

## Interpretation of Ground Penetrating Radar Data: Clell Miller Gravesite

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After reviewing newspaper accounts and circumstances surrounding the deaths of Clelland D. Miller and William Chadwell, who were James Younger gang members, there was some doubt that Miller's corpse was returned to his family in Clay County, Missouri, for burial. This supposition was based on interpretation of specific events following Chadwell and Miller's deaths on September 7, 1876, in Northfield, Minnesota. Namely, the dead robbers were misidentified and some newspaper accounts reported Dr. Henry Wheeler kept Miller's body, the robber he killed during the Northfield Raid.<sup>1-6</sup> To address these inconsistencies, a team of forensic researchers, with the support of Miller's next of kin, proposed an exhumation of the gravesite in Muddy Fork Cemetery, Kearney, Clay County, Missouri.

The strategy for identifying the interred remains was to have an archeologist excavate the gravesite and interpret the artifacts. However, the examination of the remains would not have been limited to just an archeologist. Any human remains found would have been examined by three forensic scientists: a pathologist, radiologist and physical anthropologist. Miller sustained a shotgun injury to the face; therefore, his gravesite may contain shot pellets, so a tool mark expert would also have examined any firearms evidence located in the gravesite. DNA analysis from samples of bone, hair and teeth could determine if someone other than Miller was buried in the gravesite. Therefore, a DNA expert would have examined any potential sources for DNA. Also, forensic scientists could have used a Scanning Electron Microscopy (SEM) analysis of soil and other residue collected from the site which could identify anomalous soil contaminants.

On September 13, 2012, directly prior to an exhumation hearing before Judge Rex Gabbert, Clay County Circuit Court, the researchers met in Liberty, Missouri, with Dr. Mary Dudley, Chief

Medical Examiner, who served Clay County, Missouri; Daniel White, Clay County Prosecuting Attorney; the medical examiner's investigators, some of the prosecutor's staff and an anthropologist, who was a guest of the medical examiner. Although they presented no evidence to support their arguments at the meeting, some of the medical examiner's investigators and the anthropologist argued against going forward with the exhumation hearing.<sup>7</sup> However, following the meeting in the prosecutor's conference room, the exhumation hearing took place in the courtroom. Judge Gabbert issued an exhumation order for Miller's gravesite. Since the researchers volunteered their services, no costs would have been incurred to the citizens of Clay County for the Miller exhumation or any laboratory tests. The exhumation was scheduled to take place October 8, 2012.<sup>8-11</sup>

On September 18, 2012, Chief Medical Examiner Dudley requested Prosecuting Attorney White suspend the Miller exhumation order.<sup>12</sup> Dr. Dudley justified the suspension to the public based on the results of a Ground Penetrating Radar (GPR) survey she requested.<sup>13</sup> GPR is a common subsurface imaging tool used by archaeologists and forensic scientists; however, the effectiveness of this technique is dependent on local conditions and the data are subject to interpretation. In view of the suspension, the researchers requested a copy of the GPR report in order to assess the results; however, Dr. Dudley would not release a copy. Dudley said the GPR survey indicated there were four graves on the east side of the family spire monument and that DNA from any Miller gravesite would match any member of the Miller family. Therefore, she canceled the exhumation.<sup>14-15</sup>

In order for the researchers to make an identification of the remains interred in the Miller gravesite, proof of identity from several forensic techniques were initially presented to Dr. Dudley, not exclusively DNA. Specifically, some of those techniques included anthropological assessment of skeletal remains, craniofacial superimposition, radiological examination, archeological interpretation of the site, microscopic and chemical examination of artifacts and DNA analysis provided DNA could be extracted from any remaining bone, hair or teeth.<sup>16-20</sup>

The presence of human remains, artifacts in the grave and evidence of injuries to the skeletal system

would be the most probable methods used for identifying Miller. The .50 caliber bullet to Miller's upper torso likely severed the subclavian artery and possibly damaged his clavicle or other skeletal features and evidence of this injury would be present in a radiograph. Also, Miller sustained injuries from a shotgun blast during the robbery; therefore, there could be lead pellets present in the gravesite. It is believed Miller's body was preserved at Ann Arbor Medical School with a brine solution while stored in the anatomy lab. If so, there could be high levels of sodium chloride in the soil at the depth the body was buried following decomposition.<sup>21-23</sup>

Regardless, for unknown reasons following the exhumation hearing, Dudley changed her decision concerning the exhumation. Although Dudley said her decision for cancelling the exhumation was based on the results of the GPR report, she would not allow researchers access to the report or permission to discuss the survey with the GPR technician.

