Identification of hairs and fibres in Great Lakes objects from the eighteenth and nineteenth centuries using variable pressure scanning electron microscopy

Caroline Cartwright and Jonathan C.H. King

Summary As part of the Great Lakes Research Alliance for the Study of Aboriginal Arts and Cultures led by Carleton University, Ottawa, selected fibre samples have been studied from 23 items in the British Museum collections. These include clothing, moccasins, bags, gorgets, roaches, sash straps, pouches, wampum belts and an embroidered cover to a birch bark book, possibly from the Ursuline Convent in Quebec, dating from c.1750–1775. These embroidered objects are mostly composite items including animal hairs and plant fibres that have been identified using variable pressure scanning electron microscopy (VP-SEM), which also characterized any features produced while preparing the hairs for use. Even with VP-SEM, identification was not straightforward, as many of the fibres have degraded over time (some are 300 years old, and others have been altered with use) and, as a consequence, key characteristics have become masked or been obliterated. An incidental and unintended output of this project was the visual record that demonstrates to conservators, curators and the general public the great vulnerability and fragility of these rare (often unique) articles of aboriginal heritage. This contribution suggests how, despite ambiguities arising from the condition of the fibres as a result of the age of objects, VP-SEM offers a significant advantage over optical microscopy; sufficient diagnostic features could be observed (compared with reference material) to enable the identification of moose, sheep, deer, porcupine, bison, otter and wolverine hairs, as well as dogbane (also known as Indian hemp) and cotton fibres. Selected examples are illustrated and the results to date have broadened and deepened the original field of enquiry by raising new and challenging issues. This work is important in providing further understanding of the physical characteristics of the embroidery threads in use at least from the late seventeenth century onwards by Canadian First Nations and Native Americans.

INTRODUCTION

The studies of historic Great Lakes objects presented here were conducted as part of the Great Lakes Research Alliance for the Study of Aboriginal Arts and Cultures (GRASAC) led by Carleton University, Ottawa [1], in partnership with the Ojibwe Cultural Foundation in Ontario [2], which represents the territory in which porcupine quill embroidery best survives as a living art.

The project aimed to identify a sample of fibres in selected British Museum objects that were used by the indigenous peoples of the North American Great Lakes and the contiguous areas of the north eastern United States and Canada, where a number of overlapping embroidery and decorative traditions made use of hair and wool. Best known and published are those employing animal hair, especially moose, deer and porcupine [3]. The embroidered artefacts date from the early eighteenth to the end of the nineteenth century and consist mostly of birch bark and cloth articles that were made to be sold to, and used by, non-native peoples; these are here termed ‘souvenir arts’ and have already been studied extensively [4–8]. It was important to establish evidence for the extent to which porcupine hair was used as an alternative to moose hair, deer hair and, particularly, porcupine quill in embroidered work featuring both Euro-Canadian and native-inspired floral motifs or Euro-Canadian realistic designs. The floral designs are particularly associated with the introduction of embroidery techniques by Ursuline nuns in Quebec in the early eighteenth century and the transfer of technique and
design to the Wendat, Mi’kmaq and Anishnaabe for the creation of articles made largely for sale; transfer also took place in the opposite direction, that is the nuns adopted hair embroidery on birch bark from the First Nations. A very different group of items comprises costume articles and accoutrements that were usually for the personal use of men and were often designed to be used in war. Most are components of outfits, sets of clothing or individual items that were probably used in presentations or exchanges and are typically associated with Algonquian or Haudenosaunee

