bringing the cultivation of madder to England from the Netherlands.[32] The colony at Ferryland, under Calvert, was intended to be a plantation run as a co-operative venture in which all would benefit and where a concerted effort to achieve self-sufficiency was an objective.[1] It is therefore a possibility that madder was grown in Ferryland and that the presence of some of the dyestuffs identified may be the result of the first attempts to develop a textile dyeing industry in the New World.

Mordants

It was not possible to conclusively identify the mordants used on these textiles. As presented in the Analytical Results, elements identified that are characteristic of mordants, such as aluminum, chromium and iron, may also be contaminants from burial.[52]

Weave and Fabric Type, "New" and "Old Draperies"

The technical examination of the textile fragments (excluding trim, braid, threads and knitted fragments) including thread count and identification of weave pattern reveal a variety of fancy silks including damasks, satins and velvets, as well as finely woven wools representing the "New Draperies." Thirty-six "New Drapery" samples were identified. Fifteen of these contain dye components, 15 have only ellagic acid identified, 5 have neither and 1 sample (148251) has a red iron-containing accretion. The dye components identified on the "New Draperies" are luteolin, alizarin, purpurin, carminic acid and logwood. Of the 14 woven "Old Drapery" samples analysed, 5 contain dye components (excluding the anomalous Prussian blue sample), 6 have only ellagic acid identified and 2 have neither. Alizarin and purpurin were identified on the "Old Draperies."

Worsted Wool

Most of the "New Draperies" would be considered worsted wools, based on their long fibres. Some of these new fabrics were produced by combining yarns of different materials such as wool and silk. Within this collection, however, only like yarns were used. The middle-period deposits contained 23% of the finely woven worsted wools (Events 111 and 116).

Silk Damask

Finely woven silks were identified that also fall into the "New Draperies" category. The Ferryland textile collection contains no coarsely woven silks. The two silk damask pieces from Ferryland, 124974 (dyed with cochineal and madder) and 127294 (dyed with cochineal) have a woven floral pattern that appears to repeat. **Figure 6** shows one section of the leaf pattern. As previously mentioned, these fragments closely match a 17th-century French silk damask sample at the ROM and are similar in pattern to silk fragments identified as French at the V&A.

Velvet

Three pieces of velvet are part of the Ferryland collection. All three are cut velvet with silk threads attached; the latter probably served as finishing threads. Though dye analysis was done on two samples, only one tested positive. A triangular piece, 90000a, possibly a gusset, had no dyestuffs detected on the fibres analysed, while the smaller sample, 101147, was dyed with cochineal and madder (**Figure 7**).

Silk Taffeta and Satin

To date there are six fragments identified as silk taffeta in the collection. Textile fragments 148251, 126182 and 126395 appear to join and represent a silk garter. All are tabby woven with thread counts of 50/20 per square centimetre. Samples 126182 and 126395 were analysed but only tannins were identified. Many silk taffeta fabrics were also used in ribbons and for women's gowns, hoods and aprons.[60] Four fragments of silk satin were identified in the collection (75184a, 75432, 126420, 126469).

Tablet Woven Trim

Tablet woven trim was manufactured using tablets, rectangular wooden slabs with holes that varied in size depending on the width of trim to be produced, ranging from 1 to 100 cm in width. Four samples of silk trim from Ferryland were identified as tablet woven.[62] Two of these, 87101 (**Figure 8**) and 124904, had been dyed using weld, while another sample, 124936, was dyed with cochineal (**Figure 9**).

Construction

The textile remains that resemble garments are few, given that most of the collection comes from a privy where the textiles served as toilet paper made of square cut-offs of garments. However, there are some examples of construction, such as fragment 78130, a doublet front with button holes trimmed with silk threads (**Figure 10**). This is a double-layered wool fabric that would be considered a "New Drapery." The dyestuff identified on both the wool and silk thread samples is weld. The skill shown in the blanket stitch on the button holes is not that of an expert suggesting that its construction may have occurred in Ferryland. Though this is a relatively fancy piece, it was not tailored; this also suggests that it is not of the gentry, since gentry costumes were usually tailored. Fragments 124974 and 127294 are identical pieces of silk damask, possibly from a skirt. Comparison with textiles in other collections suggests that these silk fragments are likely French.

