Forensic Science International 237 (2014) 137–145

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Technical note

Search protocols for hidden forensic objects beneath floors and within walls

Alastair Ruffell [a,*], Jamie K. Pringle [b], Shari Forbes [c]

[a] School of Geography, Archaeology and Palaeoecology, Queen's University, Belfast, Northern Ireland BT7 1NN, UK
[b] School of Physical and Geographical Sciences, Keele University, Keele, Staffordshire, ST5 5BG 1NN, UK
[c] School of Chemistry and Forensic Science, University of Technology, Sydney, PO Box 123, Broadway NSW 2007, Australia

ARTICLE INFO

Article history:
Received 4 July 2013
Accepted 30 December 2013
Available online 11 January 2014

Keywords:
Search
Concrete
Human remains

ABSTRACT

The burial of objects (human remains, explosives, weapons) below or behind concrete, brick, plaster or tiling may be associated with serious crime and are difficult locations to search. These are quite common forensic search scenarios but little has been published on them to-date. Most documented discoveries are accidental or from suspect/witness testimony. The problem in locating such hidden objects means a random or chance-based approach is not advisable. A preliminary strategy is presented here, based on previous studies, augmented by primary research where new technology or applications are required. This blend allows a rudimentary search workflow, from remote desktop study, to non-destructive investigation through to recommendations as to how the above may inform excavation, demonstrated here with a case study from a homicide investigation. Published case studies on the search for human remains demonstrate the problems encountered when trying to find and recover sealed-in and sealed-over locations. Established methods include desktop study, photography, geophysics and search dogs: these are integrated with new technology (LiDAR and laser scanning; photographic rectification; close-quarter aerial imagery; ground-penetrating radar on walls and gamma-ray/neutron activation radiography) to propose this possible search strategy.

1. Introduction

1.1. General background

Concrete, brick and other constructed layers are like hard natural surfaces (mineral crusts, rock) in that they are not diggable [1,2] by either the perpetrator or investigator, making some aspects of established search methodology inapplicable [3]. Such a horizontal hard layer may cover an object in the floor of a building; occur over a pre-existing void (natural collapses like caves; human-made – drains, wells, basements), or an intentionally dug outdoor (soil-based) burial. Brick, blocks and cement may also encase something in the vertical or inclined wall of a structure, again be it excavated for the purpose, or pre-existing (e.g. a chimney flue). Concrete, tiles and brick (for instance) differ from naturally firm ground in that humans can create hard constructed surfaces, providing a specific challenge for the search specialist where only some of the guidelines for the search of soil, sediment [4] and open ground apply: part of the impetus behind writing this work. Common items that may be hidden in, below and behind such hard, made-structures include: human remains (dead or alive when hidden); other organic remains (liquor, animals, some drugs); valuable items (legally owned, but needing to be hidden), stolen goods or contraband, weapons, and explosives. Most common are human remains, often the result of murder/homicide and death from accidents [5] or natural causes.

1.2. Rationale for this work

Although [5–8] indicate that burial locations under floors and behind walls are uncommon, they are often high-profile, may need good planning by the perpetrator, and can be the result of premeditation, especially by serial killers (see review below). Conversely, Hawley et al. [6] state, "Common paving materials ... concrete and asphalt ... pose an unusual and complex barrier to disinterment and examination of human remains. Although not commonly encountered, these materials are seen with sufficient frequency to justify consideration of the procedures and equipment necessary for disinterment". The type of perpetrator and nature of the burial/immurement make such hidden items difficult to detect, another rationale for writing this work. An object hidden behind bricks, in a brick wall, or below concrete slabs amongst

* Corresponding author. Tel.: 00 44 289 097 3407; fax: 00 44 289 097 321 280,.
E-mail address: a.ruffell@qub.ac.uk (A. Ruffell).

0379-0738/$ – see front matter © 2014 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.forsciint.2013.12.036

other slabs, show far subtler lateral variations than in soil or vegetational disturbances for the search team to observe, but as every contact leaves a trace, so movement of materials will leave some impression. In beginning to devise a strategy for the search of such areas, the authors have inevitably compromised between (a) reviewing the literature to extract the most fit for purpose methods and (b) presenting examples of cases studied in order to combine published and unpublished work and develop a preliminary set of possible ways to investigate cases. The work is thus a mixture of background information, published cases and published methods (where available) and the author's own casework, especially where previous studies are unavailable.