<table>
<thead>
<tr>
<th>Object number and description</th>
<th>Fibre</th>
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<tbody>
<tr>
<td>Am1921.1014.85 moccasin A: vamp decoration</td>
<td>✓</td>
</tr>
<tr>
<td>Am1921, 1014.106 finger-woven sash strap</td>
<td>✓</td>
</tr>
<tr>
<td>Am1944.02.214 Beasley bag</td>
<td>✓</td>
</tr>
<tr>
<td>Am2643 net sash (Christy collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am,+.6993 bag (Christy collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am,+.6992 gorget (Christy collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am1878.1101.625 wampum pouch (Meyrick collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am,St.775.a–b pair of puckered vamp mocassins</td>
<td>✓</td>
</tr>
<tr>
<td>Am1986.18.16.a–b pair of mocassins</td>
<td>✓</td>
</tr>
<tr>
<td>Am1983.23.1 woven burden strap</td>
<td>✓</td>
</tr>
<tr>
<td>Am,+.6996 hair ornament (Christy collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am1930,-.21 roach</td>
<td>✓</td>
</tr>
<tr>
<td>Am1930,-.22 roach</td>
<td>✓</td>
</tr>
<tr>
<td>Am1903,-.27 roach</td>
<td>✓</td>
</tr>
<tr>
<td>2010.208.1 roach</td>
<td>✓</td>
</tr>
<tr>
<td>Am,SLMisc.203 seventeenth-century Huron pouch (Sloane collection)</td>
<td>✓</td>
</tr>
<tr>
<td>Am2597 Huron chair seat cover</td>
<td>✓</td>
</tr>
<tr>
<td>Am2603 fan</td>
<td>✓</td>
</tr>
<tr>
<td>Am1994.02.5 embroidered cover to birch bark book c. 1750–1775</td>
<td>✓</td>
</tr>
<tr>
<td>Am1954.05.965 coat</td>
<td>✓</td>
</tr>
<tr>
<td>Am1949.22.175 coat</td>
<td>✓</td>
</tr>
<tr>
<td>Am1901,-.3 bison robe</td>
<td>✓</td>
</tr>
<tr>
<td>NN Q78 Am glass bead wampum belt (undocumented, but recovered from box of un-accessioned early Woodlands items 1978)</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: the species in each case are: white tailed deer (*Odocoileus virginianus*); sheep (*Ovis* sp.); moose (*Alces alces*); porcupine (*Erethizon dorsatum*); bison (*Bison bison*); wolverine (*Gulo gulo*); river otter (*Lundra canadensis*); dogbane (*Apocynum cannabinum*); and cotton (*Gossypium* sp.)
figures, often represented as 'Mohawks'. The articles that are parts of costumes include moccasins, garters and garter drops (shirts and leggings seldom survive), bandoleer bags, chest straps, gorgets and neck or head ornaments. Also important are the hair-filled metal cones and various edging materials, as well as embroidery threads used in moccasins. A small number of plant fibre articles, a twined pouch and plaited burden straps/warrior ties were also examined.

This contribution focuses on the use of variable pressure scanning electron microscopy (VP-SEM) to identify fibres sampled from selected examples of the clothing listed above in artefacts in the British Museum collections and the results obtained from these studies. The principal objectives were to draw attention to some of the variability encountered when trying to make such fibre identifications, to characterize possible indicators of use or wear and to highlight the difficulties of comparing modern or 'textbook' specimens with used, dirty or aged materials. It should be stressed that this is not intended to be a manual for fibre identification; limitations of space mean that only selected examples can be illustrated. Nor is it intended to be a comprehensive description of all categories of material used for each object, as specific areas were targeted for sampling as described below.

THE BRITISH MUSEUM MATERIAL EXAMINED

Five groups of objects were selected for examination:

1. Bags and straps sometimes recorded as being made of buffalo or bison hair, especially the finger-woven bags used as bandoleers in Mohawk type outfits.
2. The contents of hair-filled, metal tinkler cones (to determine whether these often rather stiff materials were plant fibres or, if not, whether they comprised sheep wool, deer hair or moose hair).
3. Deer hair ornaments, including the one Great Lakes hair ornament. In contrast to these, more recent Plains roaches were selected to determine whether turkey beard or porcupine hair was, and is, in common use. One late twentieth-century Kiowa roach acquired by the British Museum in 2010 was documented (and subsequently confirmed) as consisting of white tailed deer hair (Odocoileus virginianus).
4. The largest group comprised embroidered materials assumed to be decorated with moose hair or possibly deer hair. The artefact types included souvenir forms, i.e. cloth and birch bark items embroidered with animal hair threads, and twined and plaited plant fibre items such as a pouch and burden strap decorated with what is normally assumed to be moose hair. An opportunity was also taken to sample the plant material to confirm whether or not basswood (Tilia americana) fibre or Indian hemp/dogbane (Apocynum cannabinum) was used.
5. Two Anishnabe/Cree coats were examined to see whether hairs from the fur trim could be identified.

An initial, subjective selection of items in the above groups was made, based on the quality of documentation available for the various objects and their perceived quality and age. From these, a sub-group of 23 objects was examined using VP-SEM, Table 1.