Because the Ferryland collection has little evidence of

construction, it is difficult to identify the garments represented. For example: a gathered fragment of silk taffeta, such as fragment 126395, could be part of a skirt, sleeve or garter; and yellow silk trim similar to fragment 87101 was identified in the V&A collection on both a man's doublet (ca.1620) and a woman's bodice (ca.1660). This demonstrates the wide use of trim during the century, and that it was applied to both men's and women's costumes. A velvet mule (ca.1650) and an early 17th-century gown in the V&A collection show the use of velvet in both dress and footwear, complicating garment identification from fragments of cloth.

Conclusions

The range of textile fragments of both silk and wool make the Ferryland collection a rich resource for this period. The information obtained through this research is the result of the combined efforts of conservation scientists, a conservator and archaeologists. The collaborative results have allowed some preliminary conclusions to be drawn about early colonial culture. For example, textiles recovered from the privy consist of a mixture of both the "Old" and "New Draperies." The identification of these newer textiles shows that this fashion trend was relatively quick to cross the Atlantic. The two textiles dyed with logwood, from Areas D and F, must date from the mid to late 17th century based on their context and because the ban on the use of this dye was not lifted until the 1680s. This evidence and the identification of two silk damask fragments, probably French, provide further evidence of the quick transfer of fashion to the American colonies. The added exports boosted the worsted wool industry in England, since a lightweight fabric that draped like silk without the high cost of silk was a desirable commodity among the gentry and middle classes.

The majority of the Ferryland privy textiles, approximately 66%, date from between 1630 and the late 1660s. Most of the textiles from outside the privy date to the last quarter of the 17th century. Within the entire collection, most of the silk fragments represent items of trim; dyes were not detected on many of these fragments. Where dye appears weld and cochineal are present on some silk fragments that look coloured to the eye, including damask, satin and velvet pieces, as well as a tablet woven trim. Dyes were detected on 42% of the woven wool items identified as "New Draperies" and on 42% of the woven wool items identified as "Old Draperies" which were sampled for this project. Dye compounds identified on the "New Draperies" include carminic acid, alizarin, purpurin, luteolin and logwood, while alizarin and purpurin were identified on the "Old Draperies." Evidence for the use of mordants remains inconclusive.

The use of common dyestuffs such as weld and madder on fine silks at Ferryland was noted by historic dye researchers as unusual during this period.[63] The Ferryland collection, however, represents lower, middle, and gentry class costume not usually preserved in typical museum collections. Perhaps the use of cheaper dyestuffs such as weld and madder, or the mixing of cheap and expensive dyes (as found on a silk damask where madder was mixed with cochineal), demonstrates cost-cutting measures that made some of the finer fabrics available to a growing middle class.

Finally, approximately a third of the collection was dyed using madder. An experiment conducted by one of the authors (C.M.) proved that madder can easily be grown in the present day Newfoundland climate. Perhaps the growing of madder in Ferryland was introduced by George Calvert and these textile fragments represent the initial efforts of a New World textile dyeing industry. The presence of madder-dyed textiles on site is consistent with the development of madder cultivation; however, excavation of dyeing equipment or dye plant seeds at Ferryland would be required to confirm this. To date such evidence has not been uncovered. Nevertheless, the presence of textile remains indicative of high fashion provides evidence of the growth and cosmopolitan nature of this colony during the 17th century.

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Notes and References

1. Pope, Peter E., "Six Letters from the Early Colony of Avalon," *Avalon Chronicles*, vol. 1, 1996, pp. 1-20.

2. Gaulton, Barry and Tuck, James A., "The Archaeology of Ferryland, Newfoundland, Until 1696," *Avalon Chronicles*, vol. 8, 2003, pp. 187-224.