Mark DeSchepper, a GPR technician with Construction Solutions, conducted the GPR survey for the medical examiner's office. Since the GPR report was unavailable, the researchers requested Construction Solutions to conduct a second survey of the gravesite for the researchers. However, when asked about a second survey, DeSchepper declined. He expressed it would be unethical to conduct a second survey of the same site for another party because of his previous survey conducted for the medical examiner. His response was unanticipated since duplicating a scientific examination would have the same outcome. The technician's response and medical examiner's sudden refusal to cooperate with the researchers raised uncertainties concerning the interpretation of the DeSchepper's GPR data.

Therefore, to obtain GPR data for interpretation from the Miller plot, the researchers employed Kurt Schamberger with Ground Penetrating Radar Systems, Inc. in Kansas City to conduct a GPR survey, which was completed on September 22, 2014. Schamberger's interpretation of the data differed from the information released earlier by Dr. Dudley. Schamberger's data indicated anomalies identifying only one potential gravesite on the east side of the Miller spire monument, not four.

Although there was an absence of anomalies to indicate more than one gravesite, it was not a

forgone conclusion no graves were present. After researching soil composition further in Muddy Fork Cemetery, it was determined soil conditions in the Miller plot are not conducive for a GPR survey.<sup>24</sup> However, without access to the medical examiner's GPR report, there was no way to explain the inconsistencies in the interpretation of GPR data.

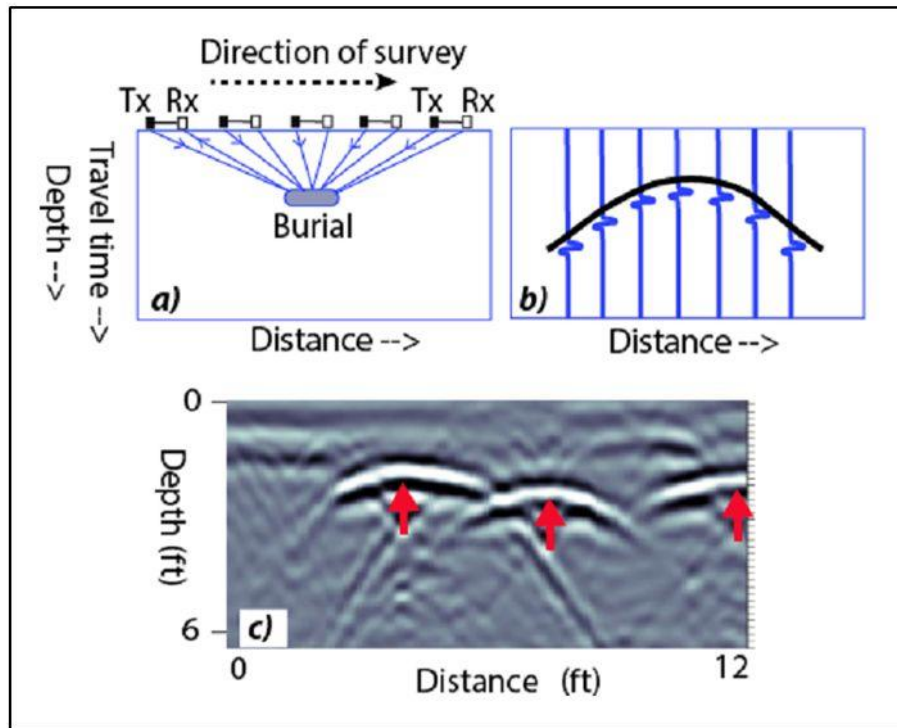
### **Introduction to Ground Penetrating Radar**