IDENTIFICATION OF FIBRES

Published and on-line fibre atlases

Printed and on-line fibre atlases are very useful, but there is always a difficult comparative exercise to be accomplished when attempting to match morphological characteristics exhibited in 'textbook' images of clean, modern fibres with those of historical, aged or archaeological fibres, many of which have been altered through burial in different types of deposit [9], or been preserved or replaced through close association with metals. Although it might on occasion be desirable to perform mitochondrial DNA (mtDNA) analysis on such 'non-textbook' material as a confirmatory means of taxon identification, mtDNA analysis may not be available, affordable or feasible due to contamination. Accordingly, specialist identification of ancient and historical fibres is crucial, whether through direct consultation or by accessing fibre atlases and published specialist articles, e.g. [10]. Without attempting to provide a comprehensive listing or critical overview of fibre websites or printed atlases such as that by Teerink [11], some key examples that are most relevant to the subject matter under discussion here are cited below.

In their Table 1 Sessions et al. provide a very useful summary of key morphological features of guard hair and underfur of 21 selected mammal species of the western USA [12], which is directly relevant and complementary to the study reported here. They characterize scale position (in relation to the shaft), scale patterns, hair width, scale length and height for a great many taxa. The taxa included by Sessions et al. [12] include: bighorn sheep (Ovis canadensis); wapiti or elk (Cervus canadensis); white tailed deer (Odocoileus virginianus); coyote (Canis latrans); red fox (Vulpes vulpes); cougar (Puma concolor); striped skunk (Mephitis mephitis); American badger (Taxidea taxus); northern raccoon (Procyon lotor); American black bear (Ursus americanus); pallid badger (Taxidea taxus); Virginia opossum (Didelphis virginiana); Merriam's shrew (Sorex merriami); broad footed mole (Scapanus latimanus); white tailed jackrabbit (Lepus townsendii); American beaver (Castor canadensis); North American porcupine (Erethizon dorsatum); northern pocket gopher (Thomomys talpoides); little pocket mouse (Perognathus longimembris); muskrat (Ondatra zibethicus); and golden...
mantled ground squirrel (Callospermophilus lateralis, syn. Spermophilus lateralis). An identification chart and SEM images illustrate guard hair and underfur specimens for each species, but the authors are careful to note that hair identification at the specific level cannot be based on a single characteristic or specimen and that more examples assist in greater accuracy [12].

Carrlee provides descriptive and diagnostic text for the fur of about 50 mammals including bears, beaver, American bison, caribou, moose, cattle, sheep, musk ox, Sitka black tailed deer, coyote, dog, elk, fisher, foxes, mountain goat, hares, lynx, marmots, marten, mink, muskrat, otters, pika, porcupine, raccoon, sable, squirrels, weasels, wolf, wolverine, woodchuck, sea lion and seals; polarized light microscope (PLM) images of fibres are also included [13]. Other websites exist for the identification of fur; a prime example that uses both computerized morphological descriptors and microscope images of 134 taxa is that by Galatik et al. [14]. Another, from Davison [15], covers plant fibres, manufactured fibres and a restricted range of animal hairs. The textile fibres on the latter website were mainly imaged using dark or bright field PLM, or differential interference contrast optical microscopy. Forensic science frequently covers fibre and hair identifications, and good examples are provided by Deedrich and Koch [16], which has photomicrographs, diagrams and associated text, and Jakes [17], which includes SEM and LM images of various animal hairs. More exotic animal hairs and hair casts are illustrated by Partin [18], including transverse sections to show the medulla. Finally, articles by Gabra-Sanders et al. [19] and De Marinis and Asprea [20] cover less exotic taxa.

**Identifying fibres using VP-SEM**

High vacuum SEM (using a JEOL 840) was formerly used very successfully to provide images of caribou and seal hair structures from fibres sampled from Inuit Arctic clothing in the British Museum collections. Samples of hair were cut transversely and longitudinally with a scalpel blade to provide sections that revealed the internal structures. The samples were mounted on stubs with carbon adhesive and...
coated with a very thin layer of gold – a routine procedure to make the samples conductive in the SEM and to provide bright secondary electron images with much detail [10]. However, such good preservation of fibres and resultant clear diagnostic detail in the images is not routinely encountered when studying historical or archaeological material.

