PLANNING THE ARCHAEOLOGICAL RECOVERY OF EVIDENCE FROM RECENT MASS GRAVES

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Summary

Mass graves commonly contain hundreds of putrefying bodies, which bear evidence of torture and extrajudicial execution. These require careful excavation using archaeological techniques to recover the bodies for identification and to obtain associated evidence which document human rights abuses. In order to derive forensically defensible conclusions, exhumation of a mass grave may take weeks or months. Specialized protective suits and breathing apparatus will permit the investigating team to take the time required to retrieve even subtle evidence from repellant remains. Strategies for sampling tissues and bodies which reduce the magnitude of the recovery operation are described.

Key words: Mass graves; Torture; Forensic archaeology; Protective suits

Introduction

Techniques for controlled recovery of forensic evidence from a mass grave are described in this paper. Accumulations of bodies have occurred through (a) volcanic mudflows as in Columbia recently where 23 000 perished [1], (b) collapse of apartment buildings, as in the Mexican earthquake [2], (c) serial murders [3] and (d) deliberate inhumation of victims of extrajudicial torture and execution [4]. According to one recent report on actions by the previous military government of Argentina, “Government authorities have discovered mass graves in cemeteries all over the capital (Buenos Aires), and in Cordoba Province diggers uncovered the remains of 700 corpses” [4]. In one northern suburb, 300 more corpses were found in 1 week. The scale of human dying can be overwhelming, as in the “killing fields” of Kampuchea [5,6]. Is there a point where the “illegal disposal of the dead” [7] must be left uninvestigated?

Apparent reluctance to apply controlled recovery techniques to mass graves seems to prevail. The biggest obstacle perhaps is the potentially appalling state of the remains; who is prepared to climb into a mass grave time after time to make the necessarily acute forensic observations of, for example, whether a
rotting cloth remnant is a blindfold, a ligature round the neck or just a neckerchief? The homicide in Texas of many young boys by Dean Allen Corll is typical of various pressures that develop in a mass grave situation:

Because of tremendous public interest and curiosity, large crowds accumulated, including television and press personnel. Since security became a major problem, the police used this as an excuse to remove the bodies as quickly as possible—so care was sacrificed for haste. No archaeologists were consulted and no archaeological techniques were used. At first, convict volunteers were employed in the digging. Since many became ill on account of the odor, a back hoe was used and later a bulldozer [8:324].

There is only one (unpublished) account of careful investigation of a mass grave situation: George Fully's 1955 Doctoral dissertation entitled (in translation): "The identification of the skeletons of the dead deportees in the German concentration camps". He emphasized the need for archaeological techniques to recover the bodies [9].

The purpose of this paper is to anticipate the specific problem of recognizing and collecting forensic evidence from a mass of actively decomposing bodies. Emphasis is placed on victims of state torture and secret disposal. The nature of forensic evidence encountered in a mass grave, particularly where torture may be suspected, is discussed in light of time constraints. An organizational framework is provided with summaries of equipment, personnel and procedures. The specific contribution that archaeological recovery techniques can make is described with modifications of "dry bones" archaeological methods for meticulous exposing and making observations in situ of decomposing bodies. Lastly, sampling strategies for tissues and bodies that help limit the recovery problem to manageable proportions are considered. Those authorities are addressed whose cooperation is required to ensure proper recovery of the bodies with associated forensic evidence, and archaeologists asked to participate as forensic investigators. It is proposed that, instead of despairing that a mass grave is too big, smells too bad and takes too long to deal with, we should develop procedures that will work.

Mass Graves, Physical Evidence and Torture

A mass grave contains at least half a dozen individuals. Unlike a multiple burial, a mass grave contains bodies that usually have been placed indiscriminately and tightly together with no reverence for the individual. Related methods of disposing of awkward dead are "body dumps" (James Welsh, pers. comm.) and the "secret cemetery" [10]. A mass grave may contain as many as 700 bodies and mass graves themselves may be numerous [4,6]. Snow has described the typical mass grave as being in a remote location to which the victims were brought alive and executed with attempts to make identification of the body and grave site impossible [11]. Charles Warren is a physical anthropologist experienced with processing large numbers of bodies from the field. Some American and allied military personnel killed in major engagements in...
the Philippines during World War II were buried by Japanese in unmarked trenches excavated by bulldozer [12]. Warren describes one of several brick and clay mounds inside the walls of the Citadel of Hue City in Vietnam which contained seven incomplete skeletons [13]. He remarks that physical anthropologists employed in military identification laboratories where large numbers of war dead are processed have written little about their experiences [14]. In 1985, forensic scientists sponsored by the AAAS Committee on Scientific Freedom and Responsibility directed a 5 week workshop in Argentina on the identification of human skeletal remains; in response to the belief that most of 9000 "desaparicidos" were buried in mass graves [4,15].

Four fundamental varieties of physical evidence can be obtained from a mass grave. The first two of these – evidence of identity and when death occurred – are familiar if difficult questions to the death investigator. The other two – evidence of premortem, perhaps prolonged suffering, and cause, manner and mode of death revealed by perimortem traumata – assume a new significance in torture victims interred in a mass grave.

