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INTRODUCTION

There does not exist a category of science to which one can give the name applied science. There are science and the applications of science, bound together as the fruit of the tree which bears it.

—Louis Pasteur

OVERVIEW OF THE FIELD

Pasteur's observation on science appears particularly appropriate to forensic anthropology. The American Board of Forensic Anthropology offers the following definition:

Forensic anthropology is the application of the science of physical anthropology to the legal process. The identification of skeletal, badly decomposed, or otherwise unidentified human remains is important for both legal and humanitarian reasons. Forensic anthropologists apply standard scientific techniques developed in physical anthropology to identify human remains, and to assist in the detection of crime. Forensic anthropologists frequently work in conjunction with forensic pathologists, odontologists, and homicide investigators to identify a decedent, discover evidence of foul play, and/or the postmortem interval. In addition to assisting in locating and recovering suspicious remains, forensic anthropologists work to suggest the age, sex, ancestry, stature, and unique features of a decedent from the skeleton.

The roots of forensic anthropology are firmly planted in the twentieth-century academic research of physical (i.e. biological) anthropology, especially bioarchaeology. The quest for extracting the maximum information from skeletal remains of past peoples pushed the envelope of osteology beyond the parameters of study routinely addressed by physicians and anatomists. The knowledge, skills and experience that physical anthropologists focused on to derive biological, and even cultural, information from human skeletons in an archaeological context has proven directly applicable to medical–legal contexts. This is not to state that the research to application flow has been essentially one-way, for that is, indeed, not the case. The growth of research and practice in the forensic realm has created a back-flow of information to bioarchaeological and paleontological endeavors.

Reading the bones for clues to personal identification summed up most of the initial work by anthropologists, who were called upon pretty much on a sporadic, *ad hoc* basis. Increasingly they are called upon to help interpret skeletal evidence with an eye to cause and manner of death. “Simply put, the *cause of death* is any injury or disease that produces a physiological derangement in the body that results in the individual dying” (DiMaio and DiMaio, 1993, p. 3). Therefore, causes of death can be as diverse as gunshot wound, melanoma, or toxic shock. While determinations of causes of death are ultimately the call of pathologists, medical examiners, and coroners, when remains are skeletal, the opinion of the forensic anthropologist counts. However, anthropologists lacking soft tissue evidence must be especially cautious in their pronouncements. For instance, there is no absolute association between linear skull fractures and degree of brain injury, and the cause of death may or may not have any direct connection with a cranial fracture. The *manner of death* is the circumstance that gave rise to the cause of death. In contrast to the myriad possible causes of death, the manner of death has but five categories: natural causes, accident, homicide, suicide, and undetermined. For example, a gunshot wound to the head as a cause of death could result from accidental, homicidal, suicidal, or undetermined circumstances. The circumstances of death are part of the medical–legal investigation that is often amenable to anthropological probing—from assigning manner of death to evaluating the believability of a suspect’s account of events.

The *mechanism of death* is the physiological or chemical process, initiated by the cause of death, that leads to the failure of vital organs or organ systems. It is a description of how that bullet to the head or chest eventuated in death. This is not an area of primary concern to the anthropologist and should usually be left to medical personnel.

What is of concern to the anthropologist is maintaining the chain of evidence or chain of custody. The anthropologist must vouch for the security of any remains or other evidence left in his or her custody. The anthropologist

must guarantee that the evidence was not tampered with in any undocumented way. Often, but not always, there is a chain of custody form signed and dated in serial fashion by each custodian. In any event, anthropologists should record dates, times, and circumstances of the arrival and departure of evidence and where it was housed in the interim.

Mass disasters and recovery from mass graves present special challenges and obstacles that differ from more typical death investigations in that agencies and command structures, foreign settings, and bureaucracies must be dealt with. Each such instance has its own idiosyncrasies.

Finally, forensic anthropology is very much analogous to clinical practice, especially in regard to decision-making, as described by Dawes *et al.* (1989). We employ both "clinical" judgment, where the practitioner processes information in his or her head, and actuarial judgment, where interpretation is the product of an automatic routine or calculation based on empirically established formulations. The Dawes and co-workers study concluded that in medicine and psychology the actuarially based decisions were superior to the clinically based ones. Their conclusion is of interest to anthropology, but (and this is a very big but) the databases on which their actuarial procedures were based are very much larger than those characteristic of anthropology, and their formulations have been more intensively cross-validated. Discretionary decisions in forensic anthropology retain value and must even be applied to the formulae themselves. The era of autopilot has not yet arrived. Attention must be paid.