Following the acquisition of a VP-SEM (Hitachi S-3700N) with an attached energy dispersive X-ray (EDX) analyser by the British Museum in 2007, examination, imaging and identification of materials, and these fibres in particular, entered a fresh phase as the new equipment offered the following advantages:

- samples could be placed in the (large) SEM chamber without the need for coating with gold, carbon or platinum;
- samples could be examined at different operating conditions using the secondary electron (SE) detector, the backscattered electron (BSE) detector or in environmental secondary electron mode (ESED);
- different pressures could be selected within the chamber, including partial evacuation or conventional high vacuum conditions;
- fibre samples required minimal, rapid preparation by simple mounting on aluminium SEM stubs using adhesive carbon pads or affixing to the stubs using a tiny pellet of ‘Blu-Tack’;
- several examples of fibres from a single sampling location on an object could be mounted on a large stub for comparison; because of the flexible nature of the SEM stage and chamber, other stubs with mounted identified fibres (from the British Museum’s comparative collection) could be placed alongside for easy reference.

These factors were vital to the study described here, particularly as the condition of the fibres from the 23 selected items was so variable (see below for the significance of this). Routine VP-SEM examination of the fibres was undertaken using the backscattered electron detector at 15 kV with a working distance of between c.14 and 21 mm. Depending on the condition of the material, the accelerating voltage (that determines the velocity at which electrons...
travel down the column) was dropped to 12 kV for some of the more fragile examples and increased to 18 or 20 kV for more robust samples or some of the modern reference specimens. For all samples, the SEM chamber was partially evacuated (30 or 40 Pa) under VP conditions. The 3D mode (rather than Compositional) was selected to maximize the opportunity to reveal diagnostic features on the fibres and to characterize wear due to use, abrasion, dirt, encrustation and fungus. The VP-SEM images that have been selected for this paper (Figures 1–10) represent a very small selection of
FIGURE 5. Examples of roaches with porcupine hair and/or quills: (a) roach Am1930,-21; (b) roach Am1903,-27; (c) roach Am1930,-22; (d) VP-SEM image showing a transverse section of the structure of a narrow porcupine quill from the roach seen in (a); and (e) VP-SEM image showing part of a transverse section of the structure of a reference specimen of fresh porcupine quill.

FIGURE 6. Gorget Am+.6992 (Christy collection): (a) detail from the gorget; (b) VP-SEM image of a longitudinal view of a crumpled area and surface scale patterns – identified as white tailed deer hair; and (c) VP-SEM image of a transverse section (shape altered to a flattened oval through preparation or use) – identified as white tailed deer hair.
those produced, but all the images have been archived for future reference.

In order to assist others who might wish to refer to these images when examining fibres using VP-SEM, attention is drawn to the data bar at the foot of each image that gives operating details for the examination of the fibre(s) illustrated. Reading left to right, the information consists of: the model of SEM and operator initials (S3700CRC); accelerating voltage (kV); working distance (mm); detector and mode (BSE3D); partial evacuation status (Pa); magnification (×); and scale (in micrometres or millimetres).

RESULTS AND DISCUSSION

Table 1 contains the detailed results of VP-SEM identification of selected fibres from the 23 British Museum objects. It should again be stressed that particular questions have been addressed in these targeted samples and that these objects often contain other fibres that were not sampled in this pilot study, as well as other organic components. Consequently, it is the presence of a taxon that is significant. In all instances extreme care was taken to establish (through examination of the material and accompanying documentation) that there were no areas that had been restored or replaced with different types of fibres or hairs at a previous point in the object’s history, which could clearly lead to very misleading results, not only for PLM or SEM fibre identifications, but also for DNA analyses.

Due to space constraints and to avoid duplication/replication, the descriptive text offered by Sessions et al. [12], Carrlee [13] and others are not repeated here and readers are directed to these sources for detailed information on diagnostic features for the relevant taxa.

VP-SEM revealed much useful information about the condition of the fibres; many display encrustation (possibly from the historical use of insecticides), (non-active) fungal hyphae, loose particles (dirt), abrasion or deterioration. Figure 1 shows four typical examples. It is crucial to document fibres in such condition for several reasons:

- to inform active conservation and care of the British Museum collections;
to add to the body of knowledge about the effects of preparation of the fibres (or skins) during the manufacture of the object, its use by the owner, as well as its subsequent storage.

