STATE OF THE DISCIPLINE

Osteological Research in Classical Archaeology

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Abstract

The purpose of this article is threefold: (1) to provide a brief historical overview of human and nonhuman osteological studies in classical archaeology to get a sense of why and how the disciplines developed as they did; (2) to examine the current state of research in human osteology and zooarchaeology in the classical context, providing examples of case studies to help highlight the value (and limitations) of osteological analyses in reconstructing aspects of ancient Greek and Roman cultures and the environments in which they lived; and (3) to outline future directions for these disciplines, specifically in terms of connections that human osteologists and zooarchaeologists can share with one another, and how both, in turn, can cultivate ties to the wider fields of classics, archaeology, and anthropology to increase our knowledge of the natural and cultural worlds of antiquity. While some aspects of osteological work in classical archaeology remain underdeveloped, the future holds strong promise for greater use and integration of osteological data within this context.*

INTRODUCTION

For many, a skeleton elicits fascination and intrigue. The last parts of an animal's body to survive, bones are a durable remnant of that creature's life. Clues to our own lives remain on our skeletons, while the bones of the animals we use provide information about their roles and value in human society. Skeletal remains, both human and nonhuman, represent an important category of archaeological finds. On some sites they are all that remains of a culture or its activities.

Considering that bones are frequently encountered at classical archaeological sites, one might expect an impressive database of osteological material to have accumulated, with an equally long history of growth within the discipline and a consequent mass of available information. But is this really the case? What is the history of osteological research for classical sites? How have bones been treated and examined within the field of classical archaeology over the course of its development? What important information have they yielded in our analysis of ancient Greek and Roman cultures? What impact has bone analysis had on the discipline? And what might the future hold for osteological research in classical archaeology? Despite periods of uncertainty throughout its history, I argue in this State of the Discipline piece that osteological research is now firmly entrenched within classical archaeology. Nevertheless, while the potential in some aspects of the discipline remains untapped, the future holds strong promise for greater use and integration of osteological data to reconstruct a more holistic view of the classical world.

DEFINITION CONTROVERSIES: THE NAME GAME

Despite their common presence on archaeological sites, there is still some confusion about how and under what theoretical and methodological umbrella osteological remains should be analyzed. The confusion extends to the name of the discipline housing their examination. This is a pivotal question, since the definition (and subsequent academic department placement or affiliation) of the discipline itself often shapes the analytical procedures and theoretical directions pursued. In the world of classification, there are "splitters," who fragment concepts into smaller parts, and "lumpers," who collect concepts together. Both are essential in any field seeking to create order among a multitude of facts, methodologies, and data. How-

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ever, each can promote chaos as researchers haggle over what best applies where and when. What exactly is meant by "bioarchaeology" and "osteoarchaeology" (both of which are used in relation to bone research in archaeology)? Much of this depends on the approach taken, but even at this stage, there is disagreement.

The terms "bioarchaeology" and "osteoarchaeology" never existed in any official sense until processual archaeology emerged in the 1960s and 1970s. Binford, Clark, and others advocated a more scientific and less culture-historical approach. This "New Archaeology" stressed model building and hypothesis testing, with a greater input from the physical and biological sciences. Bones, seeds, soils, sediments, and related biological and geological remains received increased attention during excavations for the data they revealed about issues such as site formation, paleoenvironments, and diets. Coalitions of disciplines formed within the processual agenda as archaeology looked to biology, osteology, botany, geology, and other fields to increase its scientific relevance.

The term "osteoarchaeology" is perhaps the easier of the two to define, but not without controversy. Introduced in 1973 by researchers such as Møller-Christensen and Uerpmann,[1] the term generally refers to the analysis of bone (Greek *osteon*) remains. Osteoarchaeology could be restricted to include only "bone" remains or branch out to incorporate bones and bony structures (e.g., shell, cartilage). The term itself implies no strict division between human and nonhuman bones, but perhaps the first question asked of an osteoarchaeologist is one's focus—human bones or animal bones?—ignoring that humans are animals and that osteologically there are great similarities among all animals.