In general, GPR can be used for mapping at depths from a few decimeters to a few meters. It is a non-destructive method with applications in different professions. The construction industry uses it to locate underground storage tanks and rebar encased within concrete. Geologists use the technique to study stratigraphy of shallow subsurface. Archeologists use GPR for mapping and identifying areas to excavate, and forensic investigators use it to locate gravesites.<sup>25</sup>

A GPR system transmits a pulse of electromagnetic energy, typically at frequencies between 100 and 500 MHz, that propagates downward into the subsurface and is reflected upward as the wave encounters geologic layers or buried materials with different electrical properties. Higher frequency antennas provide images with greater definition, but the signals attenuate more quickly limiting the depth of investigation. Dry sandy soils with little salt are most favorable to radar propagation, whereas more conductive soils, like those present in Clay County, Missouri, typically limit the effectiveness of the technique.<sup>26-27</sup>

A GPR profiling system consists of transmitting and receiving antennas which are moved along the ground surface. The received data are digitized and converted into a graph known as a radargram, which displays distance on the horizontal axis and the depth or two-way travel time on the vertical axis.<sup>28</sup> The stronger the differences between the electrical properties of two materials, the stronger the amplitude of the reflected signal in the radargram.<sup>29</sup> Technicians examine these radargrams looking for characteristic anomalies, with depths and positions that are consistent with a burial.

Where the soil stratigraphy is sufficiently developed, continuous reflectors may delineate different soil horizons. When the digging of a grave disrupts this layering, truncated reflectors and areas of disturbance may provide evidence of excavation and backfilling. An image of characteristic



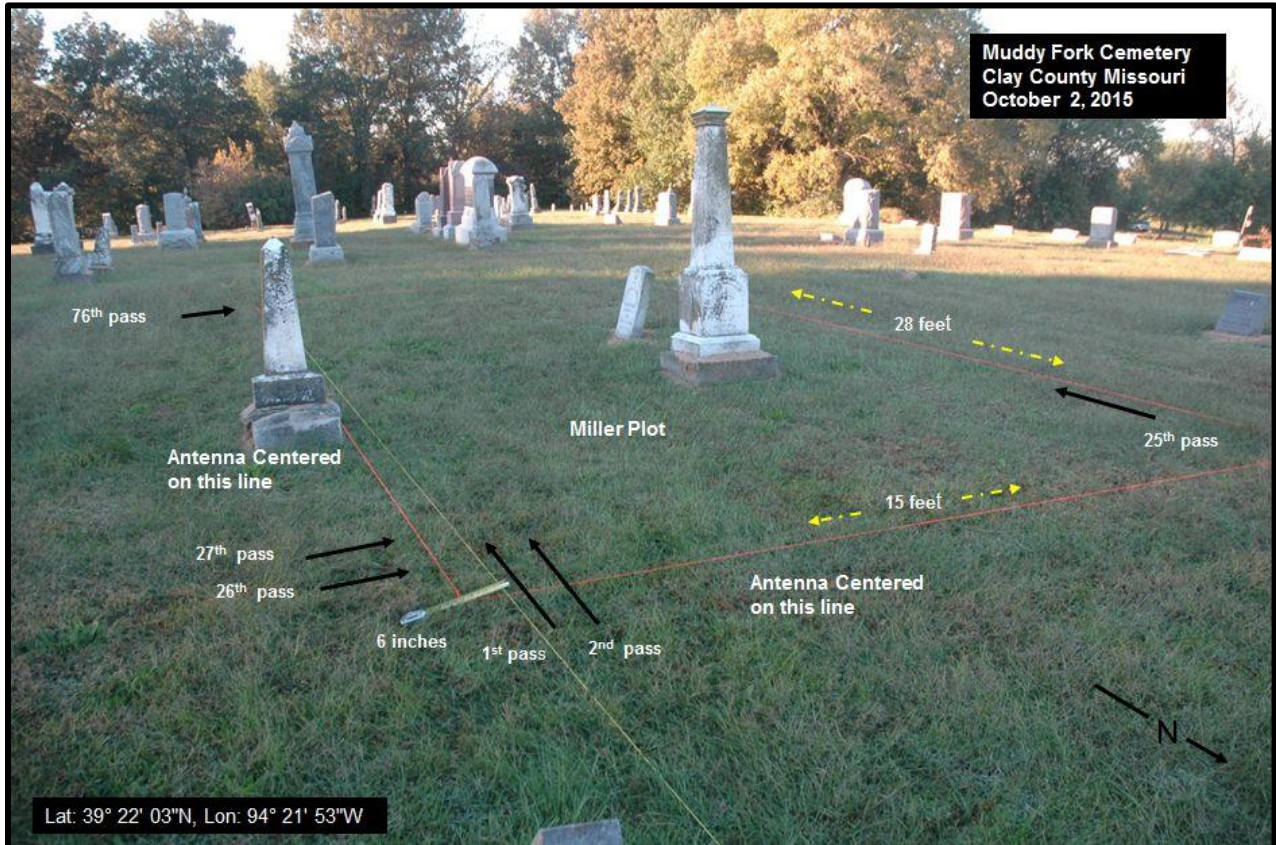
**Figure 1. Diagram of GPR Mapping:** a) GPR profiling system consists of transmitting (Tx) and receiving (Rx) antennas that are moved along the ground surface. Radar energy is reflected from buried materials, with the slant range decreasing as the system approaches the burial and increasing as it moves beyond. b) When the GPR traces are displayed with the antenna position on the x-axis and two-way travel time on the y-axis these reflected arrivals form a hyperbola shape. c) Example of a 500 MHz radar image showing hyperbola reflectors (arrows) associated with three mid-twentieth century burials collected under conditions of moderate soil suitability in central North Carolina. (Authors' Collection)