The archaeologist, and those involving him at the grave site, must acknowledge that his methods and observations form an integral preliminary to a complete autopsy which will in great part determine the forensic resolution of the case. The role of the forensic archaeologist should be viewed, not as a useful but inessential service forensically less significant than the pathologist's well-respected contribution, but as part of a coordinated team approach to complex crime scene investigation.

There is a growing mystique about our ability to identify large numbers of people from mass disasters. Certainly in air disasters with a closed population – crew and passenger list – and victims from social classes most of whom see dentists fairly regularly, many if not all get identified due to the dedicated efforts of forensic odontologists [17,18]. With mass graves it will be more difficult to obtain identifications. Charney and Wilber observe that in the Big Thompson flood, 65% of the identifications were made from physical features like ear shape, hammertoes, and fractures, rather than dental records [19]. They go on to note that perhaps only 40% of the American public see a dentist. In Third World countries, the proportion will be much less. Therefore, in obtaining identifications from mass graves, we cannot place our faith on resecting jaws and discarding the noisome rest. The entire body will have to be scrutinized and recovered where possible.

According to Amnesty International more than a third of the world's governments during the 1980s used or tolerated torture or ill-treatment of prisoners [10]. For example, the Buenos Aires Bar Association of Argentina has stated (1982) that "The existence of torture as a system of police investigation is a notorious and indisputable fact" [10:144]. Torture is the infliction of mental and/or physical suffering for the benefit of the operator or an authority for whom he acts [16]. Torture of the mind and torture techniques that leave little effect on the body will be difficult or impossible to demonstrate. "There is no test that is so specific as to determine positively that a given mark or symptom
is the result of a particular act of torture” [10:92]. Because the body tends to heal itself, the profound behavioral and neurological disorders attendant upon torture cannot easily be "proven" to have been caused from torture. This is why dead bodies are so important forensically. Prior to severe decomposition, the soft tissues can preserve mute testimony to torture so severe as to lead to death. Even in advanced decomposition, there may be hard tissue evidence, such as fractures and objects with the bodies, which strongly suggest torture was inflicted before death.

The distinction to be drawn between premortem and perimortem trauma (that associated with death) is analogous to the problem of injury interpretation in dead, battered children. It is important forensically to know whether there was only one episode or repeated abuse to the individual. The case of death may be only an intensification, perhaps accidental, of a prolonged torture technique. Alternatively, these varieties of evidence may be very different; e.g., a victim may have been tortured, allowed to recover physically, and then shot at the grave site.

Not only should torture be substantiated, it may prove possible to link particular perpetrators of torture with specific evidence from a mass grave situation through a process known as “fingerprinting the cognitive style” [from Cunningham, 1970 cited in 16:305]. This relies on correlating physical evidence, from the mass grave, of consistently damaged anatomical areas (e.g., genitals), variety of injury (e.g., cigarette burns), and associated objects (e.g., garotte), with reported behavioral patterns of specific interrogators. The point is that physical trauma will have to be carefully observed, collected, preserved and interpreted if forensically defensible conclusions are to be drawn.

Most archaeologists will need assistance to evaluate decomposing soft tissue evidence as it is encountered. The archaeologist will not likely be cognizant of techniques of interrogation that employ ill-treatment or torture and their sequelae produced on the soft and hard tissues. Nor will he be familiar with torture apparatus that may accompany the body. Figure 1 illustrates evidence that those exhuming murder victims from a grave might encounter. The subtlety and significance of certain evidence should be appreciated. For example, bone erosion from severe bed sores is best substantiated by documentation of anatomical change in specific pressure prone localities in individuals who are bed or chair fast [20]. Even in the absence of overt signs of physical abuse, such bone erosion can indicate identity, time spent in incarceration, and certainly less than adequate institutional care. Torture techniques commonly do not mark the body. However, persons dying under torture are less likely to have such evidence of torture (e.g., plugs up nose in "water treatment") removed from the body. Some torture techniques may mark the body sufficiently to be noticeable although the evidence will be subtle. Electricity may be applied to sensitive body parts such as genitals or soles of the feet. Placement of electrodes can be indicated by the formation of small scabs [10, cf. 21]. Guatemalan torture victims report the use of quicklime inside an inner-
Fig. 1. Typical evidence associated with torture victims, murder victims, and others disposed in burial situations. A: soft tissue evidence; B: hard tissue evidence and objects. (Source: A: clockwise from 'ear cut off' - 21, 22, 23, 22, 24, 25, 26, 27, 25, 7, 25, 25, 21, 25, 28, 28, 28; B: clockwise from 'ice pick' - 23, 21, 22, 25, 23, 22, 6, 22, 23, 25, 28, 7, 29, 13, 23, 22, 20, 30, 22, 29, 22, 31, 6, 23, 28).
tube. In Syria a heated metal skewer that inserts into the anus of a bound victim has been used. Police from India are reputed to have inserted bicycle spokes into eyeballs and wrapped acid-soaked pads over the eyes. Jaws have been dislocated by beating (Angola), needles pushed under nails (Rwanda), teeth pulled out (South Africa), naked victims exposed to the sun (Zaire), hot pepper inserted into body orifices (Tanzania), insecticide placed inside a hood (Guatemala), hair pulled out (Bangladesh), and beetles placed under a cup on a victim's stomach (Libya) [10]. Practices such as these should make anyone, including the forensic archaeologist or pathologist, who has the responsibility for collecting evidence of torture very careful indeed. Only complete and careful evidence recovery techniques will allow conclusions to be drawn with confidence. Interpreting motive can be aided by noting the presence or absence of evidence; e.g., jewellery known to have been worn by the victim [23]. Is anatomical absence (nails missing) or anatomical displacement (limbs reversed) due to perimortem trauma or recovery damage? Is a rope fragment tied around one leg or two, or is it from a tied bag used to transport the body?