Defining bioarchaeology presents more complications. Although "bio" generally refers to "life" or "living organisms," the term "bioarchaeology" was proposed by Clark[2] to refer to the study of animal bones in an archaeological context (currently a field known as zooarchaeology or archaeozoology)[3] but subsequently expanded its domain to include the analysis of all types of biological remains, plant and animal, recovered from a site. Thus, bone analyses from archaeological sites (cf. osteoarchaeology) compose only a portion of bioarchaeology. The term still carries its encompassing definition among many academic departments in Britain and Europe and has become allied with environmental archaeology in some areas. Bioarchaeology in this respect is lumped with a larger range of material analyses of ancient life—plant and animal, including human.

In North America, bioarchaeology has become more restricted in scope. Buikstra redefined the term to refer to human biology in archaeology, specifically to archaeological applications of principles from biological or physical anthropology.[4] Given that bones tend to be what chiefly survive of human beings, bioarchaeology has since come to denote, at least for a North American audience, the scientific study of human skeletal remains from archaeological sites. Under this definition, bioarchaeology is removed from its larger ties to the study of all types of biological remains.

Definitions and home departments for disciplines become even more confusing with the addition of "classical" to the mix. How does one qualify osteoarchaeological or bioarchaeological research that is conducted in the context of classical archaeology? "Classical bioarchaeology" is formed by a jumble of disciplines—classics, anthropology, biology, archaeology—that intermix to cover a range of humanistic, social scientific, and natural scientific aspects. At its core, therefore, classical bioarchaeology should provide a truly interdisciplinary means to reconstruct the natural and cultural world of classical antiquity. The same can be said of "classical osteoarchaeology." By default, it, too, is an interdisciplinary field, even if it achieves its reconstructions of ancient life mainly through the analysis of bones from archaeological contexts.

OSTEOLOGICAL RESEARCH IN CLASSICAL ARCHAEOLOGY: AVENUES TO PURSUE AND LIMITATIONS TO ADDRESS

It is in this spirit of interdisciplinary research that I examine the development, current status, and future role of osteoarchaeology in the classical context. Looking past the difficulty of defining bioarchaeology, I

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[1] Møller-Christensen 1973; Uerpmann 1973.

[2] Clark 1972.

[3] The relative merits of the two terms have been argued among animal bone osteologists for some time. The basic disagreement centers on which aspect to stress. Fundamentally, one might argue that zooarchaeologists focus on archaeological reconstruction using animal bone remains, while archaeozoologists stress the zoological application of their work within an archaeological context. In current practice, however, there is much overlap in the underlying goals, methodologies, and reporting tactics for both. North American scholars tend to use the term "zooarchaeology," while "archaeozoology" is more common among European institutes. The separation by name today merely reflects the traditional use of the term in different geographic areas, as opposed to any important methodological or theoretical divergence underlying each.

[4] Buikstra 1977; Buikstra and Beck 2006.

restrict my analysis here to osteological remains—that is, the human and nonhuman animal bones retrieved from classical archaeological sites—as these tend to be recovered more often than do plant remains.[5] "Interdisciplinary" is something of a buzzword in academia. The notion of strength in numbers, extending branches to other disciplines, tying methods of research together, and combining forces tends to imply a greater importance or completeness in interdisciplinary research than can be achieved by any single discipline alone. It can also double the complications and biases.

Although there are similarities in how human and nonhuman bones are examined, the fact remains that in most cases, their studies have followed separate paths. Archaeological human bone is often analyzed by a human osteologist, physical anthropologist, or bioarchaeologist, while nonhuman animal bones are studied by an animal bone osteologist, faunal analyst, zooarchaeologist, archaeozoologist, or bioarchaeologist. In some cases, the same expert may serve both roles. However, the questions asked and the format and manner of reporting often vary depending on whether the researcher is examining human or nonhuman bones. Although such a division is not always appropriate and has led, in my opinion, to some unnecessary methodological and theoretical divergence in these osteological camps, it is largely a factor of the historical development of osteological research in archaeology. Human bone analyses followed one path of development, while nonhuman bone research followed another. Therefore, it is easiest to separate these components and to consider the topics along three lines: (1) a brief historical overview of human and nonhuman osteological studies in classical archaeology, for a sense of why and how the disciplines developed; (2) an examination of the current state of research in human osteology and animal bone osteology (= zooarchaeology) in the classical context, providing examples of case studies to help highlight the value (and limitations) of osteological analyses in reconstructing aspects of ancient life; and (3) an outline of future directions for these disciplines, specifically the connections that human and nonhuman osteologists can share and how both can cultivate ties to the wider fields of classics, archaeology, and anthropology to increase our knowledge of the natural and cultural worlds of antiquity.[6]