3. Krugler, John D., "George Calvert: Courtier, Colonizer, Capitalist, Catholic," *Avalon Chronicles*, vol. 6, 2001, pp. 1-18.

4. Pope, Peter E., "Baltimore vs. Kirke: Newfoundland Evidence in an Interregnum Lawsuit," *Avalon Chronicles*, vol. 3, 1998, pp. 63-98.

5. Tuck, James A., "Archaeology at Ferryland, Newfoundland, 1936-1995," *Avalon Chronicles*, vol. 1, 1996, pp. 21-41.

6. Pope, Peter E., *Documents Relating to Ferryland 1597-1726*

(St. John's NF: Memorial University, 1993). Unpublished report on file at the Archaeology Unit, Memorial University.

7. Trautman, Patricia, "Dress in Seventeenth-Century Cambridge, Massachusetts: An Inventory-Based Reconstruction," in: *Early American Probate Inventories*, The Dublin Seminar for New England Folklife Annual Proceedings, 1987, edited by Peter Benes (Boston: Boston University Scholarly Publication, 1989), pp. 51-73.

8. The tabby weave is the simplest of the three basic types of weaves where a horizontal weft thread is passed over and under a vertical warp thread. The warp threads, fixed to the loom, are generally made of the strongest fibre as they hold the tension of the cloth. In a twill weave, the movement of the weft thread varies with the number of warp threads passed over or under each time; the weft thread passes over one or more warp threads before passing under. A satin weave can be either weft- or warp-faced. In either case, a greater amount of fibre is visible without the interruption of a cross thread. A weft-faced satin may have the weft thread pass over five warp threads before going under one warp and again passing over five warp threads.

9. A damask woven fabric is a patterned textile in which the back is a reverse pattern of the front. This pattern is produced by the contrast of binding systems. A velvet textile can be made of wool or silk. The ground is usually a tabby weave with the pile warp raised in a loop above the ground. Taffeta refers to a tabby woven silk with a stiffness and lustre to its finish.

10. Pritchard, Francis, "The New Draperies: Examples from Archaeological Deposits in England," in: *Textilien aus Archäologie und Geschichte: Festschrift für Klaus Tidow*, edited by J. Banck, L. Bender Jorgensen and A. Rast-Eicher (Neumünster: Wachholtz Verlag, 2003), pp. 222-232.

11. Croft, Pauline, "The Rise of the English Stocking Export Trade," *Textile History*, vol. 18, no. 1, 1987, pp. 3-16.

12. Kerridge, Eric, *Textile Manufacturers in Early Modern England* (Manchester: Manchester University Press, 1985).

13. Aspin, Chris, *The Woollen Industry* (Great Britain: Shire Publications, 1982).

14. Benson, Joel, *Changes and Expansion in the English Cloth Trade in the Seventeenth Century* (United Kingdom: The Edwin Mellen Press, 2002).

15. Lipson, E., *A Short History of Wool and Its Manufacture* (London: William Heinemann, 1953).

16. Ramsay, G.D., *The English Woollen Industry, 1500-1750: Studies in Economic and Social History* (London: The MacMillan Press, 1982).

17. Lipson, E., *The History of the Woollen and Worsted Industries* (London: Frank Cass & Company, 1965).

18. Zell, Michael, "Credit in the Pre-industrial England Woollen Industry," *Economic History Review*, vol. 49, no. 4, 1996, pp. 667-691.

19. The fulling of fabric refers to the thickening and shrinking of the cloth by various methods which can include soaking of the fabric, beating, stretching and drying.

20. Z twist refers to the direction in which the yarn is twisted; in this case the direction of twist is counter-clockwise or follows the long diagonal stroke of the letter Z.

21. Priestley, Ursula, "The Marketing of Norwich Stuffs, ca.1660-1730," *Textile History*, vol. 22, no. 2, 1991, pp. 193-209.