The contribution that archaeology makes to forensic investigation is the application of detailed mapping procedures and careful excavation and location recording of buried or surface evidence. Knowing the spatial relationship between items allows one to interpret the significance of juxtaposition (e.g., hands tied behind the back [23]) and the sequence with which items were buried (e.g., which body entered the grave first). In addition to offering a degree of control over time and space relationships within or between sites, careful archaeological recovery helps one to establish the number of buried individuals (for example, from congruence of anatomical joint surfaces in dismembered bodies [44]). In a Michigan homicide of a young woman who died of gunshot wounds to the head, a sanitary tampon was found inside the pelvic area indicating probable lack of sexual molestation [22]. Smith reports the identification of a round worm parasite, from the abdomen of a murder victim buried in a garden, which escaped into the grave soil [30]. Identifiable stomach contents indicating likelihood of identity and elapsed time between consumption and death could preserve in a mass grave situation [22]; for example, rumen contents and most soft tissue survived in a goat buried for three years in damp soil in Vancouver. Various objects indicative of identity can be expected (e.g., clothing, glasses) [23].

The personnel utilizing archaeological techniques do not have to be archaeologists. However, the excavator should be thoroughly trained in deriving information from the human skeleton. There are a number of excellent guides to archaeological field procedures [42,43]. It would be superfluous to review their contents here. Several articles advocate the application of specifically archaeological expertise in forensic contexts [8,12,26,29,34,38,39,40]. One book deals exclusively with techniques for enhanced recovery of recently skeletonized human remains from the field [41].
Organization

The archaeologist's role is to expose the bodies so as to obtain information on identity, cause, manner, and mode of death, and time of death. Specifically there is the responsibility to search for indications of premortem and peri-mortem torture and homicide; evidence which may be lost with subsequent removal and handling of the body and associated evidence. The subtlety of this evidence has already been stressed. The archaeologist will want to be careful because almost certainly, if there are legal proceedings, he or she will have to testify. The subject matter—torture, homicide by the state, and illegal disposal of the dead—is awesomely serious and demands at least the care archaeologists customarily give to excavating their nation's heritage.

There is a danger that, because the archaeologist initiates the collection of primary data from a mass grave, he or she will be expected or may expect to oversee the general operation. This will not work. Time and again investigators of mass disasters have deplored poor organization and called for an integrated team approach [19] where each member understands his or her exact role and function, knows to whom he or she is responsible and others whose efforts can be directed [31]. It is essential that there be a clear chain of command, particularly if more than one jurisdictional area is involved; for example, as could happen in mass grave exhumation by an impartial team of international investigators. Both Charney [32] and Eckert [33] have decried the Tenerife, Canary Islands aircraft accident (1977) as a forensic disaster marked by differing perceptions at the time of what should be done by the Spanish, Dutch and American investigators, and by utilization of primarily inexperienced military personnel to the exclusion of available experienced personnel with the result that apparently some 160 bodies had to be consigned, unidentified, to a common grave. Only pre-planning will avoid this. "Ad hoc-cery" will result in misidentifications of bodies, lack of identifications and more cases which never reach the courts.

Figure 2 outlines one way of organizing the requisite field personnel for mass grave exhumation. A similar grouping of personnel and specialists should be created to collect and coordinate information on the history of missing persons and their suspected fate. Each forensic investigator who handles evidence and who may testify in court should be prepared to answer the following questions: (a) when was your assistance requested? (b) by whom? (c) by what means (e.g., verbal)? (d) what were you told as background? (e) time of arrival at scene? (f) location? (g) personnel present? (h) conditions of weather, light and visibility? (i) actions taken by you?

Facilities

Mass grave exhumation will be a protracted process. Accommodation should be in town, with transportation for personnel laid on, or at the site in
excellent field circumstances; otherwise work quality will suffer. Consultation with disaster planning agencies, such as civil defence, could help enormously. I will assume here that typical field operations have been created at the site; *viz.*, sleeping and eating areas, toilets, and so on, and will restrict my comments to facilities needed for processing the bodies and associated evidence [17,19]. Help should be enlisted at the site to ensure that normal public health
TABLE 1

PHYSICAL SET-UP FOR MASS GRAVE EXHUMATION

1. Overall site security (e.g., fencing, guards)
2. Coordinating office (with communications)
3. Control of labelling area
4. Morgue: body inspection (autopsy)
5. Morgue: body preparation
6. Morgue: body storage
7. Physical evidence (high security) storage
8. Records office (with computer terminal)
9. Field equipment storage
10. Decontamination area for body excavators

practices for obtaining water and disposing of wastes are implemented and pose no threat to personnel or local inhabitants. Table 1 lists the physical areas deemed necessary for mass grave exhumation.