HISTORICAL DEVELOPMENT

Human Osteology in Classical Archaeology

Early classical archaeology was very much dominated by antiquarianism. The discipline grew out of 18th-century traditions of aesthetic connoisseurship of ancient art, architecture, and artifacts. A growing desire to obtain, study, and collect these valued commodities inspired some of the earliest excavations of the mid to late 19th century, such as Schliemann's work at Troy and Mycenae, Delattre's campaigns in Carthage, and Evans' excavations at Knossos shortly thereafter. The study of ancient cemeteries proved especially rewarding, and throughout this time, numerous burials were excavated, although generally with a greater attention to finding valuable artifacts than to studying any associated skeletal remains. Cemetery plans and burial sketches figure occasionally in these early excavation reports, but in most cases, no details are provided about inhumed or cremated skeletons that were unearthed. Nonhuman animal bones were virtually ignored or simply discarded in these early years.

While skeletal material remained poorly examined during this formative period of classical archaeology, it was not totally disregarded. Two important issues dominating early physical anthropology at this time were population origins and human taxonomy. Scientists computed various indices (e.g., the cephalic index) from body and skeletal dimensions to help divide the human species into races. Measurements and indices from the skull proved especially popular as racial categorizers. Once index standards were established using modern populations, attention focused on extrapolating these racial categories onto past populations by measuring archaeological skeletal material (chiefly crania). Virchow's early publications on skeletal material from excavations at Troy, Assos, and Cyprus were almost exclusively craniometric studies of skulls exhumed from the sites.[7] His overall conclusions were that the "Pelasgians" were brachycephalic (i.e., had a broad, short head) while the "Hellenes" were dolichocephalic (i.e., had a long, narrow head). In Italy, interest focused on tracing Italian ancestry to Roman

[5] I do, however, see great potential in the analysis of archaeobotanical materials from classical sites, and invite such specialists to consider similar State of the Discipline articles for this important aspect.

[6] It is important to address personal research biases here. Although I consider myself an osteoarchaeologist in that I have examined both human and nonhuman bones from archaeological sites, the bulk of my research has focused on zooarchaeological remains from Roman (and to a lesser extent, Greek Archaic and Hellenistic) sites in the Mediterranean. Within this region, I have worked at sites in Tunisia, Greece, Macedonia, Portugal, Spain, and Italy.

[7] Virchow 1882, 1884.

and Etruscan times using biological traits that might facilitate these connections. Sergi, one of the earliest researchers of this topic, stirred up controversy by suggesting an African origin to Europeans and claiming an Italic supremacy over Germanic peoples.[8]

Considering the apparent simplicity of the process, it was only a matter of time before racial profiling using cranial indices and skeletal dimensions spread to other archaeological contexts. An early 20th-century report from Carthage provides one interesting osteological comment about an old man recovered from a marble sarcophagus of Punic date. Delattre states that this individual was dolichocephalic, a condition he thought was the normal head shape of the Carthaginian Punic people.[9] His findings were anticipated by those of Bertholon, who, a decade earlier, examined two Punic crania found in Tunisia.[10] Given the connection researchers afforded between cranial indices and race recognition, it is not surprising that both Bertholon and Delattre attributed their findings to what they considered a Punic race of people, more akin to the North African Berbers than to European settlers. Their purpose in distinguishing such groups on the basis of cranial indices, however, was more likely related to their adherence to late 19th- and early 20th-century notions of colonialism and control, rather than to a scientific effort to characterize and trace population variation on the basis of osteometric data.

Where practiced, human osteological research in the classical context continued to emphasize racial recognition throughout much of this formative period in the early 20th century. The situation in Greece and the eastern Mediterranean, however, changed during the late 1930s and into the 1940s, 1950s, and 1960s with the influential work of Angel, in particular. Although he initially (like his contemporaries) focused on recognizing and tracing racial history from skeletal remains, Angel was later instrumental in shifting attention to other osteoarchaeological topics, including paleoecology, health, and human adaptation.[11] He examined skeletal materials from scores of classical sites in Greece and the eastern Mediterranean, including the Athenian Agora, Corinth, Eleusis, Lerna, Argos, Pylos, Olynthus (Macedonia), Troy, Kerameikos (Athens), and Kampi (Cyprus), among many others. His research laid a solid foundation for human skeletal research among classical sites, especially in Greece and Turkey. His publication list is outstanding, with more than 100 articles and reports devoted to osteological analyses of prehistoric and classical material. Significant among these is an entire monograph on human skeletal remains from excavations at Troy published in 1951, which represents the first complete volume devoted to skeletal investigations (beyond simply craniometrics) from a Mediterranean site.[12]

