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CASE REPORT
CRIMINALISTICS

Michael D. Clark,[1] *M.Sc.*

Toolmark Identification of a Mattock to a Clod of Soil from a Grave

ABSTRACT: At a recent bushland gravesite that contained a deceased male, a clod of soil displaying a striated toolmark was collected during the excavation of the grave. This clod was preserved, and the mark was cast using Mikrosil™. Shovels and a mattock, which had been discarded by the suspects, were subsequently found at another location. A toolmark comparison identified the hoe end of the mattock head as having produced the striated toolmark.

KEYWORDS: forensic science, toolmark comparison, toolmark identification, soil, gravesite examination, forensic geotaphonomy

Toolmark identification as defined by the Association of Firearm and Toolmark Examiner's Glossary is a discipline of forensic science, the primary concern of which is to determine whether a toolmark was produced by a particular tool (1). As a result, toolmark examiners routinely compare tools (such as screwdrivers, pliers, wire cutters, and bolt cutters) to items (such as casts of damage to door jambs or damaged door knobs, wire, and padlocks). The purpose of the comparison is to either exclude or identify a particular tool as having caused the damage to a particular item. This is achieved by comparing individual characteristics in the form of impressed or striated marks in the exhibit toolmark to test marks made by the tool. These individual characteristics result from random and unique macroscopic and microscopic features present on the surface of the tool, formed incidental to the manufacturing process and through subsequent use, damage, and corrosion. If there is a sufficient quality and quantity of marks present in the toolmark for a comparison, only the responsible tool will provide matching marks.

Occasionally, a toolmark examiner may be required to compare atypical toolmark substrates, such as bone (2) and plant branches or stalks (3). On this occasion, a clod of soil was located within a gravesite. This clod displayed a potential toolmark suitable for a comparison with any located tools.

This forensic examination falls within the realms of both toolmark identification and forensic geotaphonomy. Geotaphonomy involves the study of the geophysical characteristics of and changes in subterranean features associated with the interment of buried objects (4). Forensic geotaphonomy applies this study toward the recovery of evidence from clandestine graves or other crime scenes with buried evidence (5). In forensic geotaphonomy, impressions and abrasions in the soil matrix assist in the investigation into gravesites and can provide information with regard to tools used, timing, and possible suspects (5). This investigation concentrated on the comparison of several tools to a toolmark within clay.

[1]Ballistics Unit, Scientific Section, Forensic Services Branch, Queensland Police Service, 200 Roma Street, Brisbane, Qld 4000, Australia.

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Background

The body of a deceased male was located in a grave in southeast Queensland, Australia, after having been buried the previous day. During daylight the following day, the grave was carefully excavated during which a clod of soil of approximately 19 cm × 13.5 cm × 11.5 cm in dimension was removed and observed to contain striations on one face of the clod (Fig. 1). This clod of soil was subsequently packaged and transported to the laboratory.

Suspects for the homicide were shortly apprehended with one suspect nominating the location of the tools that had allegedly been used to dig the grave. After police divers had searched the nominated river, two shovels and a mattock were located. These were forwarded to the Scientific Section for examination.

FIG. 1—*Clod of soil recovered from gravesite depicting striated toolmarks.*

FIG. 2—*Striated toolmark present on one side of clod.*

FIG. 3—*Mattock recovered from river.*

Results and Discussion

The day following the collection of the clod of soil, a cast of the area displaying the toolmark damage was obtained using the casting medium Mikrosil™ (Kjell Carlsson Innovation, Sundbyberg, Sweden). This was carried out to preserve the evidence and to allow a future comparison with any recovered tool. Close-up photographs were also obtained as another means of preserving the evidence (Fig. 2). This was necessary as it was immediately observed upon removal of the clod from the grave that moisture was evaporating out of the soil and it was uncertain for how long the integrity of the clod would remain before drying out and crumbling.

Upon the submission of the two shovels and the mattock recovered from the river, it was determined that because of the width of the mark depicted in the clod of soil the shovels were eliminated.

The mattock was observed to have a broken handle, and the head of the mattock contained both a hoe end and a pick end (Figs 3 and 4). The hoe end of the mattock showed class characteristics similar to the exhibit mark. Comparison test marks were then carried out by driving the hoe end of the mattock into a slab of modeling clay. The cut was then separated, and both surfaces of the cut were then cast using Mikrosil™.

A Leica DMC comparison microscope (Leica Microsystems GmBH, Wetzlar, Germany) that allows the simultaneous comparison

