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Forensic Analysis of Mummified Human Scalp Trophy

James A. Bailey, Maher Noureddine, Erwin J. Vermeij and *Pieter Van Driessche*

Introduction

The Northfield Historical Society, Northfield, Minnesota, has a mummified human scalp trophy in their collection that was examined for possible identification. The trophy allegedly belonged to Clelland "Clell" Miller, William "Bill" Chadwell or Samuel "Sam" Wells, three members of a gang of 19th century bandits from Missouri known as the James-Younger Gang. Miller and Chadwell were killed September 7, 1876, during the Northfield Bank robbery in Northfield. Two weeks later on September 21, 1876, a posse killed Wells a few miles northwest of Madelia, Minnesota. Medical students allegedly removed a portion of the scalp from one of the three cadavers as a human scalp trophy. Oddly the trophy included an ear.[1-3] Generally, human scalp trophies do not include an ear.

Following the coroner's inquest for Miller and Chadwell on September 8th, Henry Wheeler, a medical student from Northfield who shot and killed Miller on the day of the raid, arranged to obtain Miller and Chadwell's bodies. Wheeler persuaded Clarence Persons, a medical school classmate, to disinter the two bodies from the Northfield Cemetery and directed him to ship them to the University of Michigan Medical School to be used in their anatomy classes.[4] In order to carry out Wheeler's directives, Robert Carmichael, a young farmer from nearby Castle Rock, Minnesota, was recruited to assist with shipping the bodies. Well known for his pork curing skills, Carmichael was proficient in using brine as a preservative and he owned large vats that could hold the two bodies. In addition to the vats, he had barrels large enough to hold the bodies for shipping to the University of Michigan. To disguise the contents, the barrels were marked "mixed paint."[5-8]

While Wheeler had possession of the gang members' bodies at medical school, he and a senior classmate, Charles Virgin Porter, removed the human scalp trophy from one of the bodies which included an ear.[9] Dr. Porter's great grandsons, Jeff and Eric Porter, related their grandfather's story of the medical students taking the human scalp trophy from one of the James-Younger Gang members. Their great grandfather kept the trophy and occasionally displayed it to select audiences until his death in 1931. Dr. Porter's son, Charles V. Porter, Jr., inherited the mummified human scalp trophy. Porter, Jr., with assistance of Mary Porter (Freeman), his daughter, had the mummified tissue transported from Wisconsin to Minnesota when he donated the trophy to the W.F. Schilling Museum in Northfield.[10-12]

For over six decades, no one in Northfield heard anything about the human scalp trophy taken from one of the three bandits until W.F. "Bill" Schilling acquired it. Schilling, founded the Hobby House Museum, a private museum, to display the items he collected. He originally acquired the mummified human scalp trophy for his museum sometime between 1938 and 1942 from Porter.[13] The human scalp trophy remained in Schilling's museum collection for approximately forty years until Schilling's son and daughter-in-law, Louis and Alice Schilling, donated the mummified human scalp trophy and other Northfield Raid items to the Northfield Historical Society in 1978.[14] Yet another thirty-five years lapsed before forensic scientists examined the human scalp trophy in search of its origin and preservation.

Analysis of the Ear

The trophy measures approximately 12 x 15 cm in size. The epidermis of the mummified alopecic human scalp trophy is light brown in color with a leathery appearance; however, the texture is brittle. The dermis is dehydrated. Although there has been significant shrinkage due to mummification, the ear morphology landmarks are present. Consequently, the ear is readily identified as the right ear.

A sample of the mummified scalp tissue, $1 \times 1 cm^2$, was collected superiorly to the ear from the mummified scalp for DNA analysis. Unfortunately, the amplification procedure did not produce sufficient DNA for a Y-STR profile at a threshold level for comparison to markers from buccal swab samples collected from Wells, Miller or Chadwell's male relatives. The small sample taken from the

mummified tissue only yielded one marker. All the same, an important discovery was made from the presence of the one marker. That marker confirmed the unidentified scalp came from a human male.

