CHAPTER VI

The Investigative Role of the Forensic Anthropologist and Archaeologist

VI. A. Rationale

The purpose of this section is to show that there exist a number of scientific disciplines whose members, usually to be found in universities, possess skills which may be of direct use to forensic investigators. Collectively, scientists investigate a wide range of phenomena using procedures designed to provide answers which are as accurate and reliable as possible. This emphasis on new and contributory research results in a body of knowledge on a particular topic which, in its recency and reliability, can ensure that the quality of interpretation of evidence in courts of law is of the highest calibre. Since evidence can be of any and all kinds, virtually any academic pursuit may be useful to the forensic investigator. Here, only that expertise pertaining to forensic anthropology, archaeology, and bones in particular, will be discussed in any detail.

VI. B. Comments on Analytical Methods

How do physical anthropologists get information from bones? No attempt will be made here to describe techniques in detail. Rather, our aim is to outline the types of analysis undertaken so that the investigating officer can evaluate the reports submitted by the forensic anthropologist.

Most of our work is simply observational, looking at the external features of the bones and teeth, in the light of experience. This reliable but subjective approach is usually

supplemented by metrical (measuring) procedures (to determine age, sex, race and stature) using calipers, OSTEOMETRIC BOARDS, and the like, in conjunction with suitable biometrical formulae descriptive of these variables in known samples of people.

To these techniques we may add the use of an x-ray machine with which we ascertain tooth formation in children, or internal features of bone indicating physiological stress or trauma. We also employ slow speed wafering saws to produce thin sections of adult bones and teeth for microscopic examination.

As the occasion demands we may utilize more ambitious analyses. We have used x-ray emission spectroscopy to demonstrate the presence of lead in remains suspected to be historic, not prehistoric, in age.[1] Currently we are using video equipment[2] to superimpose separate images of a skull and photograph, both of which show evidence of facial scarring in similar positions when superimposed (technique suggested by Hillsdon-Smith 1979).

What do archaeologists do? In a nutshell, they dig sites of former human activity, recovering evidence produced by that activity. Consequently archaeologists are equipped to recover and interpret all manner of evidence; for example, soils, articles of human manufacture ranging from stone tools to historic artifacts like glass or nails, plant and animal remains reflecting what the people ate or used as materials for manufacture. They also of course study human skeletal remains, and try to date a site by developing knowledge of such techniques as tree ring dating and trace element analysis. These activities are of direct relevance to forensic cases. Naturally the equipment for recovery and analysis of such evidence is to be found somewhere in the university. Archaeologists and anthropologists, who have taken on the broad task of studying all of human kind through time, are great borrowers of ideas and tools of other more specialized disciplines. So, often, if an archaeologist cannot help, he can usually recommend someone who can. Here, however, we shall restrict ourselves to mentioning special problems of forensic investigation in which archaeologists and physical anthropologists have expert knowledge.

---

1. Recent living bone incorporates atmospheric lead isotopes derived from the combustion of leaded fuels. This work was started at Simon Fraser University by Dr. O. Beattie and analysis in this case was undertaken by A. Cormie.

2. We thank Frank Campbell, Production Technician, Simon Fraser University Instructional Media Centre, for his kind assistance.

VI. C. Special Techniques

VI. C. 1. *Animal remains*

All manner of animal remains are found in archaeological sites and require study. For example, at the present time there are in the Department of Archaeology at Simon Fraser University students and faculty studying life forms ranging from land snails through fresh and marine water bivalves to large mammals like deer and domesticated species.

Recently we learned of a case of suspected substitution by a restaurant owner of poached deer for beef. A conviction could not be obtained due to the inability of the analyst to show by chemical means the species involved, since the evidence consisted of cooked, and therefore denatured, cuts of flesh and bone. Here an expert in animal bone morphology, particularly the incomplete portions usually seen by zooarchaeologists, should have been able at least to discern reliably that the bone was not from a cow, if not also identifying the precise species involved. Either way a case for fraud could be substantiated. We have also been involved at the request of Fish and Wildlife officers in demonstrating that a butchered leg bone seized from a suspect's freezer belonged without question to the remains of an abandoned deer carcass obviously shot out of season. This finding was based on physical matching of two adjoining bone segments: the **RADIUS** lacking the distal epiphysis (the "freezer" specimen), with the distal epiphysis and rest of the deer's foot found in the field.