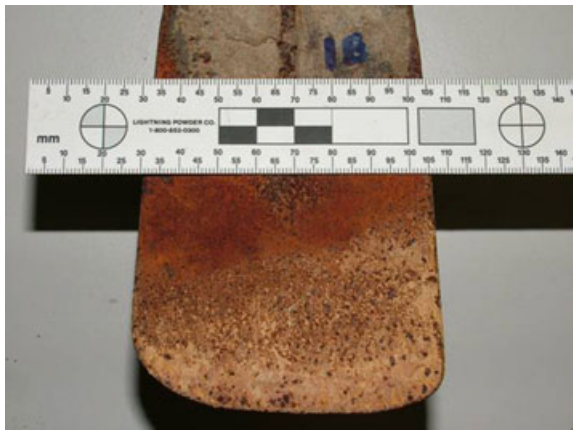

FIG. 4—*Close-up view of hoe end of mattock.*

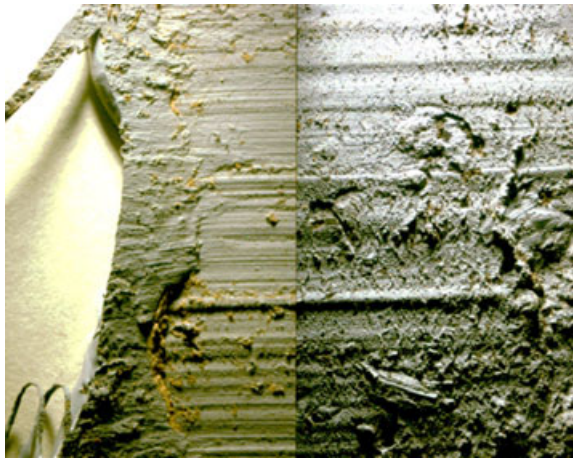

FIG. 5—*Comparison of cast of mark caused by mattock (left-hand side of dividing line) to cast of clod of soil (right-hand side of dividing line).*

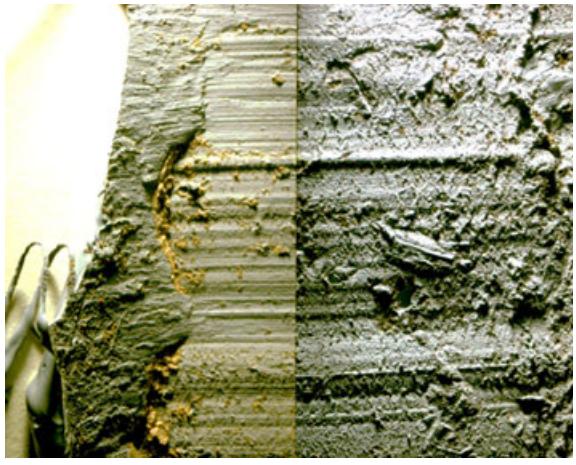

FIG. 6—*Comparison of cast of mark caused by mattock (left-hand side of dividing line) to cast of clod of soil (right-hand side of dividing line).*

of two items was subsequently utilized to compare both the test casts and the exhibit cast. After the comparison of the striated marks depicted in the exhibit cast to those produced by one of the sides of the hoe end of the mattock, it was determined that this tool was responsible for causing the toolmark in the soil (Figs 5–7). Digital

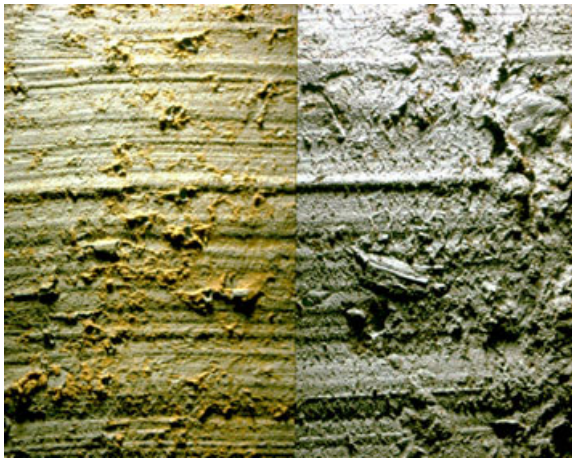

FIG. 7—*Comparison of cast of mark caused by mattock (left-hand side of dividing line) to cast of clod of soil (right-hand side of dividing line).*

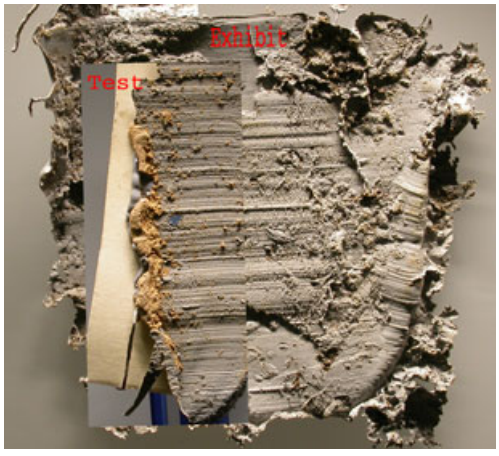

FIG. 8—*Digitial photograph comparison of cast of marks caused by mattock (insert) to cast of clod of soil.*

photographs were also placed side by side to better appreciate the entire toolmark at lower magnification (Fig. 8).

Conclusion

As discussed in this case report, toolmarks may be located within soil during the careful excavation of a gravesite. Mikrosil™ and photographs were utilized to permanently retain these marks before deterioration of the clod of soil and facilitated the positive identification obtained with the suspected tool. The success of a toolmark identification is, however, dependent on the type of soil and the marking ability of a particular tool. Further studies may assist with how long these marks would be retained in the soil over time.

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Additional information and reprint requests:
Michael D. Clark, M.Sc.
Ballistics Unit, Scientific Section
Forensic Services Branch
Queensland Police Service
200 Roma Street
Brisbane, Qld 4000
Australia
E-mail: clark.michaeld@police.qld.gov.au