Two examples of the information that can be gained are offered by the wear and tear seen on the sheep wool fibre from the finger-woven sash strap, Am1921.1014.106 (Figure 1a) and the fungal hyphae that obscure diagnostic detail of the (presumed) white tailed deer fibre from hair ornament Am.+6996, Figure 1b.

Taking the decision to examine these fibres in the VP-SEM without first cleaning and preparing them (for example by thin-sectioning, embedding in resin and polishing or obtaining casts) has yielded significant additional information, some of which is detailed here. Perhaps the most interesting of the effects seen on threads used in weaving was observed for the porcupine hair on the embroidered cover of a birch bark book, possibly from the Ursuline Convent in Quebec, dating from c.1750–1775 (Am1994.02.5: Figures 2 and 3), where the preparation of hair for embroidery was shown to include the flattening of the fibre by drawing through the mouth, which has collapsed the internal cell structure, Figure 3. The presence of porcupine hair on this object and on a seventeenth-century Huron pouch (Am,SLMisc.203: Figure 4) was unexpected and is proving to be of significant interest. Using light microscopy, MacDonald observed the many similarities in both scale pattern and internal structure between porcupine and moose fibres [3], and Sessions et al. described and illustrated examples of guard hair and underfur of both taxa [12]. In this VP-SEM study, several samples were taken from different locations on the birch bark book and each was rigorously examined and imaged. Many fresh reference specimens from Canada were likewise examined and imaged in the VP-SEM to understand better the variability of scale patterns and internal structure between examples of guard hair and underfur in both porcupine hair and quills (a rather artificial subdivision in many respects, as quills are greatly enlarged hairs) and to provide data to compare with those for the book, the pouch and the roaches illustrated in Figure 5. This threw into sharp focus the importance of understanding the variability within a single taxon, not least depending on the size of the fibre and the location of the area examined on the shaft/tip/root. It also reinforced the difficulty encountered by many fibre scientists and conservators in comparing museum specimens in aged, worn or fragile condition with textbook examples of clean, modern, unmodified fibres imaged using (P)L.M or SEM. There is no substitute for a ‘purpose-built’ fibre reference collection that includes specimens in as many conditions as possible.

Identification of the objects containing moose or deer hair (Table 1) reflected anticipated results: the pouch and burden straps are, as expected, decorated with moose hair; the tinkler cones on moccasins and other articles are frequently filled (e.g. gorget Am.+6992: Figure 6) or decorated with white tailed deer hair, including hair ornament Am.+6996, Figure 7. Another interesting example of possible evidence for preparation techniques is present on one of the moose hairs on a Huron chair seat cover (Am.2597: Figures 8a and 8b) in the form of wrinkling and flattening that may have been caused by drawing between front teeth, Figure 8c.

Figure 8. Huron chair seat cover Am.2597: (a) detail of front; (b) detail of the back, showing the potential for fibre sampling; and (c) VP-SEM image showing the scale patterns on the longitudinal surface of a moose hair, with wrinkling and flattening possibly caused by drawing between front teeth.
The Beasley collection bag (Am1944,02.214: Figure 9a) was originally collected by Colonel Burn for the Royal Artillery Museum, perhaps in c.1778–1814. Four samples taken from the bag lining were identified in the VP-SEM as cotton, Table 1 and Figure 9b. This printed cloth interior may have been manufactured in India and imported to North America via Britain. Four samples taken from the bag edging, strap edging and fringe were identified as sheep’s wool, Figure 9c. It is the wool fringe of this bag that is particularly worn and degraded, presumably indicating intensive use.

The choice of sheep’s wool for the bag (and for other objects) raised questions about the possible breed(s) of sheep involved and prompted a preliminary VP-SEM examination of the variability of scale patterns on sheep hairs according to breed. It would be of much interest to historians of sheep breeding and to current breeders of native sheep if diagnostic criteria could be documented to inform such differentiation. However, identification of such samples to specific breeds would require much further research; the preliminary VP-SEM study of a limited range of reference samples produced promising results but also opened up complex issues regarding the variability of key features (see also Ryder [21]). Figure 10, for example, shows the variability of surface scale patterns, width and size amongst modern reference examples of hair from just four native British sheep breeds. While these results are not significant in terms of the Beasley bag, they emphasize that there is no single ‘textbook’ example of sheep wool and that there is much variability within a single breed of sheep as well as between breeds.