22. Feltwell, John, *The Story of Silk* (Gloucestershire: Alan Sutton Publishing, 1990).

23. Thornton, P., *Baroque and Rococo Silks* (New York: Taplinger Publishing, 1965).

24. May, Florence Lewis, *Silk Textiles of Spain: Eighth to Fifteenth Centuries* (New York: The Hispanic Society of America, 1957).

25. Zainer, Claudio, "Current Research into the Silk Industry in Italy," *Textile History*, vol. 25, no. 1, 1994, pp. 61-78.

26. Frost, Patricia, *Miller's Collecting Textiles* (London: Octopus Publishing Group, 2000), p. 72.

27. Swindlehurst, Catherine, "An unruly and presumptuous rabble: the reaction of the Spitalfields weaving community to the settlement of the Huguenots, 1660-90," in: *From Strangers to Citizens: the Integration of Immigrant Communities in Britain, Ireland and Colonial America, 1550-1750*, edited by Randolph Vigne and Charles Littleton (Portland: Sussex Academic Press, 2001), p. 368.

28. Muthesius, Anna, *Studies in Byzantine and Islamic Silk Weaving* (London: Pindar Press, 1995), p. 16.

29. De Francesco, Grete "Silk Fabrics in Venetian Paintings," *CIBA Review*, vol. 29, 1940, pp. 135-149.

30. Frost, Patricia, *Miller's Collecting Textiles* (London: Octopus Publishing Group, 2000), pp. 66-67.

31. Walton, P. and Taylor, G., "The Characterization of Dyes in Textiles from Archaeological Excavations," *Chromatography and Analysis*, June 1991, pp. 5-7.

32. Chenciner, Robert, *Madder Red: A History of Luxury and Trade* (London: Curzon, 2000), p. 60.

33. Cunnington, C.W. and Cunnington, Phillis, *Handbook of English Costume in the Seventeenth Century* (London: Faber and Faber Ltd., 1963).

34. Mills, J. S. and White, R., *The Organic Chemistry of Museum Objects*, Second Edition (Oxford: Butterworth-Heinemann, 1994), pp. 141-153.

35. Wouters, J., "High Performance Liquid Chromatography of Anthraquinones: Analysis of Plant and Insect Extracts and Dyed Textiles," *Studies in Conservation*, vol. 30, no. 3, 1985, pp. 119-128.

36. Berrie, B. H., "Prussian Blue," in: *Artists' Pigments: A Handbook of Their History and Characteristics*, vol. 3, edited by E. W. Fitzhugh (Washington: National Gallery of Art, 1997), pp. 194-195.

37. Brunello, F., *The Art of Dyeing in the History of Mankind*, First American Edition (Vicenza, Italy: Neri Pozza Editore, 1973), pp. 197-231.

38. Androsko, R. J., *Natural Dyes and Home Dyeing* (New York: Dover Publications, Inc., 1971), pp. 45-47.

39. "Chromium Compounds," in: *Kirk-Othmer Encyclopedia of Chemical Technology*, 4th ed., vol. 6 (New York: John Wiley & Sons, 1993), p. 263.

40. Gaulton, Barry, "Seventeenth-Century Stone Construction at Ferryland, Newfoundland (Area C)," *Avalon Chronicles*, vol. 2, 1997, pp. 1-42.

41. Carter, Matthew, "A Seventeenth-Century Smithy at Ferryland, Newfoundland," *Avalon Chronicles*, vol. 2, 1997, pp. 73-106.

42. Gaulton, Barry and Mathias, Cathy, "Portuguese Terra Sigillata Earthenware Discovered at a 17th-Century Colonial Site in Ferryland, Newfoundland," *Avalon Chronicles*, vol. 3, 1998, pp. 1-17.

43. Carter, Matthew, Gaulton, Barry, and Tuck, James A., "Archaeology at Ferryland, Newfoundland - 1997," *Avalon Chronicles*, vol. 3, 1998, pp. 49-62.