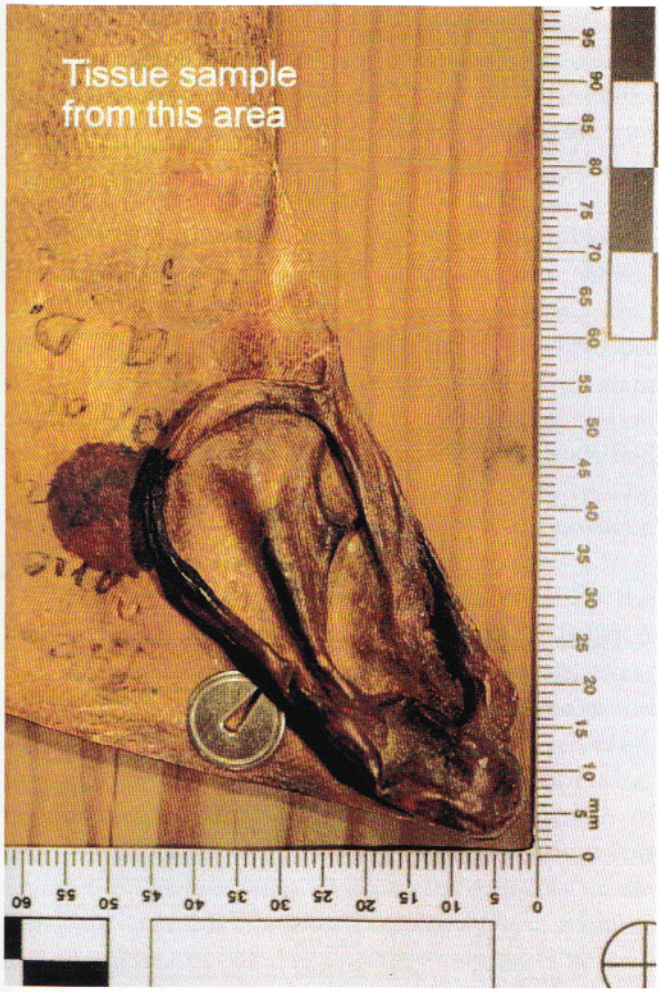

Fig. 1 Mummified human scalp sample.
(Authors' Collection)

The inability to extract DNA from tissue, especially mummified tissue, depends on numerous factors. Some factors affecting the degradation of DNA include the type of biological tissue being tested, storage conditions, age, temperature, humidity, bacterial and fungal environment. The types of chemical elements or contaminates the tissue has been exposed to may also affect the DNA extraction or amplification process.[15-16] Since DNA markers could not be extracted from the mummified tissue, researchers conducted two additional examinations to determine more about the tissue. As a result, further testing of the mummified human trophy became a collaborative effort between forensic scientists in the United States and Netherlands.

The tissue was examined with a Scanning Electron Microscope-Energy Dispersive X-ray Spectroscopy (SEM-EDX) to identify chemical elements present from preservatives used in the mummification process on the epidermis. Also, a histological examination was performed to evaluate the microanatomy of the cells and tissue.

The mummification process may be spontaneous or anthropogenic. Spontaneous mummification occurs when natural dehydration of tissue takes place without any human intervention or preservatives to prevent decay. This type of mummification could occur by desiccation or dehydration of the tissue from exposure in a dry environment. In addition, spontaneous mummification typically occurs when conditions permit a rapid loss of moisture by evaporation. As a result, the rapid desiccation of the soft tissue could prevent decomposition by the presence of any microorganisms. Therefore, spontaneous mummification could occur in a hot or cold environment. Accordingly, the color and texture of the mummified scalp and ear tissue are dark and leathery which are typical characteristics of spontaneous mummification of skin.[17-18]

However, anthropogenic mummification occurs when preservatives are used to prevent decay.[19] Anthropogenic mummification is the most common form of mummification. It is the intentional act of preserving a body or tissue. Thus, circumstantial evidence and condition of the Northfield ear suggest an anthropogenic process for its preservation.

An SEM – EDX elemental analysis was performed on a sample of the epidermis to determine if there were any elements from preservatives present in the tissue that were used during the Victorian era. During this era, medical schools in the United States primarily used solutions of arsenic, zinc or chloral hydrate for preservation of cadavers. Taxidermists preserved biological specimens but some taxidermists used different solutions from those used in medical schools.[20] In addition to arsenic, the taxidermy mixtures contained other elements. Typical taxidermy compounds included: aluminum sulfate, potassium nitrate, potassium carbonate, potassium chloride, calcium carbonate, sodium chloride, camphor and turpentine.[21-22] Wheeler and Porter may have used

similar solutions to preserve the human scalp trophy.

The SEM – EDX elemental analysis identified twenty chemical elements from twenty-six particles on the epidermis of the skin (Table 1). The chemical elements are listed in order of atomic number. All particles examined contained carbon and oxygen. However, 84% of the particles contained calcium and silicon. Only 4% of the particles contained barium, gold, silver and titanium. Table 2 lists the percentage of chemical elements identified on all particles.