Most identification officers will probably have difficulty distinguishing the bones of young children from animal bones. This is particularly so with fetal bones which commonly are dismissed as small animal bones, even by archaeologists who should know better. One of us (M.F.S.) must confess to finding recently, during a burial excavation, two small bones outside the pelvis of a backlying female. These were not recognized immediatedly for what they were -- skull portions of a fetus -- but were cheerfully labelled U.F.O.'s -- Unidentified Foot Objects.

VI. C. 2. *Cremations and fragmented bodies*

The burning of a body, whether intentional or accidental, and violent trauma (e.g., an aircraft accident, perhaps accompanied by burning), can result in extreme fragmentation of the body and the bones.

For purposes of reconstructing a criminal event, for identification, or for providing surviving relatives with the assurance that the body portions recovered for burial belong only to one individual, it is often necessary to employ the services of personnel experienced in identification and reconstruction of small hard tissue fragments. It is the nature of the archaeological record that bones are seldom intact. Physical anthropologists naturally have more experience with reconstructing fragmented bones than do forensic pathologists or medical practitioners. The lack of soft tissues, or soft tissues that are charred beyond recognition, may signal to these latter experts the end of useful investigation of such items; but to the physical anthropologist this is just the familiar beginning in his study to derive information about the individual concerned.

Apart from the role of physical anthropologists in assisting with the task of identification in mass disasters, there are two related problem areas in which he or she can be very useful: recognition of the human nature of burned and highly fragmented bone and teeth, and their controlled recovery.

Cremated bone and the effects of burning on human hard tissues may be familiar to some physical anthropologists because cremation has been practised by many cultures in the past for disposing of their dead. It is usually possible to show that bone was burned in a green (that is, fleshed) state. Burned flesh may be deposited on bone as a black, shiny substance. Higher temperatures and prolonged burning of bone produce colour changes characteristic of firing temperatures involved, as well as structural changes (for example, **VITRIFICATION**) and characteristic fracture patterns of bone shafts and teeth (Stewart 1979). Knowledge of these effects will assist in reconstructing not only the bone fragments but also some aspects of the nature of the fire (for example, temperature, hot spots, and gradients). Tooth crowns tend to explode when heated due to water in the pulp of the tooth turning to steam. These fragments are nevertheless recognizable, sometimes even to having come from a particular tooth. Furthermore, dental "fillings" (restorations), which even if lost through the effects of the heat or through fragmentation, may leave evidence of their previous presence on a tooth in the form of metal oxides driven from the **AMALGAM** and redeposited on the tooth's surface. Also, dental restorations will differentially transmit heat to the tooth's tissues during burning, producing marked, differentially burned, margins on the tooth surrounding the restorations. **PROSTHESES** can resist a fire remarkably well and are of course invaluable in identification. These should be examined by a forensic odontologist who is a specialist in the identification of persons from teeth and dental

work. A typical severe cremation yields bone fragments 1 to 15 centimeters in length, numbering in the hundreds or thousands and weighing, in total, less than 1500 grams.

Armed with such knowledge, the forensic anthropologist can be very helpful in the initial task of finding evidence of a burnt victim in severe fires. Finding such, the next task is to recover the evidence. Precision recovery serves two functions, both based on spatial relationships amongst bone fragments. Obviously it is easier to start trying to reconstruct bones and teeth from fragments close to each other than from starting with a whole mess of fragments recovered as a unit (for example, a plastic garbage bag into which everything has been shovelled).

The second aspect is the relationship between the bones of the body and external features, such as the structure and temperature gradients within the fire, or physical features like the ground, floors, walls and doors. Mapping the identifiable bone fragments even without reconstruction can indicate orientation of the head and limbs or body as a whole, information which can be vital for reconstructing events prior to cremation. On a larger scale, mapping of the body area relative to structures (for example the location of a door in a now destroyed wall) may be very important in terms of later claims about fire safety procedures or criminal negligence.