Personnel involved in a situation of this nature should consult with public health authorities about immunization against local health hazards. Specifically, one can receive protection for 6 months through immunoglobulin injections from Hepatitis A (epidemic) which is contracted through contact with a virus found in fecally contaminated waste and food. For personnel handling materials from the mass grave, the primary concern is self-inoculation through the accidental introduction of pathogens from the hands into the mouth or into the bloodstream through puncturing the skin [47]. The former can be avoided through scrupulous adherence to rules of personal hygiene, particularly, of course, wearing gloves. (The matter of glove cumbersomeness will have to be a compromise between the need for protection against piercing the glove's material and sensitivity of touch; e.g., sufficient to handle a pair of tweezers.) The second danger, that of scratching or piercing the skin is taken care of by wearing protective clothing which, of course, has the essential feature of placing a barrier between one's own body and the decomposing bodies. Diseases that one could commonly expect to encounter include polio, diphtheria, tetanus and of course staphylococcal and streptococcal infections. It might be wise to seek protection from typhoid and enteritis.

A major consideration is the degree to which autopsies will be performed in the field. Even were bodies, or body parts, simply being lifted and prepared for transport, forensically important observations will inevitably be made as the bodies are handled. Consequently, a field morgue, comprising inspection, preparation and storage areas (i.e., three rooms), is mandatory. Refrigerated trucks (reefers) or railway cars are suitable for the latter [19]. Ice hockey stadiums or sports arenas with temperature control have been used [17] for air disaster victims. Running water is essential; for example Fisher et al. report that mud-soiled scalp hair appears grey or blonde, with prolonged washing necessary to distinguish dyed or bleached hair [18]. A special decontamination area where
the personnel handling the bodies down in the mass grave can clean their outfits and themselves should be provided apart from the regular wash-up areas. As each body, or body part, is removed from the mass grave it should go to a control of labelling area where the following items are recorded: body identification number, origin within the grave, identification numbers for additional items such as clothing removed afterwards, basic description of body integrity and appearance. A considerable amount of tape-recorded, photographic, written, video-taped and even verbal information about the site and each body will be generated by various investigators. This evidence is the ultimate responsibility of the evidence officer who will have to liaise with an experienced records clerk preferably with data and word processing skills in a records office located on the site. Physical evidence apart from bodies, but always keyed to them or the grave in terms of record keeping, will have to be stored in a high security physical evidence area (with freezer). There will need to be in addition a coordinating office (containing communications and space for consultation with visitors), a secure facility for field equipment storage (both large and small items), and lastly a means of keeping the entire site secure (essential but not at all easy to accomplish). Appendix 1 lists required equipment.

**Procedures**

Basically, exhumation of a mass grave proceeds in five steps: search and discovery, mapping, excavation, evidence processing including bodies, site shut down. Subsequent sections of this paper concentrate on archaelogical excavation procedures and body processing. Table 2 is a checklist of field procedures for exhumation of mass graves.

**TABLE 2**

CHECKLIST OF FIELD PROCEDURES FOR EXHUMATION OF MASS GRAVES

- Aerial photography of site and environs
- Site security (fencing) and protection
- Erection of field facilities
- Procedures for videotaping operation and evidence
- Procedures for handling media and visitors
- Procedures for obtaining supplies
- Site survey
- Site description prior to alteration (with photographs)
- Chronological and personnel log
- Record of necessary alterations to site
- Mapping and sketching of excavation in plan view and section
- Procedures for exposing and handling bodies
- Procedures for exposing and handling associated evidence
- Procedures for cataloguing, describing, photographing, storing evidence
- Arrangement for release and receipt of bodies
- Arrangement for release and receipt of evidence
A. *Finding the mass grave*

This will not be difficult especially since there will be a number of potential informants. There is a comparatively large literature on techniques for finding buried bodies. Remote aerial sensing by means of heat sensitive infra-red camera equipment is recommended by a number of investigators [36,38,39]. Single bodies take some time to cool to ambient temperature. Masses of bodies will take even longer. Within a day or two, with the start of putrefaction from endogenous bacteria and autolytic decomposition, the body will start to heat up again slightly. Dickinson, who describes the technique in detail [36], notes that a dead possum buried 17 days at a depth of 25 cm was observable using an infra-red camera from an altitude of 60 m. However, Duncan [40] reports lack of success in tests of the technique using deeply buried bodies. Buried bodies give off methane gas which can be sensed with Vapor-Tect® equipment [8,27,34]. The metal tube gas detector must have been inserted into the grave directly above the body for gas to be sensed [27]. Dead dogs buried at a depth of 76 cm for 6 months were successfully located using this method [34]. Other ways to find buried bodies include looking for a mound, or alternatively a sunken area of refilled dirt, altered vegetation growth (either reduced, enhanced or different [weed] species) [27]. Duncan [40] provides the most thorough treatment of field search techniques discussing visual search of cultivated land, beaches and deserts. Geberth describes methods of crime scene search (such as strip, spiral and grid methods) which should be utilized even after a buried body or bodies are found with a view to locating further evidence and multiple crime scenes [27].