The VP-SEM examination and identification of these fibres has provided results that have broadened and deepened the original field of enquiry by raising new and challenging issues, and these now need to be placed within a wider cultural framework. Ancient pictographic designs were occasionally used in the decoration of the objects examined here. They are usually found on quill-embroidered and engraved articles designed as souvenirs, while the depictions of aspects of indigenous Indian life found on these objects are heavily influenced by aesthetic conventions introduced after contact with other cultures. These introductions include the portrayal...
of figures and scenes typical of those depicted in watercolours by non-native artists. While only a few such examples from the British Museum collection have been examined as yet, it is hoped that future work might include other objects, specifically those from the Mi’kmaq and Anishnaabe, to determine whether the use of animal hair varied between ethnic groups. Overlapping with this tradition, and beginning at about the same time, is the development of a pan-Woodlands costume that was both used by First Nations people and obtained by Europeans in Canada and the United States – and is perhaps best regarded as a visible expression of the involvement of European-Americans in the affairs of Native North Americans, particularly in respect to war. The costume normally consists of breechclout, leggings, moccasins, garters and garter drops, with various sashes, a bandoleer and a powder horn. Additional accoutrements include headaddresses, hair roaches, cloaks and gorgets, occasionally a cotton shirt and a trade knife in an embroidered case hung around the neck.

It can be argued that the most common use of animal hair is in the decoration of moccasins, which continues today. This is sometimes as sewn embroidery, but elsewhere it is used in applique piping and edging (i.e. deer or moose hair laid longitudinally on moccasins or other items as space-defining edges) or bound to the backing. Another common use is as the filler of metal tinklers, which consist of tin or zinc rolled into a cone around a clump of hair (often from the white tailed deer) that protrudes beyond the end of the cones. These may have copied aboriginal dew-claw ornaments that were used, for instance, as rattles in leg ornaments. These hair-filled metal tinklers are perhaps the most ubiquitous of all decorative ornaments on Woodlands, and indeed Plains, costumes or accoutrements and occur on everything from moccasins to wampum belts, sashes, garters and garter drops. Of particular interest is that they occur in objects where all the aboriginal raw materials have been replaced with imported materials such as glass beads, cotton thread, calico, etc., with the result that only through the use of deer hair to fill the tinklers is the sense of the original aboriginal materials retained, Table 1.

PROSPECTS FOR FUTURE STUDY

In addition to providing primary information on the use of different types of material, the importance of the study of Woodlands regalia and souvenir art lies in the contribution
it can make to modelling the way in which a series of factors intersects and interacts in the creation of material culture and art traditions.

White sets the scene for a wide area around the Great Lakes and adjoining rivers, and explores the history and ethnohistory of the First Nations and Native American peoples as they were impacted by European arrival and interactions with Native North Americans in the period from c.1650 to 1815 [22]. He looks in particular at the processes of trade and war, competition between French, British and Americans, and rivalry between First Nations. Emphasizing agency, that is the active participation in the process by indigenous people even as populations collapsed through epidemic disease, White looks at the disappearance and reformation of ethnic identities at the edge of this ‘Middle Ground’. An important development was the incorporation of remnant or refugee ethnic populations into new ethnic groups and, while White recognized that peoples from three language groups – Iroquoian, Algonquian and Siouan – were involved, he designates them all as Algonquian. In explaining this ethnohistorical process, White provided a parallel narrative to the physical evidence from the era, which comprises the costumes, or more usually costume parts, and souvenir arts that survive in museums. In a general anthropological framework these then are the variables that form the basis for modelling: the raw materials; the techniques used to create objects; indigenous languages (which should be extended beyond the three mentioned above to include Iroquoian Cherokee and Muskogean Creek); and languages introduced by Europeans (French, English, and, to some extent, German). Although White focuses on Algonquin-speaking peoples (who were especially active in the fur trade), the Wendat and Haundenosaunne were crucial in the creation of these Woodlands hybrids as they provided leaders who worked not only with the British, but also with the French and in Canada.

This argument about the hybridization of costume can be taken further to the south east of the United States and related to the War of 1812 (which spanned 1812 to 1814), during which the Algonquan-Shawnee leader Tecumseh (1768–1813), from southern Ohio, worked with Creeks in Georgia to defeat the United States. The Creeks were divided into pro- and anti-American factions and at the Battle of Horseshoe Bend in 1814 the United States, with their Creek allies, Cherokees and other Native Americans, defeated the pro-British Red Stick Creek rebels. Subsequently the Red Sticks fled to Florida, combining with the Seminole.