hyperbola reflectors may be observed in a radargram when the radar signal interacts with a coffin or other buried material.<sup>30-31</sup> Figure 1 shows a series of hyperbola reflectors associated with three mid-twentieth century burials in central North Carolina. However, the presence of these signals is strongly dependent on local soil conditions, which may limit the depth to which the radar signals penetrate. In addition, the age of the burial and mortuary practices can also impact the level of deterioration of the coffin and remains.

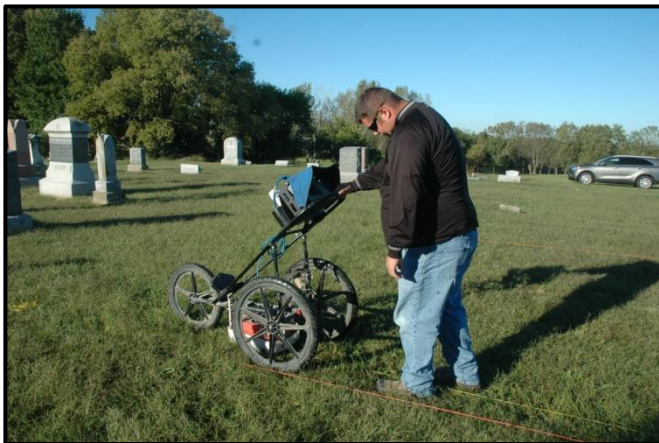
When Schamberger conducted the second GPR survey in 2014, he made approximately ten passes with the GPR on the east and west sides of the Miller spire monument. Data were collected by the instrument as the operator pushed it in a northern to southern direction on one pass and then a southern to northern direction on a subsequent pass. This created data slices which were

perpendicular to any suspected gravesites in the Miller plot.

After reviewing the 2014 GPR data, another GPR survey was scheduled to collect additional GPR data. In October 2015, Schamberger and Terry Jeffries, GPR technician, conducted another survey for the researchers. The entire Miller plot was surveyed using an orthogonal grid to collect GPR.<sup>32</sup> Data from twenty-five passes were collected with the instrument traveling north to south and data from forty-six passes were collected with the instrument traveling east to west. A geophysicist reviewing these data identified no definitive evidence for a gravesite. However, given the poor suitability of the local soils for GPR surveys and possibly the deteriorated state of the coffin and remains, this result cannot be taken as evidence for the absence of burials within the Miller plot.