44. Wicks, John, "Seventeenth- and Eighteenth-Century Bottle Seals from Ferryland, Newfoundland," *Avalon Chronicles*, vol. 3, 1998, pp. 99-108.

45. Gaulton, Barry, "Seventeenth- and Eighteenth-Century Marked Clay Tobacco Pipes from Ferryland, Newfoundland," *Avalon Chronicles*, vol. 4, 1999, pp. 25-59.

46. Nixon, Douglas, "A Seventeenth-Century Planter's House at Ferryland, Newfoundland," *Avalon Chronicles*, vol. 4, 1999, pp. 57-95.

47. Crompton, Amanda, "A Planter's House at Ferryland, Newfoundland," *Avalon Chronicles*, vol. 5, 2000, pp. 1-48.

48. Stoddart, Eleanor, "Seventeenth-Century Tin-Glazed Earthenware from Ferryland," *Avalon Chronicles*, vol. 5, 2000, pp. 49-99.

49. Tuck, James A., and Gaulton, Barry, "Archaeology at Ferryland 1998-2000," *Avalon Chronicles*, vol. 6, 2001, pp. 89-106.

50. Berry, Paul, "The Numismatics of Ferryland," *Avalon Chronicles*, vol. 7, 2002, pp. 1-71.

51. This information is based on one of the authors' (C.M.) experience excavating the privy in 1993 and 1994, and faunal analysis performed by Dr. Lisa Hodgetts, Memorial University of Newfoundland, 2003.

52. Green, Lorna R. and Daniels, V. D., "Identification of Mordants Using Analytical Techniques," in: *Dyes in History and Archaeology, no. 9,* Proceedings of the Ninth Annual Meeting of the Association of Researchers into Dyes in History and Archaeology, York, 1990, edited by P. Walton Rogers (York: Textile Research Associates, 1990), pp. 10-14.

53. Mathias, C., *Examination of Interactions Between Ferrous Metals and the Archaeological Burial Environment at a Seventeenth-Century Plantation Site*, (St. John's NF: Memorial University, 1998). M. Sc. thesis, p. 239.

54. Items examined from the V&A, London, include: a man's costume; a buff leather coat; a silk doublet; a velvet gown with silver spangles; two woman's bodices; three examples of hose; and two silk mules.

55. Items examined from the Museum of Costume, Bath, include: a silver tissue dress; a man's shirt, jacket and cap; a woman's smock and two jackets; a pair of gloves; three pair of men's leather gauntlets; and eight examples of matching baby head cloths and bibs.

56. Items examined from the Gallery of Costume, Manchester, include: two bibs; two head cloths; three cuffs; a kerchief; a hood; two coif caps; one pair of sleeves; one pair of silk taffeta roses for shoes; one silk band for garters; two fragments of embroidered silk; a man's collar; a woman's cape; a baby's collar; and a leather glove.

57. Items examined from the ROM, Toronto, include: a stomacher; two coifs; a purse; a woman's jacket front; and one flat textile.

58. Examples of "Old Draperies" from the V&A include one tabby woven wool fragment (T.111-1933); documentation of this item indicated that it had been excavated along the Thames from a 17th century context.

59. Straub, Bly (Curator of Collections, Jamestown, Virginia), personal communication, 2002.

60. Ordoñez, Margaret, T. and Welters, Linda, "Textiles from the Seventeenth-Century Privy at the Cross Street Back Lot Site," *Historical Archaeology*, vol. 32, no. 3, 1998, pp. 81-90.

61. Pope, Peter E., *The South Avalon Planters, 1630 to 1700: Residence, Labour, Demand and Exchange in Seventeenth-Century Newfoundland* (St. John's NF: Memorial University, 1992). Ph. D. dissertation, p. 383.

62. Burnham, Dorothy (former Curator of Textiles, Royal Ontario Museum, Toronto), personal communication, 2001.

63. Wouters, Jan (Laboratory for Materials and Techniques, Royal Institute for Cultural Heritage, Brussels, Belgium), personal communication, 2004.