B. *Establishing spatial control*

Likely the locale of the mass grave will be unfamiliar to the forensic investigators. Aerial photographs may aid in establishing the scale of the problem, alternative routes to the site, sources of supply, and so on. Such an overview, taken prior to excavation will be very useful for communication to the court [27]. The first element of spatial control is site security [35]. The object here is to be able to assure relatives and the court that no unauthorized persons had access to the evidence such that it was added to, altered, or removed. Site security is an aspect of “chain of custody” or “continuity of evidence” [41]. A proper high security fenced area with lockable gates guarded by people and/or dogs should be created around the mass grave for the duration of the exhumation, since public interest and media coverage are likely to be intense. A site security officer should keep a log of all important events, such as the finding of significant evidence, and the coming and going of all identified personnel and visitors to the site [27]. Geberth describes various agents which are guaranteed to contaminate crime scenes: weather, relatives and friends of the deceased, suspects and associates, souvenir hunters, and finally other police personnel. In a long term project such as mass grave exhumation the problem of scene integrity is simply prolonged.

The next step is to map the area which contains evidence and is to be
excavated. Mapping is done over large areas to show site location and size, and over a small area— the site itself—to pinpoint relationships among items of evidence and bodies. Mapping is a straightforward process familiar not only to archaeologists but also to forensic and mass disaster investigators. Le Cheminant [37] describes large scale surveying procedures.

C. Archaeological handling of evidence from mass graves

One may imagine a large pit about the size of a dug-out for watering a herd of cattle, filled with bodies and covered with dirt to form an obvious mound. At its worst, a mass grave will be repugnant. I can see no solution to having to see, moreover examine closely, and physically handle the decomposing corpses. Without some means of reducing the mass grave environment to a form acceptable to the senses, proper recovery of bodies and observation of forensically significant associations will not come about. It is possible, however, to avoid breathing the smell of putrefaction and to avoid skin contact, through the use of breathing apparatus and protective clothing [46] which are described in Appendix 2. In addition, equipment for recording observations despite one's mouth and hands being covered is proposed (Appendix 1). Personnel using archaeological techniques of body recovery should avail themselves of sophisticated “hazardous materials” protective gear. Assuming that basic elements of site description have been accomplished and spatial controls established, the first step is to test the thickness, compaction and nature of overburden by hand trenching or test pitting. This should disclose the margins of the grave proper. Damage to the bodies may have resulted from the crushing weight of further bodies, dirt and heavy equipment passing to and fro. Obviously, exposing the bodies is a major task. My recommendation is that the entire overburden be removed by hand with help from a long-necked power shovel whose body weight lies outside the area of the mass grave. As the bodies are reached personnel will have to descend into the pit to complete exposing each body with its associated evidence.

The archaeologist will encounter evidence of three basic varieties: body materials, objects and impressions [27]. When two or more items of evidence occur together in a single individual, that fact, the nature of the association, and just what things are associated must be carefully recorded. Even archaeologists improperly dissociate bones and artifacts without recording the fact of association. Warren has strongly warned about the irreparable harm done in field operations when bodies and associated identifying materials become separated [45]. Indeed, he feels that “field examination can serve no useful purpose” [45:191]. This judgement is too harsh for it ignores the fact that field recovery inevitably affects the evidence and proper recording procedures must be instituted from the beginning.

Each separate set of remains, recognizable as a portion or all of an individual, should be assigned a field number, in consultation with the evidence officer. Objects or further body parts felt to be associated with that individual
should receive the same number prefix followed by its own unique number. Each numbered body object should be tagged or labelled and this number entered in a previously prepared “evidence catalogue” [37]. The evidence catalogue should record item number, item location (in three dimensions), item description, and a space for comments and caveats (e.g., association with other objects or bodies). Potentially important objects should be photographed in situ, in black and white and colour, with and without a scale and catalogue number.

Personal experience suggests that where partially-fleshed skeletons are involved a forensic anthropologist and forensic pathologist should work side-by-side, exposing and examining the remains. The pathologist will be able to recognize tissues suitable for special preservation and testing (e.g., for drugs). The orientation of the body and limbs should be recorded. As the body is further excavated for removal, observations should be made of the number, size, location and nature of wounds. Fragile clothing should be examined for tears that may correspond to wounds, before the body is removed. The hands should be paper bagged to preserve fibre evidence under the nails. A running description of what is seen, and thoughts that occur, should be tape-recorded for transcription.

There should exist an attitude towards the recovery of evidence from mass graves that will encourage all personnel concerned to take sufficient time to recover the evidence. Consider how long it takes to solve just one murder. If a pit contains 250 bodies, it means in effect 250 homicide cases, 250 scenes of crime, 250 court cases; not one collective event. As Geberth reiterates: “Do it right the first time. You only get one chance” [27:xix].

A guide to the time required is afforded by air crash disasters. Peterson and Kogon examined 134 dental specimens from 109 victims from the Woodbridge air disaster over nine, 12-14-h days [17] but “external pressure obliged the coroner to terminate active investigation”. Fisher et al. report completed examination of 81 extremely fragmented bodies over only a 5-day period due to extreme pressure from relatives and funeral directors [18]. However, it had taken eight days previously to recover almost 8000 pounds of tissue (3/4 of estimated total) by a crew of more than 40 individuals. The excavation of a mound containing seven individuals in Hue City reported by Warren took two days but the workers felt pressed and Warren suggests that under strict archaeological conditions it should have taken at least a week. Dr. Warren has made several recommendations that are significant to mass graves; viz., more details as to site location, special training in disinterment techniques, better site security, and foreknowledge of the likely decompositional state of the remains [13]. It took two months to process and identify 23 American pilots who had died in captivity and whose boxed bodies had been turned over by the North Vietnamese [48]. All 139 bodies from the Big Thompson flood disaster were identified within three months [31] although 75% of these were identified in the first week (some bodies were not found for weeks) [19].
simulation of forensic archaeological excavation, Morse, Stoutamire and Duncan determined that:

the optimum number of individuals needed to excavate a single grave would be four, two working in the grave, one supervisor taking notes and photographs and the fourth in charge of dirt screening. The time necessary would depend on a variety of factors but is estimated at from half a day to a day and a half [34:47].