Arsenic was found on 50% of the particles examined. The presence of arsenic on the epidermis is consistent with the use of a preservative on the trophy. Some chemical elements present on the human scalp trophy may be contaminates; however, ten of the twenty chemical elements identified are the same as the chemical elements used in some 19th century preservative mixtures.

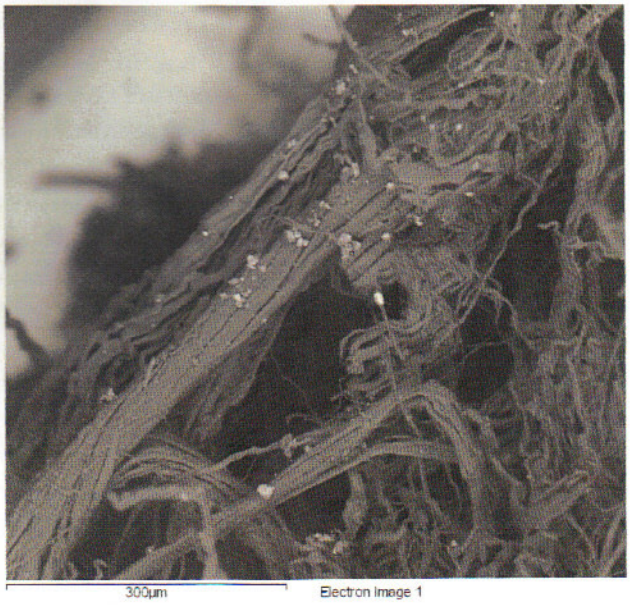

Fig. 2 SEM micrograph of dehydrated dermis at 400X.
(Authors' Collection)

Particles	Elements Detected
1	C, O, Si, Sn
2	C, O, Si
3	C, O, Mg, Al, Si, S, Fe
4	C, O, Si, Fe, Sn,
5	C, O, Al, Si, K, Ca, Fe, Au,
6	C, O, Mg, Al, Sn
7	C, O, Al, Si, S, Ca, Fe, Ag
8	C, O, Al, Si, S, K, Ca, Fe
9	C, O, Al, Si, S, K, Ca, Fe, Zn
10	C, O, Al, Si, P, K, Ca, Fe, As, Pb
11	C, O, Na, Al, Si, P, K, Ca, Fe, As, Pb,
12	C, O, Na, Si, P, Cl, K, Ca, Fe, As, Pb
13	C, O, Mg, Al, Si, Cl, Ca, Fe
14	C, O, Al, Si, S, Ca, Ba
15	C, O, Na, Al, Si, P, S, Cl, K, Ca, Fe, As, Pb
16	C, O, Al, P, S, K, Ca, Fe, As, Pb
17	C, O, Mg, Al, Si, S, K, Ca, Fe, Pb
18	C, O, Al, Si, P, Cl, K, Ca, Fe, Zn, As, Pb
19	C, O, Al, Si, P, K, Ca, Fe, As, Pb
20	C, O, Na, Mg, Al, S, K, Ca, Fe, As, Pb,
21	C, O, Na, Al, P, S, Cl, K, Ca, Fe, As, Pb
22	C, O, Na, Al, Si, P, S, Cl, K, Ca, Fe, As, Pb
23	C, O, Na, P, S, Cl, K, Ca, Fe, As, Pb
24	C, O, Si, Ca, Zn,
25	C, O, Al, Si, P, S, Cl, K, Ca, Ti, Fe, As, Pb
26	C, O, Na, Al, Si, P, S, Cl, K, Ca, As, Pb

Table 1 Summary of chemical elements identified with the SEM-EDX from twenty-six particles examined on the epidermis of the mummified tissue. (Authors' Collection)

Particles Examined (Number/Percent)	Chemical Elements	Medical School & Taxidermy Preservatives
26/100	Carbon	+
26/100	Oxygen	+
21/84	Calcium	+
21/84	Silicon	-
20/77	Aluminum	+
20/77	Iron	-
17/65	Potassium	+
14/54	Lead	-
14/54	Sulfur	+
13/50	Arsenic	+
12/46	Phosphorus	-
12/46	Tin	-
12/46	Zinc	+
9/35	Chlorine	+
8/31	Sodium	+
5/19	Magnesium	-
4/12	Barium	-
4/12	Gold	-
4/12	Silver	-
4/12	Titanium	-

Table 2 Number of particles and percentage of chemical elements identified on all particles examined on the epidermis are represented with the "+" symbol and chemical elements not used in typical preservatives are represented with the "-" symbol. (Authors' Collection)

Sections of the tissue were stained with three types of stain for histological examination. The stains included haematoxylin eosin (HE), Elastica von Gieson (EVG), and PanKeratin. HE is a general-purpose stain used on various tissue types for detecting any morphologic changes in the tissue. Without the use of a stain, some of the cellular features would be translucent. Typically, HE stains nuclei blue in tissue; whereas the cytoplasm and extracellular matrix are stained varying degrees of pink.