EDUCATION AND TRAINING

In the United States and Canada most, but not all, programs in physical anthropology are housed in departments of anthropology. Broad undergraduate training in the four fields of anthropology automatically introduces the student to a broad range of cultural practices and to principles of archaeology. Students should have courses in both field archaeology and in archaeological method and theory. Admission to the Physical Anthropology section of the American Academy of Forensic Sciences requires a masters degree in anthropology, which should reflect an emphasis on physical anthropology, and even more specifically on human osteology/skeletal biology. In practice very few university degrees specify such detail. A Ph.D. in physical anthropology with the same emphasis on some aspect of human osteology is one of the requirements for becoming eligible to sit for the American Board of Forensic Anthropology certifying examination. Galloway and Simmons (1997) present an in-depth look at education in forensic anthropology under changing circumstances.

Forensic anthropology is one of the forensic sciences, and successful practitioners should have the basics of biology, physics, chemistry and mathematics under their belts. These courses teach the student critical thinking and scientific attitude, and promote efficient interagency and interdisciplinary cooperation. Physical anthropology graduates from departments of anatomy typically fulfill the natural science basic courses without special effort, but may need to familiarize themselves with archaeology. A working knowledge of descriptive and inferential statistics is also essential for research design and interpretation. Paleopathology and bone histology are very instructive. Participation in casework and internships is desirable, but for many universities located outside major urban areas, the opportunities may be limited.

Quality control in the practice of forensic anthropology has been a nagging problem. Since there is no such legal infraction as “practicing anthropology without a license”, several *very* lightly trained workers in aligned areas have been lured into amateur play, much to the detriment of the field. I do not wish to contribute to this practice of professional crossover, and I offer this—Warning: *This Book Will NOT Make You an Expert!*

OVERVIEW OF THE BOOK

The emphasis of this book follows the two main subdivisions of forensic anthropological work: the quest for personal identification from skeletal remains and the role of the anthropologist in the broader medical–legal investigation. Although somewhat peripheral to the practice of a majority of forensic anthropologists, genetics and DNA analysis will be presented in a very brief overview of the basics of terminology and interpretation that physical anthropologists need in the forensic science world. Physical anthropologists are already familiar with the basic concepts of both Mendelian and population genetics. The technologies change, but the principles remain. The emphasis of this book is the *core knowledge* that one needs to know in order to practice anthropological forensics; the volume deals only in passing with the related discipline of taphonomy and not at all with archaeological survey and excavation. Other special techniques that some anthropologists practice, such as facial reconstruction and photographic superimposition, will not be covered in this book.

The targeted audience for this book is advanced undergraduate and graduate students and post-graduates who have familiarity with skeletal anatomy and some introduction to statistics. Less specifically prepared readers will find sections of interest and learn of strengths and limitations, but will not fully benefit from the issues and critiques discussed herein. The aim of the

book is to provide the essential foundation for the practice of forensic anthropology and to serve as a guide to the evaluation and use of the primary literature. The book routinely gives sample sizes (n values) and the demographic breakdown of samples. While this scarcely makes for a page-turner, it does allow the reader to evaluate the bases from which the conclusions were drawn and, therefore, the extent of their valid applicability. The emphasis is on presenting those aspects of skeletal biology that are of most direct use in forensic casework. Potential pitfalls of methods, applications and areas of uncertainty and disagreement are included.

This book is not a compendium of all available charts and regression formulae; it is not a cookbook of pretested recipes for arriving at identifications. Instead, the critical and evaluative approach stresses the cautionary note that the variation inherent in human biology places certain constraints on the techniques of forensic anthropology, especially on the narrowness of confidence intervals and the degrees of certainty. We must remember that, even under ideal circumstances, 95 percent confidence in an answer means error is expected five percent of the time, just on the basis of chance. Perhaps this will add perspective to dramatic journalism and case portrayals that attribute an amazing degree of precision to the analyses of forensic investigation. For various reasons journalists, the general public, law enforcement and legal professionals, and sometimes forensic scientists themselves, are prone to representing forensic science as more exact than it really is. This volume simply cannot cover the entire field of forensic anthropology in all its diverse aspects. Its focus is not on practical laboratory or field procedures. Instead it examines the theoretical and methodological foundations of the discipline.

The cited bibliographic references are far from a comprehensive survey of the published literature relating to forensic anthropology. Many well-designed studies and instructive case reports have not been included, and non-inclusion should not be interpreted as an inference or innuendo of scientific shortcoming. This volume is intended to serve students in human skeletal biology as a basic, yet guided, tour of the research and practice of forensic anthropology at the dawn of the twenty-first century. Selection criteria for cited literature include historical importance and continuing influence, broadness of applicability in case work, promise of improved standards, level of methodological sophistication appropriate to the student or novice, or illustration of an important principle.

With the exception of a couple of material suppliers (FORDISC at University of Tennessee, Knoxville, and France Casting of Bellvue, Colorado), I have decided not to include lists of forensics-related websites, anatomical and anthropological equipment, laboratory suppliers, or commercial DNA laboratories, since all of these have a tendency to change with some regularity.