In the context of an interest in art, costume and fibre, the question is whether the pan-Indian alliance against the United States of 1812–1814 was unified by sharing elements of a common costume and to what extent that costume was taken up in Florida as a consequence of the arrival of the fleeing Red Stick Creeks. Of particular relevance is the availability of fibres to those transmitting and adapting this early pan-Indian costume, as moose hair and porcupine hair/quill were not available in the south east of the United States. The study of such materials can inform an understanding of the actual appearance of Cherokee or Creek costume in the War of 1812 and the extent to which it was hybridized with local costume traditions. Finally, it is possible to return to the question of souvenir arts, in which the hybridization of materials, embroidery, sewing and weaving techniques moved in the other direction (with European forms becoming indigenized). A bigger picture can then be modelled in which none of the individual variables – technique, language, ethnic group, artefact form or fibre and thread – is dominant, but all are subject to endless replacement, hybridization and continuous development.

CONCLUSIONS

Variable pressure scanning electron microscopy has been used successfully to identify selected animal hairs and plant fibres from 23 North American Woodlands items in the British Museum collections. While these identifications have not always been straightforward, as many of the fibres have degraded over time, VP-SEM offered a significant advantage over optical microscopy inasmuch as it permitted characterization of condition, possible methods of fibre preparation and the effects of use or wear. With suitable reference material, sufficient diagnostic features could be observed to enable the identification of moose, sheep, deer, porcupine, bison, otter and wolverine hairs, as well as dogbane (also known as Indian hemp) and cotton fibres. The results have contributed broader and deeper elements to the original field of enquiry from which new and challenging avenues of interest are emerging, particularly after some of the results from this study were presented to the GRASAC conference at the Ojibwe Cultural Foundation, Manitoulin Island, Ontario in June 2011. Two specific interpretive questions arise out of this study. The first relates to indigenous cognition in the natural world and the need to develop usable, viable language materials for the GRASAC, as noted by Phillips [7]. In looking at indigenous use of threads and fibres in the Great Lakes, accurate aboriginal etymologies need to be developed that provide a way of reconceptualizing these extraordinary materials – porcupine, deer and moose, and their hairs, and the embroidery, twining and other technical information. These etymologies will perforce be embedded in the cognition and understanding, not of the natural world, which is a western rather than Native concept, but of the whole world view of indigenous people. What needs to be understood generally are the culturally specific processes that underlie indigenous peoples’ conceptions of biological kinds, see [23]. How are fibres and threads thought of among Algonquian, Iroquoian and Siouan speakers; how are deer, whether moose or white tailed, thought of as a category; what sort of animal, in indigenous thought, is the porcupine? Phillips [7] and others have looked at the
meaning of flowers in embroidery, but another layer of meaning relates to the fibres, the species from which they originate and the generic terms used for them. Beyond the fibres are cognitive elements that relate to construction, for instance the twining of Indian hemp or the production of twined pouches and plaited warrior ties or tumplines. Finally, in considering souvenir arts, it is essential to recover an understanding of how, for example, Wendat and Oddawa spoke of birch bark articles and in what way they constructed meaning for these new objects within their own indigenous world views.

The second theoretical point is rather different and concerns the anthropological modelling of technique, design, materials, language and ethnicity. In Woodlands North America a relatively small number of language groups – three – intersected with material culture traditions spread over a broad area. They were capable of rapidly incorporating the new techniques and materials introduced by Europeans into their own designs, techniques and materials. With the political and ethnic reshaping of eastern North America through the wars and colonization of the eighteenth and nineteenth centuries, ethnic collapse, reformation and survival were cross-associated with relatively stable hybridized material culture traditions. Perhaps the most interesting and extreme of these developments was Canadian influence in Oregon territory, where Plateau beaded bags contain floral designs that originated in the eastern Woodlands and were transferred by voyageurs and the fur trade to western North America in the period 1790–1846.

ACKNOWLEDGEMENTS

Fresh porcupine and other fibre reference samples were generously provided by Ruth Phillips, Alan Corbiere (then of the Ojibwe Cultural Foundation, Ontario) and Linda Sioui, from Wendat, Québec. Fresh sheep wool samples from named eighteenth- and nineteenth-century breeds were very helpfully sourced locally in Lancashire by Lucinda Woodcock.

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