Four days/skeleton for one to two excavators including reconnoiter and mapping of the area, is recommended by Skinner and Lazenby [41]. The most relevant information on the time required to excavate a mass grave may come from the Crow Creek Massacre site (South Dakota), a 14th Century burial pit containing about 500 commingled native skeletons. The bone deposit covered 20' x 18' x 3' (approx. 6.6 x 6 x 1 m) at its deepest. The authors report that concerted work seven days a week spanning more than three months was not sufficient to finish excavation of the site [49, emphasis mine]. While admittedly no soft tissue is involved to keep the bodies intact, which makes removing "individuals" more time consuming, by the same token a lot of forensically important but perishable information has disappeared which would speed things up. One must conclude that proper exhumation of a mass of bodies and associated evidence is a task of months in the field and a comparable and probably longer time in the laboratory. Taking half a year to collect and interpret the evidence will pay enormous dividends and may ultimately speed up criminal court proceedings that could span years.

D. Strategies for sampling bodies and tissues

There may be need or justification for doing less than a complete job of exhumation and autopsy in a mass grave situation. Progressively decomposed bodies will be decreasingly suitable for traditional autopsy and perhaps should be defleshed and passed directly to the forensic osteologist/anthropologist. Alternately, a body may be so fresh that only the most able autopsy with the best hospital facilities is warranted. The amount of time one should spend on each set of remains will depend on what the excavation and autopsy are expected to accomplish. If this is merely identification, and matching dental records exist, then examination should cease; but if one is searching for atrocity evidence that will stand up in court, then a long close look is warranted. The chief investigator knows the priorities. If proof of torture is the goal, then it may be necessary to demonstrate this fact on only a single body. Appreciation of these factors, then, argues for consideration of a "sampling strategy" which has the added attractive feature of reducing the general problem to more manageable proportions.

Bodies, carefully carried from the pit to the field morgue in a body bag or on a stretcher, should first be processed through the control of labelling area as a double check on the catalogue. If identification is the only object and morgue storage facilities are limited then, depending on the state of decomposition,
one could perform the following sampling procedures: (a) photograph recognizable soft tissue features (face, ears, scars, tattoos); (b) radiograph the limbs, trunk and head for fractures (healed and perimortem), prostheses, and individualizing bony details; (c) record ridged skin details; (d) resect the jaws; (e) take tissue samples for analysis of drugs. All this might conceivably be done in the field. The remainder of the body, if not identifiable at that time, could be reburied in a marked grave for retrieval later if desired.

For very decomposed bodies where identification is still eagerly sought [12], the remains should be defleshed [51,52] for examination by a forensic anthropologist. There comes a point where soft tissue is no longer an asset but a discouraging hindrance to examination of the bones and the remains should pass from the pathologist to the anthropologist. I am reluctantly recommending that, while ideally both specialists should have a thorough go at the remains, in a mass grave situation it might be better to render the remains to acceptably clean, dry bone so leisurely examination will be assured. However, there are strong arguments against too hasty dismissal of decomposing soft tissue evidence. Simpson has reported being able to observe 15 months after death, from a body buried under a stone slab, the presence of a blood spot on the thyroid cartilage indicating strangulation [28]. In the famous Crippen homicide an abdominal scar was demonstrable on a tissue fragment buried under a brick floor for more than 5 months [24]. In another case, a vital reaction in the tissue to a stab wound was observable despite burial for five weeks in a shallow grave [28]. Nash reports that visual recognition from the facial features was possible in a homicide victim buried for three months in Berkeley [53]. Fingerprint identification was made from a corpse buried 10 inches deep in Ontario for 11 months [23]. Noguchi et al. report being able to demonstrate the presence of amitriptyline in bone marrow, lung tissue and leg muscle buried for 8 months [50]. On the other hand, the recognized sophistication of a competent anthropologist’s knowledge of skeletal variability can only be employed when skeletonization has occurred.

If documentation of premortem traumata and cause, manner and mode of death is the goal, then identifiable bodies in good shape could be selected for very thorough examination at a good autopsy facility. After whatever degree of autopsy is felt warranted at the field facilities, the body parts will have to go into temporary storage. There are mortician’s supplies which contain powdered formaldehyde to slow decomposition through inhibition of bacterial action. Tissues so treated may no longer be suitable for drug analysis [31].

Conclusions

With pre-planning, exhumation of a mass grave for the purpose of identifying the victims of torture and extrajudicial execution is possible. Careful archaeological techniques of excavation combined with specialized protective clothing and breathing apparatus will make it possible to record even subtle evidence from repellant remains. Extreme pressure to speed or even cease
investigation can be countered by: (a) educating concerned personnel that mass grave exhumation is a process that could take weeks or even months; (b) invoking time-saving strategies of sampling bodies and tissues which reflect whether the object is comprehensive identification, limited identifications or simply the demonstration of premortem torture and maltreatment having occurred.