**Data Collection: Miller Grave Plot, Muddy Fork Cemetery, Clay County, Missouri  
(Authors' Collection)**



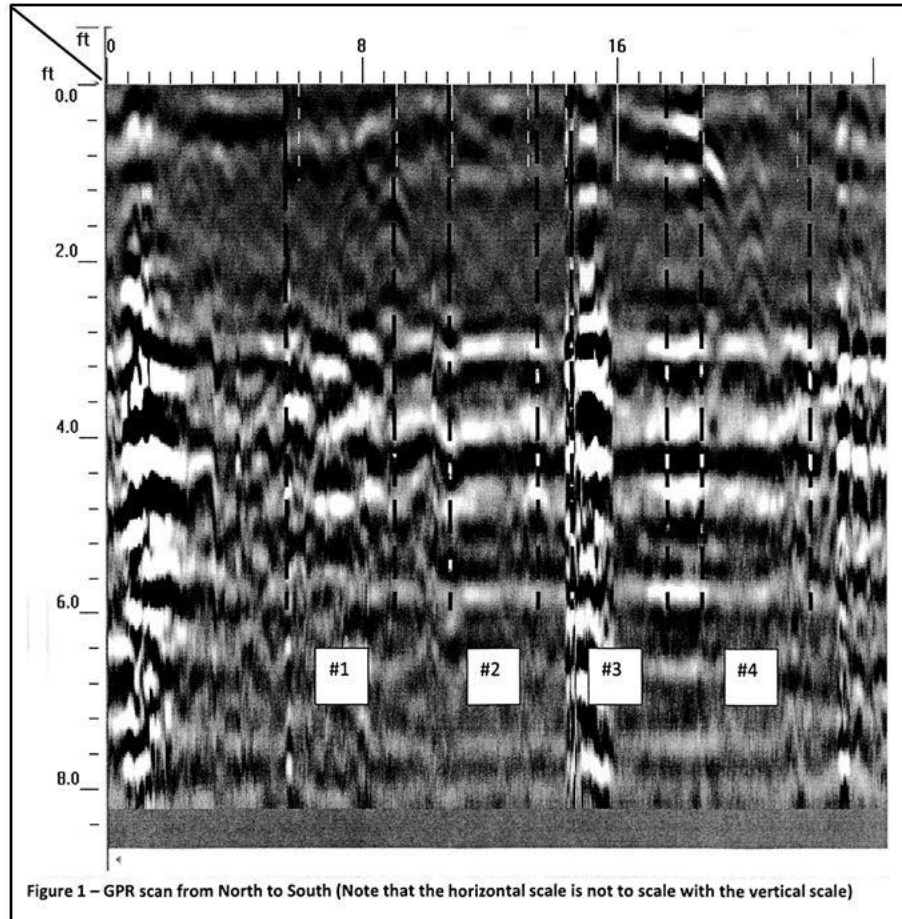
**Terry Jeffries, GPR technician, October 2015  
Surveying Miller Grave Plot**

### **Medical Examiner Released 2012 GPR Report**

On November 30, 2017 a request was made to Dr. Diane C. Peterson, Chief Medical Examiner, Dr. Mary Dudley's successor, for access to the 2012 GPR DeSchepper GPR report. The purpose of the

request was to compare the 2012 GPR findings to the 2014 and 2015 GPR findings for a presentation to the Wild West History Association on the GPR results for the Miller plot. Dr. Peterson released the report.

DeSchepper's report, which was brief, follows. "Based on the GPR scans around the Miller family monument it was determined that there are 4 interpreted graves aligned in the same row." The report contained one GPR image to support his assertions. However, geophysicists with experience in forensics and archaeology have interpreted the image differently. The geophysicist's interpretation of the report indicated only the site marked #1 shows clear evidence of disturbed soils consistent with excavation for a gravesite. The other three areas identified in the report showed no clear indications of a burial. Although it is unknown how DeSchepper arrived at his conclusions, Dr. Dudley justified her decision to cancel the exhumation based on the DeSchepper report.