With the exception of Angel's work, few osteological advancements were made in the classical context from the 1920s to the 1950s, no doubt a factor of political and social complications from World War I and II. Although greater efforts were expended to collect and curate skeletal remains from classical sites during this time, the process was far from systematic or complete, and much of the material recovered was shipped to museums in London, Paris, or other foreign cities, resulting in considerable loss of key contextual data for each skeleton. Racial profiling continued to dominate most physical anthropological work, but it became increasingly difficult to argue direct lines of population affinity in the wake of evidence for osteological variability across and within cultures. Barnicot and Brothwell's evaluation of the biology of the Etruscans, as measured through craniometric analyses of ancient skulls, for example, failed to elicit significant results to determine population origins of this important ancient culture.[13]

Research emphases in human skeletal studies changed, however, with the rise of processual archaeology (i.e., New Archaeology) during the 1960s and 1970s. The increased focus of processualism on scientific rigor in excavation and analysis encouraged greater attention to recovering and examining skeletal material. Still, in its early phases, the impact of the new methodology was not universal across classical archaeological sites, often due to strongly established academic practices dictating the way archaeological material was investigated. Excavations sponsored by entities initially beyond the influence of processualism (particularly by universities in continental Europe, or worldwide by classics departments largely unaware of the processual agenda) maintained the status quo for skeletal research. In many cases where skeletons were unearthed at ancient cemetery sites, the body position (generally supine or flexed) was mentioned, along with the placement of the arms and the direction of the head, but little was done with these data (aside from tabulating them and making general comparisons with other sites), while the individual bones of the skeleton were minimally, if at all, examined. The concentration

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[8] Sergi 1901; Gillette 2002; Killgrove 2005, 16.
[9] Delattre 1901.
[10] Bertholon 1890.
[11] Jacobsen and Cullen 1990.
[12] For a listing of Angel's works, see Roberts et al. 2005.
[13] Barnicot and Brothwell 1959.

of the research in the 1960s and early 1970s at many of these ancient cemetery sites was on establishing a chronology based on the observed changes in burial orientation and body positioning in the case of inhumations, or on using the variation in the frequency of cremation burials as opposed to inhumations to determine cultural and religious changes. In this manner, the skeletons themselves were treated more as artifacts to be seriated and dated than as sources of information about the ancient people themselves.

As osteological research became better established, initially in Britain and the United States in the 1980s, scholars worldwide began to realize the potential of human bone for informing us about ancient diet, disease, and behavior. Far more questions could be asked of the skeletal data. Moreover, the research was now being conducted chiefly by physical anthropologists and related specialists who were highly trained in osteological analysis but also cognizant of archaeological and ancient historical data, rather than by generalized archaeologists who had some interest in skeletons or by biologists and anatomists with little training in archaeology or ancient history.

The field of osteoarchaeological work on human skeletal remains from classical sites has grown immensely since the 1980s. Human osteology is now a common course offered in many universities worldwide, and some bone specialists within these institutions focus their attention on ancient Greek and Roman sites. In addition, specialized laboratories, including the Wiener Laboratory of the American School of Classical Studies at Athens (ASCSA), the Fitch Laboratory at the British School at Athens (BSA), as well as cultural agencies such as English Heritage in the United Kingdom and Centre National de la Recherche Scientific (CNRS) in France, sponsor or otherwise support human skeletal examination from classical sites. Legislation now exists in a number of areas, including Italy and Greece, the core countries for classical archaeology, to support studies of human remains from excavations. Today, in most places, bones cannot simply be discarded from classical sites as they may have been in the past.

At the same time that legislation and institutional support is adding to the database of human osteological materials from classical archaeological sites, new research questions and directions are shaping the analysis of those materials. Recent years have seen a blossoming of efforts to combine human osteological data with contextual and other multidisciplinary data to reconstruct aspects of ancient life more completely, or at least from a more holistic vantage. Researchers have incorporated new methodologies and techniques, which are developing in areas such as DNA and stable isotopic analyses, bone chemistry, taphonomy, and paleopathology in their investigations of skeletal materials. The scope of the research has also expanded geographically and chronologically into periods and regions previously ignored or underdeveloped (e.g., Early Iron Age northern Greece, Roman west Mediterranean, and Roman North Africa) and theoretically and methodologically through advanced scientific analyses and integrated, collaborative investigations among osteologists, archaeologists, and other specialists. The current media attention on forensics has certainly helped solidify an interest in human osteological work as well.