Appropriate methods for the collection of cremated remains will be dictated by the degree of fragmentation that has occurred. Where the elements are largely intact and identifiable, previously described methods (II.B.3.) will suffice.

From our experience, however, it seems more likely that in a cremation the investigating officer will be faced with an area of poorly delimited extent known to contain more or less fragmented human bone within a matrix (of variable depth) composed of ash, burnt wood and extraneous materials. Bone in such situations is extremely fragile and would take days to excavate. Succumbing to the temptation to shovel the whole mess into bags (for some unfortunate forensic anthropologist to deal with) results in loss of valuable information. We recommend the following procedure which has been field tested.

The object is simply to establish a delimiting grid system of sufficient areal extent as previously described. Each square meter is then subdivided into much smaller grid squares, say 10 to 20 centimeters on a side, each of which is recovered intact down to the appropriate depth. A trowel or table knife will do to cut away each

designated block of bone-bearing matrix which can then be bagged separately in labelled containers.

Inevitably, with this method, there will be damage to bone fragments spanning two block perimeters, but these can be anticipated and sometimes removed separately. This disadvantage is more than balanced by maintaining relatively precise horizontal spatial data for the fragments and by the speed with which the matrix can be recovered.

The laborious freeing of the fragile pieces can then be accomplished in the laboratory setting. In the previously mentioned case, we air dried each block of matrix and then used dissecting needles to tease apart the blocks. Only in this way can very small dental fragments be recovered without further breakage. Sieving of ash and charcoal for bone and tooth fragments is not recommended except for the final stage of examination when thoroughly-searched matrix (which has apparently yielded all it has to offer) can be gently wet screened through a series of nested sieves. Small but significant items like dental fillings may be recovered this way.

It should be noted that the recovery and analysis of such cremated material is extremely slow. Nine hundred hours were spent in one case just recovering 10000 bone and tooth fragments from one skeleton recovered in fifty-six 15 centimeter blocks of matrix. Admittedly in this case fragmentation was so severe that most of the bone sample was unanalyzable except for mapping the distribution of bone by weight, but even this helped in determining the general orientation of the body as a check against the accuracy of an informant's account of how the body was burned.

VI. C. 3. *Anatomic reconstruction*

Those physical anthropologists of most use to law enforcement agencies have experience in deriving information from archaeological (and possibly fossil) human bone. Consequently they have developed the descriptive and interpretive levels of morphological analysis of bones and teeth to a fine degree.

Three cases come to mind. The first involved a multiple gunshot slaying where three bodies had been recovered and a fourth possible victim was missing. Also recovered were six tiny fragments of bone suspected to be from one of the four, possibly the missing individual. Prolonged study of these indicated some were from the delicate bony structures comprising the base of the skull behind the face. This finding could then be checked for a corresponding

damaged area in one of the three known victims as recorded in the autopsy report. Negative findings in such an instance would indicate the missing individual was likely also dead.

The second of these cases involved the study of a badly damaged cranial vault of a young male. In many areas the skull was so badly fragmented as to be held together only by soft tissue. After taking delivery of the autopsied specimen, it was defleshed using suitable chemicals, degreased and bleached. Study and partial reconstruction of over 50 dried cranial vault fragments yielded clear evidence of wounding from two implements -- a knife (Fig. 2) and a hatchet (Fig. 3), with the edge of the latter having left a unique pattern of striations on the skull from a glancing blow. In this case and the next one, the role of the forensic anthropologist was to provide knowledge of normal variability in the appearance of bone.

A problem of interpretation arose when in the process of chemically defleshing the partially decomposed skull of a homicide victim, a small hole was revealed which perforated one of the facial bones below the eye. The *modus operandi* of the suspected killer had on a previous occasion included the driving of a nail into a victim's head. Our examination of the questioned hole revealed that the margins of the defect were rounded and the hole appeared to have been closing up for some considerable time. Thus the hole was not coincident in time with death.