Although brick and concrete are known from Egyptian times, the ease of moulding and drying mud has made bricks and clay tiles common building materials through history and pre-history. Bedouins (6500BC) knew how to make concrete, and this technology was used very extensively during Roman times, as the calcium-rich volcanic ash found near Naples in Italy provided a ready source copied elsewhere throughout their empire. British engineers in the 1800s revitalized the making of concrete and began the use of Portland Cement, when some of the earliest stories of burial and immurement start to emerge, although older historic clandestine activities using brick and concrete are possible. As with other developments in forensic science, early suggestions of hiding objects beneath floors and in walls occur in popular literature, such as Edgar Allen Poe's book 'The Cask of Amontillado' [9], in which a person is encased behind a wall alive (immurement). Popular books based on real crimes abound and illustrate the need for some strategy in searching such problematic locations. These range from rumours to actual cases. The former include the possibility that the notorious U.S. Labour leader Jimmy Hoffa is encased somewhere in concrete following his 1975 disappearance. The proven include serial killers such as Fred West (and accomplice, his wife Rose) who buried teenage female victims in their English garden and below the concrete floor of their basement [10]. John Wayne Gacy [11] stands out as one of the best-known serial killers to bury victims below a concrete floor, as Sullivan and Maiken [11] state: "William Carroll was murdered and buried directly beneath Gacy's kitchen. Carroll may have been the first of four youths known to have been murdered between June 13 and August 6, 1976, and who were buried in a common grave located beneath Gacy's kitchen and laundry room . . .John Butkovitch, being found buried beneath the concrete floor of his garage precisely where Gacy had marked the youth's grave with a can of spray paint." The spread of such popular literature, and shrewdness of some perpetrators, has caused immurement and below-floor burial to continue, with cases such as Marc Dutroux (Belgium, buried three persons beneath concrete in 1995–1996); Saeed Qashash (Jordan, hid 11 victims of a mass-shooting behind a brick wall in 1999); Dr. Larry C. Ford (Irvine, Utah, had high grade explosives buried below concrete in his yard, 2000); Ward Weaver (Oregon City, 2004) killed his daughter's friends and buried them beneath concrete; Michael Lock (Milwaukee, 2011), accused of having 3 bodies buried under concrete; Michael Fogt (Hillsboro, Ohio, 2013), placed victim in a barrel and buried below concrete.

Popular stories show the high-profile nature of such burials and hidden materials, reflected in a number of scientific publications concerning burial type and anthropology/archaeology. Congram's work [12] in Costa Rica is a thorough account of the search strategy in woodland for a grave with concrete over the top. As such, this work is more akin to the classic open-ground search strategies devised by [3]. Congram [12] outlines the 10 sites identified and how the third was the grave. The concrete cap broke up on excavation, the biggest problem in recovery being the continual filling of the grave with rainwater. Dedouit et al. [7] found excavation of concrete to be their main issue, with the lifting of concrete slabs being 'unwieldy', their investigation concentrating on the excavation rather than search. Faller-Marquardt et al. [13] faced similar problems in excavating a polymer-bound cement. Such mixes are common in modern concrete and make breaking up of any cap to a grave or burial very difficult. Hawley et al. [6] go further, in outlining the seven cases they have dealt with, each using different cement/concrete mixes, some reinforced with metal rebars, others prefabricated and yet others laid as liquid. Again, their focus is on recovery not detection, although they do comment (p. 105) on how the possible use of X-ray or gamma-ray imaging (methods discussed below) could have advanced their case. Madea et al. [14] describe two cases of victims buried in cellars/basements, with concrete poured over the top. One was discovered following a confession the second after a witness observed the concrete being poured in from a ready-mixed truck.

Preuß et al. [5] provide one of three of the most relevant background publications to this work. They state that "Common methods of dumping are covering (31.4%), dumping (22.3%), burying (21%), leaving in lonely places (14.2%), concealing in boxes, fountains or caves (8.2%), dismemberment (7%) and combusting (2.9%) ... exceptions ... are dissolving in chemicals, feeding to animals, cannibalism and sealing with concrete and/or bricks.". However [5], do not provide the actual number of victims used to calculate their percentages. Their cases include the two included in [14] and a third that is similar (a cellar filled with concrete). Their Case 4 concerned a concrete-filled trough, flush to a wall, wherein the decomposition smell permeated an adjacent basement, leading to discovery. Case 5 was a body bricked up behind a basement staircase, found by cadaver dogs and their Case 6 concerned a burial in a garden (covered with concrete), discovered following inconsistencies in the suspect's story. The second most relevant work is that of Toms et al. [15], who recorded 5 deaths in 18 years in the Los Angeles police authority area where concrete had been used to cover the victims. One of their cases was an accidental discovery, the other four were from admissions and tip-offs. The investigators used metal detectors and X-ray imaging to define their excavations, but knew from the above information where the victim (if any) would likely be. The third work considered here is by one of the authors [16], who presented results of a simulated clandestine burial of a murder victim under domestic concrete patio slabs in an outdoor semi-urban environment (Fig. 1a and [16]). The pig cadaver was repeatedly surveyed using geophysics over a 2 year monitoring period every three months, using 110 MHz, 225 MHz, 450 MHz and 900 MHz frequency ground penetrating radar (GPR) antennas. An indistinct ½ hyperbolic reflection event was observed in the 110 MHz frequency 2D profiles throughout the study period over the animal cadaver, with it becoming progressively harder to detect (Fig. 1b). Clear ½ hyperbolic reflection events were imaged by 225 MHz and 450 MHz frequency 2D profiles up to 12 months after burial, after this period results were more indistinct. From 18 months post-burial to the end of the study a horizontal reflection event was observed over the animal cadaver (Fig. 1b). This was suggested to be caused by an air gap underneath the patio, caused by compaction of the grave soil, with a slight surface depression in the patio slabs also observed. This air gap was suggested to be an important target for forensic search teams if a suspected burial was more than 18 months old. This has also been observed in GPR 2D profiles over older shallow grave vaults (covered with horizontal stone slabs) in UK graveyards and cemeteries [17]. A ½ hyperbolic reflection event was observed in the 900 MHz 2D profiles throughout the study but it would be difficult to differentiate this anomaly from the other non-target anomalies also present in the datasets (Fig. 1b). Potential forensic geoscience detection elements are summarized schematically in Fig. 1c.

In summary, whether human remains, explosives, drugs or other items behind a wall, in a covered cellar or beneath a stone,