The EVG stain is used for collagen and other connective tissues and specifically for elastic fibers. Elastic fibers are a type of connective tissue that allows skin to stretch. Elastic fibers are not visible using HE stain. PanKeratin is used to stain epithelial cells which are cells that form the lining on the inside and outside of the body. The mummified ear tissue is made up of epithelial cells. The PanKeratin stain indicates the present of collagen strands and fat tissue.

The results of the HE and EVG stain on the mummified tissue explains why no nuclear DNA was obtained in the extraction process. Nuclear DNA is contained in the nucleus of the cell, and even though the mummified ear tissue is preserved, the parts of the cell containing DNA has decomposed. The stains indicate a breakdown of the cellular tissue.[23-26] The histological examination reveal the absence of nuclei and cell borders in the HE (Fig. 4) and EVG (Fig. 5) stains. These findings are characteristic of deteriorating tissue. The two types of tissue present were identified as degenerated collagen strands and muscle tissue. The PanKeratin stain confirmed the presence of collagen strands and fat tissue. The absence of cellular structures and the presence of collagen are consistent with the histological findings in some mummified skin.[27 28]

In conclusion, the SEM identified chemical elements on the surface of the mummified human scalp in the Northfield Historical Society Museum's collection. Elements found on the human trophy are consistent with chemicals used in anthropogenic mummification. This established that the ear was preserved by human intervention. Lastly, a histological examination confirmed the presence of deteriorated tissue containing collagen, fat and muscle cells. However, the human scalp trophy which allegedly belonged to Clelland "Clell" Miller, William "Bill" Chadwell or Samuel "Sam" Wells remains unidentified and future nuclear DNA testing is not recommended due to the condition of the cellular structures and absence of DNA.

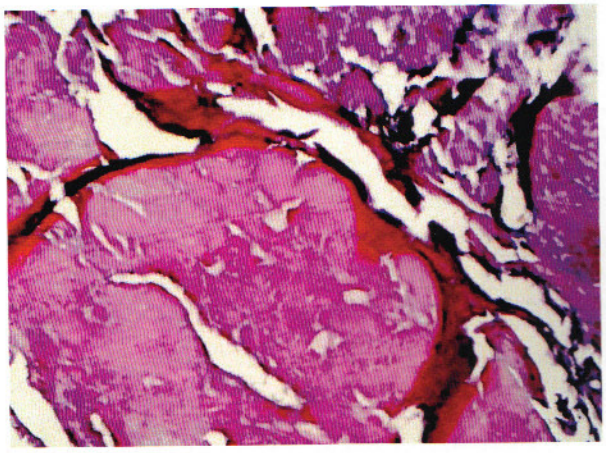

Fig. 3 Haematoxylin eosin stain from mummified tissue section. (Authors' Collection)

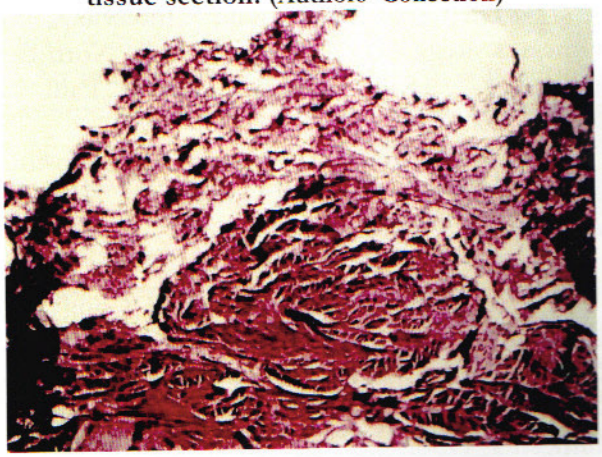

Fig. 4 Elastica von Gieson stain from mummified tissue section. (Authors' Collection)