VI. C. 4. *Facial reconstruction*

Recent years have seen the revival of a technique for reconstructing facial features on a skull; stimulated in part by new standards of soft tissue thickness for different racial groups (Snow, Gatliff and McWilliams 1970; Rhine and Campbell 1980).

Typically medical sculptors assume this role. Preferably, however, a specialist in facial reconstruction should be found, who also has a thorough grounding in forensic anthropology. Such a background would allow him or her to determine race, sex, age at death and individualizing characteristics from the skull; variables which if correctly diagnosed will ensure the quality of the reconstruction. The address of one such specialist in Canada is supplied in the Appendix.

The basic technique is outlined below; followed by guidelines, directed particularly at the investigating officer, for procedures which will enhance the information yield of the reconstruction.

Upon receipt of a skull, including lower jaw, the specialist makes a thorough study, checking any previous diagnoses of race, sex, and age at death. The specialist may request the rest of the skeleton and any clothing or jewelry, if such can indicate stature, body build, or appearance. Individualizing characteristics such as facial bone scars, dentures, or unusual front teeth, will also be checked. Most importantly, a thorough search will be made for any adhering facial or head hairs (which are not uncommonly found) since inclusion of their characteristics (colour, length, curl, and so on) will greatly enhance the reconstruction.

With these important preliminaries accomplished, the next step will be to make a cast of the skull on which to build the reconstruction. The cast is used so that the original need not suffer undue handling during the reconstruction, but is available for re-checking particular features when necessary. Also, if demanded, the skull can be made available to other specialists for their examination or can be returned for burial.

The first step in the actual reconstruction is to glue rubber posts, representing average tissue thickness, onto specific anatomical landmarks of the cast. These posts are then joined by plasticene strips laid over the facial region, contouring the depth of the strips to match that of the posts they connect. Bare areas are then filled in with a view to reflecting accurately the age and body build of the individual. Glass eyes of the appropriate colour (e.g., native -- brown eyes) are added. Size and shape of the nose are largely determined from the skull but the mouth and lips are sculpted, necessarily, more with talented imagination than with science. Addition of a wig and a shirt or scarf usually complete the reconstruction, which can now be photographed for inclusion in a poster describing what is known of the remains.

From the above description of the technique it should be obvious that, apart from the skill of the specialist in facial reconstruction, the likeness produced is only as good as the quality of the recovered evidence. Thus the investigating officer should attempt to accomplish the following:

a) Recover all skeletal and dental elements, especially the front teeth which, while often very individualizing, fall easily from the skull.

b) Search for facial and head hair. Hair is a dead tissue and may accompany bones of even several years exposure. If hair has been submitted to a hair and fibre specialist, arrange for a sample, and

the report, to be sent to the specialist in facial reconstruction for consideration.

c) Recover all clothing, eye glasses, and jewelry as these can indicate not only body build and personal appearance but may also suggest socio-economic status (which could be reflected in the reconstruction).

d) Ensure that the facial bones of the skull are protected at all times, since the degree of projection of these often very delicate processes is of utmost importance in the reconstruction.

e) If the remains are to be autopsied, try to make sure that the jaws are not sawn from the skull.

f) If there is pressure to dispose of the unidentified remains, try to retain the head for storage and later analysis.

The task of the identification officer to try to identify the remains does not end with receipt of the photograph of the reconstruction. It is his job to ensure that *all* the relevant information which could help identify the individual is recorded on the descriptive poster to be circulated. Too often we have seen such posters where, basically, only the reconstruction is illustrated while important information (such as the fact the person was diagnosed from the skull as native) was left off. Finally, the descriptive poster should be circulated as widely as possible.

In conclusion, we would like to observe that, whether simple or complex, analytical techniques are only as good as the quality of the recovery procedures and the remains themselves. Positive results are more likely to be forthcoming from a forensic anthropologist armed only with experience and presented with a complete skeleton from a documented and thorough recovery procedure than from a lab full of apparatus applied to a few scraps of bone of questionable context.