**GPR Image from 2012 Survey Released by Dr. Diane Peterson, Interim Chief Medical Examiner, Kansas City, Missouri (Authors' Collection)**

Moreover, there is no evidence the gravesite which was to be exhumed in 2012 was ever designated as anyone's gravesite except Clelland D. Miller. Additionally, in 1986, vandals damaged several gravestones in Muddy Fork Cemetery where the Miller gravesite is located. However, the Miller family spire monument, Miller's gravestone and Francis Miller's gravestone are pictured in a photo but they were not vandalized. Today, Francis Miller's marker is missing. Miller's CSA marker, which was installed in 1990, is the only remaining individual grave marker in the Miller family plot in Muddy Fork Cemetery. When the CSA marker was installed, Clelland Miller's original marker, the one in a 1986 photo, was moved and became a footstone marker. Trophy seekers chipped pieces of the gravestone from the original marker, so Miller's next of kin, Ruth Coder Fitzgerald, retrieved the original grave marker and donated it to the James Farm Museum where it is displayed.

The names Moses W. Miller, Sr., (Miller's father), Francis Miller and Clelland D. Miller were inscribed on the base of the Miller spire monument which stands as the family plot marker. Emeline Miller's name was inscribed on the spire. Although their names were inscribed on the sides of a family spire, inscriptions on this type of monument do not always reflect the location of the gravesites around the spire. However, provided Christian religious burial traditions were observed when the bodies were interred, Miller's head would have been placed at the west end of the gravesite with his feet at the east end.

Although Clell Miller's suspected gravesite location is in a family plot with multiple family members and may or may not have GPR characteristics indicative of a gravesite, research supports Clell Miller's gravesite is located in the

Miller family plot in Muddy Creek Cemetery.<sup>33-35</sup> Technicians who are experienced in interpreting GPR data in industrial settings may be inexperienced in interpreting data from gravesites which may lead to false conclusions. Identifying the position of rebar in a concrete floor or searching for underground tanks differs greatly from interpreting data for locating gravesites in forensic cases, especially historical gravesites more than one hundred years old. Thus, when investigating some gravesites using GPR data, it may be necessary to consult with an experienced geophysicist. A geophysicist can examine and interpret data collected more critically in establishing an accurate assessment of the data.

If the exhumation had been completed after the court issued the order, perhaps an exhumation could have resolved unanswered questions about the remains interred in Muddy Fork Cemetery and resulted in closure for the Miller family. One way to determine without doubt would be to excavate the gravesite since there is no GPR evidence of four graves as reported by Dr. Dudley. Misidentification of Chadwell and Miller at the time of their death and Dr. Wheeler's statements reported afterwards in newspapers raise serious questions about who was interred at Muddy Fork Cemetery in November 1876. Even though there are multiple graves in the Miller plot and interpretation of the GPR data in this case was not conclusive, the researchers believe a body is interred beneath Clell Miller's CSA marker. However, the identity of the person in the gravesite remains unknown.

### Acknowledgements

The authors express their gratitude to Dennis Garstang for assisting in this research by personally meeting with the Medical Examiner's staff in Kansas City to discuss the Miller case. Also, they are grateful to Ron Crowson, geologist with Geo Solutions Limited, Inc., Raleigh, N.C., who provided instructions and the procedure for surveying the gravesite. Most importantly, the authors appreciate Dr. Diane C. Peterson, forensic pathologist and interim Chief Medical Examiner, Kansas City, Missouri, for releasing the September 27, 2012, GPR report.

### Endnotes:

<sup>1</sup> "Bill Chadwell: A Lady in Kansas Gives Some Account of His Life," *Pioneer Press and Tribune* (Saint Paul, MN) September 29, 1876, 2.

<sup>2</sup> "Jugged Jayhawkers," *Pioneer Press and Tribune* (Saint Paul, MN) September 28, 1876, 2.