An undertaking of this nature is subject to political pressure. It requires a team effort by specialists [54] engaged to perform the task by a neutral, probably international, body such as the United Nations [11]. Documentation of human rights abuses through controlled exhumation of mass graves can serve three purposes: it shows respect for the victims, it can promote justice for past evils, and it may mobilize feelings to prevent atrocities in the future [10].

Acknowledgements

Each of the following professionals in their field provided thoughtful advice. I am grateful to each of them: Andrew Barton (Departmental Technician, Archaeology, S.F.U.), Tony Evans (Justice Institute of British Columbia), Garry McFayden (Chapel Hill Funeral Parlour, Ltd.), William Meekison, M.D. (Boundary Health Unit), Bob North (Magnum Distribution, Ltd.), Lorne Pearson (Chief, 10 Fire Hall, Surrey), and Glenn Stare (Fleck Bros., Ltd.). Jackie Duffy helpfully critiqued the manuscript.

Appendix 1

Select Field Equipment* for Mass Graves Exhumation

- Infra-red scanner
- Gas detector
- Refrigerated trucks
- Earth moving machinery
- Surveying equipment
- Transportation vehicles
- Freezer
- Washing machine
- Tents
- Electrical generator
- Flood lamps
- Computer terminals
- Stretchers
- Air pump
- Water pump
- Respirators
- Self-contained breathing apparatus
- All-encapsulating suits
- Equipment containers

Mapping/meas. instruments

- Rulers and tapes
- Flagging tape
- Topographic maps
- Nylon string

Excavating instruments

- Nylon screens
- Root clips
- Mason's trowels
- Small shovels

*From Refs. 8, 17, 18, 26, 27, 29, 31, 34-37, 39 and 41.
<table>
<thead>
<tr>
<th>Wooden/metal stakes</th>
<th>Paint brushes</th>
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<tbody>
<tr>
<td>Compass</td>
<td>Buckets</td>
</tr>
<tr>
<td>Site board</td>
<td>Chain saw</td>
</tr>
<tr>
<td>Ropes</td>
<td>Magnifiers</td>
</tr>
<tr>
<td>Reflecting ribbon</td>
<td>Flashlight</td>
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<tr>
<td></td>
<td>Metal detector</td>
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<tr>
<td></td>
<td>Ante-putrefaction masks</td>
</tr>
<tr>
<td></td>
<td>Bactericidal products</td>
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<tr>
<td></td>
<td>Defleshing chemicals</td>
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<tr>
<td></td>
<td>Gowns</td>
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<tr>
<td></td>
<td>Surgical masks</td>
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<tr>
<td></td>
<td>Surgical gloves</td>
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<tr>
<td></td>
<td>Cotton gloves</td>
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<tr>
<td></td>
<td>Cool vests</td>
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<tr>
<td></td>
<td>Dental tools/mirror</td>
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<tr>
<td></td>
<td>Knee pads</td>
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</table>

**Recording instruments**

<table>
<thead>
<tr>
<th>Tape recorder</th>
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<tbody>
<tr>
<td>Videotape recorder</td>
</tr>
<tr>
<td>Photography equipment</td>
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<tr>
<td>Casting kit</td>
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<tr>
<td>Extension cords</td>
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</tbody>
</table>

**Record keeping**

<table>
<thead>
<tr>
<th>Graph paper</th>
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</thead>
<tbody>
<tr>
<td>Burial form</td>
</tr>
<tr>
<td>Evidence catalogue</td>
</tr>
<tr>
<td>Labels</td>
</tr>
<tr>
<td>Pens/pencils</td>
</tr>
<tr>
<td>Crime scene cards</td>
</tr>
</tbody>
</table>

**Packing/containers**

<table>
<thead>
<tr>
<th>Staplers</th>
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</thead>
<tbody>
<tr>
<td>Sticky tape</td>
</tr>
<tr>
<td>Bags/vials/boxes</td>
</tr>
<tr>
<td>Wood/tool kit</td>
</tr>
<tr>
<td>Axe</td>
</tr>
<tr>
<td>85% alcohol</td>
</tr>
<tr>
<td>Body bags</td>
</tr>
</tbody>
</table>

**Tape recording of observations**

Most pathologists performing an autopsy and most scene of crime investigators can tape record their observations. The difficulty with mass grave exhumation is that the hands are occupied, so a hand-held recorder is not suitable, and the face will likely be covered with a hood or mask which at best will mean the voice has to pass through a speaking diaphragm. A new item offers a very useful solution. The Ear-Mike (TM) (Magnum Distribution, Ltd.) is a transducer which combines the functions of a microphone with that of a speaker in a unit as small as a hearing aid. It resembles the ear-piece of a hearing aid, fitting into the ear and attaching via a small wire to a “push to talk” (PTT) switch on a compact interface unit which can fit under one’s arm on the side of the chest. The PTT interface in turn attaches to any two-way radio equipped with an external speaker/microphone capability (walkie-talkie) which is worn on the operator’s person. The Ear-Mike picks up voice vibrations from the oto-laryngeal tract and eardrum and transmits one’s voice to the radio for transmission. The information can be recorded at the location of the receiving radio or on a voice-activated tape recorder attached to the operator (in which case a transmitting radio is not required). The Ear-Mike transducer will receive verbal instructions from the radio through the ear piece. Thus, it acts as
a microphone and a speaker, allowing two way communication, tape recording of observations and receipt of instructions and yet at the same time frees the operator's hands at all times, picks up even whispered observations and fits under protective clothing without interfering with breathing.