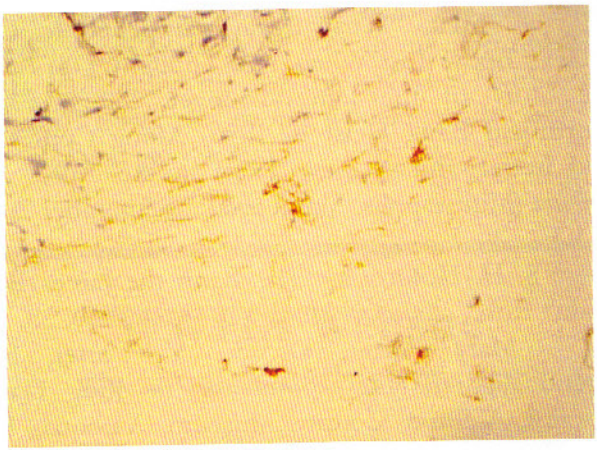

Fig. 5 PanKeratin stain from mummified tissue section. (Authors' Collection)

Acknowledgements

In 2012 DNA testing was provided by Thomas R. Reynolds, Executive Vice President, Commonwealth Biotechnologies Inc., Richmond, Virginia, USA.

DNA testing was completed on December 11, 2012 by Shelley Johnson, Senior Scientist, Commonwealth Biotechnologies Inc., Richmond, Virginia, USA

Endnotes

[1] "Northfield's Sensation: Full and Graphic Account of the Bank Robbery," *Minneapolis Tribune* (Minneapolis, MN) September 8, 1876, 4.

[2] "The Northfield Bank Robbers," *Liberty Weekly Tribune* (Liberty, Missouri) November 17, 1876, 2.

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[4] Newton Person's Personal Diary, Northfield Historical Society Archived Documents. Northfield; September 7-9, 1876.

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[10] Mary Porter, Dr. C. V. Porter, Sr.'s Granddaughter, Correspondence to Judy Gates, Curator, Vernon County Museum, Viroqua, WI, Porter, "Dr. C. V. and family," December 7, 1989.

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[21] T. Brown, *The Taxidermist's Manual: Or the Art of Collecting, Preparing, and Preserving Object of Natural History* 21st edition (Edinburgh: Fullarton and Co. Printers; 1970) np.

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[23] John D. Bancroft, *Theory and Practice of Histological Techniques*, (London: Elsevier Limited, 2008) p. 121.

[24] Authors' Note: According to J. Ochei and A. Kolhatkar, *Medical Laboratory Science: Theory and Practice* (McGraw-Hill Publishing Company, New York, 2000) p. 450, HE stains nuclei bright red, cytoplasm and collagen pale pink, muscle, keratin and colloid bright pink, erythrocytes orange-red.

[25] Authors' Note: Ira Van Gieson first described a staining protocol in 1889 as a method of evaluating and observing collagen fibers.

[26] Authors' Note: Haematoxylin is a basic dye derived from the Haematoxylum campechianum or logwood tree. It binds to the nuclei in cells. Eosin is from the organic compound fluorescein. It binds to cytoplasm producing shades of pink to red.

[27] T. A. Brown and Keri Brown, *Biomolecular Archaeology: An Introduction* (Malden, Massachusetts: Wily-Blackwell, 2011) np.

[28] Richard Maynes and Robert E. Burgeson, editors, *Structure and Function of Collagen Types* (Orlando Florida: Academic Press Inc., 1987) pp. 1-34.

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THE STRANGE AND THE THRILLING

I MET JOHN WESLEY HARDIN!!

Dennis McCown

For the last year, Austin Community College has assigned me to the Travis County Correctional Complex, a prison that can house 3,000 inmates. I work in maximum security, teaching college-level classes. Cameras follow everything I do. No cell-phones, no computer, no access to the outside world. Two "Programs" officers manage the hallway between the classrooms and the classrooms themselves. Nothing like the "maxie" I worked in for two years in Iran, but pretty rough.... Cameras everywhere. Everything recorded. Multiple barriers of razor wire and locks and security....

An inmate, John Wesley Hardin, was admitted some time ago. I wanted to meet him, but it took a lot of setting up. He was ordered out of his cell/unit to report to "Programs," where I work. He was a punk, early 20s. He was named after his "great-grandfather," a "famous cowboy."

I wish somebody had taken a cell-phone picture as he and I stood side-by-side and talked--but no photos. I told him the real John Wesley Hardin had been in Travis County Corrections for over two years, 1877-78. He wasn't much interested. I gave him a copy of my book, *The Goddess of War*. I'd love to know what he thought after he read it! (But I won't ever know....)

I wish I could have a picture of me and inmate Hardin together. It meant a lot to me after nearly 30 years researching the real John Wesley Hardin, and ... really... how many people would actually care?

But you guys would....