<sup>3</sup> "The Missouri Banditti," *Freeborn County Standard* (Albert Lea, MN) October 12, 1876, 1.

<sup>4</sup> "The Northfield Tragedy of Sept., 7: The Two Robbers Shot in the Bank Raid," *Rice County Journal* (Northfield, MN) 14 September 14, 1876, 1.

<sup>5</sup> "Northfield's Sensation," *Minneapolis Tribune* (Minneapolis, MN) September 8, 1876, 1.

<sup>6</sup> Newton Person, Personal Diary, (Northfield, MN) Northfield Historical Society Archived Documents, September 7-9, 1876.

<sup>7</sup> Authors' Note: One medical examiner investigator said Mr. Robert Thompson, the cemetery caretaker removed the Miller spire monument from the cemetery and repaired it in his workshop. Mr. Thompson told researchers the point of the Miller spire fell off its base on one occasion either from a gust of wind or from a lawn mower bumping the base of the monument. He set it back on its base. Thompson said he never removed the marker from the cemetery or repositioned any of them from their original location. A medical examiner investigator alluded to vandalism in the cemetery and possible tampering with the location of Miller's marker. According to "Vandals Invade Muddy Fork," *The Kearney Courier* (Kearney, MO) September 11, 1986, 1, the cemetery was vandalized; however, the Miller gravesite was not among the markers damaged.

<sup>8</sup> Authors' Note: Research team volunteering time and lab services included: Dr. James A. Bailey, coordinator; Dr. Douglas Scott, archaeologist; Dr. Reza R. Gerretsen, physical anthropologist; Dr. Gil Brogdon, radiologist; and Thomas Reynolds and Shelley Johnson, both DNA Specialists. Another member on the team was Ruth Coder Fitzgerald, next of kin to Clell Miller. Dr. Mary Dudley wanted to participate in research and offered to provide portable x-ray equipment at the exhumation site. Now deceased are Ruth Coder Fitzgerald and Dr. Gil Brogdon.

<sup>9</sup> Kevin M. Smith, "Finding an Outlaw," *The Kearney Courier* (Kearney, MO) 6 July 2012, n.p.

<sup>10</sup> Kevin M. Smith, "Clay County Prosecutor Asks to Dig Up Kearney James Gang Member," *The Kearney Courier* 13 August 2012, n.p.

<sup>11</sup> Glenn E. Rice, "Remains Will be Exhumed to See if They are Those of 19th Century Outlaw," *The Kansas City Star* (Kansas City, MO) 13 September 2012, np.)

<sup>12</sup> Authors' Note: The Jackson County medical examiner had jurisdiction in this case because medical examiner services were provided to Platte, Cass and Clay Counties on a contractual basis.

<sup>13</sup> J. A. Bailey and M. B. Bailey, "Clell Miller Exhumations Postponed," *Wild West History Association Journal*, October 2014, Vol. 7, No. 5, pp. 1-12.

<sup>14</sup> Authors' Note: Dudley, email to J. Bailey, September 1, 2012. "Mike, Tom, Robert Thompson, and the operator of the GPR went to the gravesite yesterday and identified 4

graves to the east of the monument. There is no record of which individual is Clell of these 4 graves. Also, 3 of the 4 bodies would match DNA from the Miller bloodline, if one of the bodies were that of Clell. I do not have court permission or desire to exhume 4 bodies at this gravesite given our new information from the GPR.”

<sup>15</sup>Authors’ Note: Dudley, email to J. Bailey, September 20, 2012. “I do not want to promise to share any reports at this time until we have a chance to review the results and discuss the project here first.”

<sup>16</sup>Angi M. Christensen, Nicholas V. Passalacqua, Eric J. Bartelink, *Forensic Anthropology: Current Methods and Practice*, (New York: Elsevier Publisher, 2014) pp. 19-115.

<sup>17</sup>J. A. Bailey, G.B. Brogdon and Brandon Nichols, “Use of Craniofacial Superimposition in Historic Investigation,” *Journal of Forensic Sciences*, 2014, Vol. 59 No. 1.