Appendix 2

Hazardous materials clothing and equipment for mass grave exhumation

The threat to personnel involved in mass grave exhumation is minimal compared to that in some industries. Therefore it should not prove difficult to obtain the advice, equipment and materials needed to examine and lift bodies. A recent "Survey of Self-Contained Breathing Apparatus and Totally-Encapsulated Chemical Protection Suits" by Buchan, Lawton, Parent, Ltd., (Ottawa) is available from the Research and Development Division, Environmental Protection Service, Environment Canada, Ottawa, Ontario, K1A 1C8, Canada. There are many good products of this nature available. Specific mention below of a product means only that I managed to obtain information on that item, not particular endorsement.

Protective suits

Option: Disposable suit. DuPont manufactures a low cost, limited use garment made of Tyvek® consisting of an open-faced hood, suit, and attached booties, which offers high tensile strength and tear resistance. It is very effective in keeping out particles and liquids. It weighs about five ounces and is comfortable at most temperature and humidity levels.

Option: Totally encapsulating chemical protection suit. This equipment screens the wearer completely from an unpleasant environment. Suits weigh about 4 lb and are made of easy to decontaminate fabric. The visual area includes 180° in a hood supplied with optical quality vinyl. Safety First Industries offers protective suits for use with umbilical air supply or self-contained breathing apparatus (see below). Excavating a mass grave will be a slow process necessitating hours every day, day after day. Worker comfort, especially in terms of over-heating, is important. Body heat discomfort starts at about 35°C (95°F). An optional cool vest worn under the suit should be considered. One variety weighs 5 lb and holds about 7 lb of ice and water. A battery driven pump circulates chilled water throughout the vest for up to 4 h (Gardwell® Cool-Vest from SFI).

Breathing apparatus

There are three basic strategies available for dealing with the foul air associated with putrefying bodies: ambient air can be cleaned, clean air from nearby the mass grave can be pumped in, or bottled air can be supplied. Each option is described below. American Optical offers a film for rent or purchase entitled "A Breath of Air", which addresses the problem of respiratory protection.
Option: Cleaning ambient air with a mask respirator. A good mask will not only clean and filter ambient air it will possess a speaking diaphragm. Respirators try to deal with two hazards: particles and fumes. For decomposing bodies, a respirator fitted with an organic vapour cartridge (universally colour-coded black) attached with a filter clip to a dust and mist prefilter will probably provide adequate protection. In the American Optical line of respirator products, inhaled air is pulled through a dual element and exhaled through a minimum resistance exhaust valve in the mask (for ease of breathing). Respirators can be half-masks which cover only the nose and mouth, or full-face masks which cover also the eyes. The latter variety can be fitted with an anti-fogging nose cup and attachments for prescription glasses (Commander® respirator by AO). Ante-putrefaction masks are absolutely effective for two to four hours before the filters need changing; even when hanging over a very “high” drowning victim, nothing can be smelled.

Option: Pumped-in “supplied air” respirator. This sort of equipment might be best for mass graves exhumation. A hood, covering the head and shoulders, is used in conjunction with a protective suit. Attached to the hood is an air hose into which is pumped clean air from nearby. The air pump can be electrically or gas driven but one should avoid oil-lubricated pumps which may produce deadly carbon monoxide and other fumes from breakdown products of oil which has become too hot. Bullard offers an electric-driven oil-less, Free-Air® pump that can supply air to a worker up to 400 ft from the pump. The pump of course should be located in a “clean” air location. The advantage of a Supplied-Air Respirator® is worker comfort with less fatigue, and fewer work breaks. This is important for mass grave exhumation. They weigh about 3 lb (1.4 kg). There is a disposable variety consisting of a Tyvek® Hood (Bullard) weighing only 15 oz. (0.43 kg).

Option: Air cylinders. The advantage here is guaranteed air quality. While the apparatus is more complicated, for example requiring oil-free compressors to fill the bottles, the technology has been around for years and despite its sophistication is familiar to skin divers and fire fighters. Two varieties of air supply to the full-face mask are available: air line respirator which means simply that the operator is hooked up via a hose to large air cylinders offering long term air supply; or self-contained breathing apparatus (SCBA), where the operator back-carries small cylinders offering 30 to 60 min of supply. (Under heavy exertion a typical worker may get 18 min supply out of a 30-min bottle, (personal communication, Tony Evans, 1984)). U.S.D. Corp. offers a Survivair Mark 2® SCBA, with an air line capability, which possesses efficient visual and speaking diaphragm features. SCBA would appear to be a viable option only when a small scale operation with maximum portability requiring guaranteed air quality is needed. Another option is a SCBA which uses a closed circuit, much smaller, air cylinder where used air is cleaned of carbon dioxide and recirculated to the user.
References