<sup>18</sup>Michael J. Thali, M.D., Mark D. Viner, B.G. Brogdon, editors, *Brogdon's Forensic Radiology*, 2<sup>nd</sup> Edition (Boca Raton: CRC Press, 2011) pp. 211-241.

<sup>19</sup>Robert J. Muckle, *Introducing Archaeology*, 2<sup>nd</sup> Edition (Toronto, Canada: University of Toronto Press, 2014) pp. 71-88.

<sup>20</sup>John M. Butler, *Fundamentals of Forensic DNA Typing* (New York: Elsevier Publishers, New York, 2010) pp. 99-205.

<sup>21</sup>“Doc was a Shooter,” *Bismarck Daily Tribune* (Bismarck, North Dakota) 26 March 1902, 3.

<sup>22</sup>W. F. Schilling, *My First Eighty Years* (Northfield, MN: Mohn Printing Company, 1952) 143.

<sup>23</sup>Peg Meier, “What Really Happened to Clell Miller's Body? Just When You Thought You Knew the Story of the James-Younger Gang's Failed Northfield Bank Heist in 1876, Along Comes an Old Letter--and a New Twist in the Tale,” *Star Tribune* (Minneapolis, MN) 7 September 2009, E 1.

<sup>24</sup>Authors’ Note: J. Bailey and M. Bailey met with Kurt Schamberger at Muddy Fork Cemetery on September 22, 2014 and observed the GPR survey of the Clell Miller grave plot. Soil maps for Clay County, Missouri indicate low soil conductivity.

<sup>25</sup>Wallace Wai-Lok Lai, Xavier Dérobert, Peter Annan, “A review of Ground Penetrating Radar application in Civil Engineering: A 30-year Journey from Locating and Testing to Imaging and Diagnosis,” *Independent Nondestructive Testing and Evaluation Journal* Vol. 96, 2018, 58-98.

<sup>26</sup>C. S. Bristow and Harry M. Jol, editors, *Ground Penetrating Radar in Sediments* (Bath, UK: Geological Society Publishing House, 2003)10-24.

<sup>27</sup>Stephen J. Yerka, Joanne B. Devlin, and Nicholas P. Herrmann, “Multi-Instrument, Geophysical Surveys of Buried Human Remains in East Tennessee,” Proceedings of the 65<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences; February 18 – 23 Washington, DC. Colorado Springs, CO: American Academy of Forensic Sciences, 2013:393-394.

<sup>28</sup>Sabine Fiedler, *op.cit.* 380–385.

<sup>29</sup>*Ibid.*

<sup>30</sup>Erica Carrick Utsi, *Ground Penetrating Radar: Theory and Practice* (Oxford, UK: Elsevier Publishing, 2017) 5-11.

<sup>31</sup>William Johnson, “Geophysical Detection of Graves – Basic Background and Case Histories from Historic Cemeteries,” Report submitted to Council for West Virginia

Archaeology Spring Workshop, Charleston, West Virginia June 7, 2003.

<sup>32</sup>Authors’ Note: J. Bailey and M. Bailey met with Kurt Schamberger at Muddy Fork Cemetery on October 2, 2015 to assist in setting up the grid for the GPR survey of the Clell Miller grave plot.

<sup>33</sup>Authors’ Note: GPR surveys have been used successfully in locating graves; however, in James A. Doolittle’s study, “The Search for Graves with Ground-Penetrating Radar in Connecticut,” p. 941, he noted, “GPR identified graves where they did not occur while failing to identify graves where they did occur.”

<sup>34</sup>Dennis Dirkmaat, editor, *A Companion to Forensic Anthropology* (West Sussex, UK: Wiley-Blackwell, 2012) 88-96.

<sup>35</sup>Sabine Fiedler, Bernhard Illich, Jochen Berger, Matthias Graw, “The Effectiveness of Ground-Penetrating Radar Surveys in the Location of Unmarked Burial Sites in Modern Cemeteries,” *Journal of Applied Geophysics* 68 (2009) 380–385.