Zooarchaeology in Classical Archaeology

The historical development of animal bone analysis in classical archaeology shares many similarities with the course followed by human bone research. With the exception of scattered mentions of animal bones from late 19th- and early 20th-century excavations at Greek and Roman sites, there was no genuine push to include faunal reports until the 1960s.[14] "Reports" is an overstatement here, for many of these were little more than a list of animal species present at the site. While the 1960s and 1970s saw major advancements in zooarchaeological methodology for prehistoric sites, academic divides further inhibited zooarchaeologists from making significant inroads into classical archaeology at this time. Although animal bones were available at these sites (and sometimes saved), the primacy of ceramic, architectural, artistic, and literary data in classical archaeology relegated bones to a lower importance. Moreover, few specialists within classical archaeology had received the training for adequate faunal analysis—it simply was not an option available to or encouraged for students specializing in

[14] The list of faunal reports for classical sites before 1950 is small. Among the Italian examples, Lanciani (1897, 373, 375) briefly mentions deposits of animal bones unearthed during his excavations in Rome. Fiorelli (1873) lists animals identified, including tortoise, deer, and wild boar, and complete skeletons of dogs, chickens, and horses from excavations at Pompeii. Early reports in the classical Aegean context include Boyd-Dawkins' (1902) study of ca. 50 bones from the 1901 excavation in the Late Minoan III and Early Iron Age cave in Crete. In Britain, Pitt-Rivers (1892) provides information about bones from the first- to third-century C.E. site of Rotherley, and the first- to fourth-century C.E. sites of Woodcuts and Woodyates. For further references to early faunal reports for classical sites, see Bökönyi 1974; King 1978, 1984, 1999; Luff 1982; Audoin-Rouzeau 1993; Lepetz 1996; Peters 1998; MacKinnon 2004.

Greek and Roman archaeology. It was not until the late 1970s that zooarchaeology in the classical context gained momentum. Much of this was the result of new theoretical and methodological questions, many with a paleoeconomic focus borrowed from the processual agenda and spilling over from zooarchaeological research on prehistoric sites, such as at Star Carr in England and at bison kill sites on the American plains. Faunal reports from most sites, classical or otherwise, began to routinely provide data on taxonomic abundance, age and sex profiles, butchery marks and related modifications, and other natural and cultural information that could be gleaned from analyses. Efforts were typically focused on reconstructing animal husbandry schemes and ancient human diets from the bones recovered, but topics such as ritual use of animals, carcass processing, spatial distribution of resources, social variation in animal exploitation, and cultural identity were increasingly tackled. Still, as the available pool of trained specialists was rather small at this time, many classical archaeologists were assigning faunal samples to zooarchaeologists whose principal research focus lay outside the Graeco-Roman period. Many of the reports from the 1970s and early 1980s, therefore, although key in promoting wider retrieval of faunal remains from classical sites, tended to be less integrated within the overall analysis of the site and were typically relegated to isolated appendices or back chapters.

The 1970s and 1980s also saw a geographic separation in zooarchaeological analyses, with different schools of research developing. The greatest activity was in Britain, largely fueled by the paleoeconomic, processual focus that dominated many archaeological departments in the country at that time. Moreover, important excavation, as at Portchester, Exeter, Canterbury, London, and elsewhere, yielded vast assemblages of animal bones from Romano-British contexts. Eager to exploit the full potential of these faunal samples, British zooarchaeologists solidified a strong future for the discipline in that country.

Compared with Britain, zooarchaeological research on classical sites progressed more slowly in countries such as France, Spain, Italy, and Greece throughout the 1970s and 1980s. The cultural-historical perspective was, and often still is, a predominant approach to classical archaeology in these European continental and Mediterranean areas. Consequently, the ancient textual, artistic, architectural, and artifact (generally, ceramic) record was favored in reconstructions of ancient cultures, rendering bones of minimal importance. The preeminence of the cultural-historical perspective also explains why zooarchaeology in these areas has been traditionally linked to early prehistoric sites, where the recovery of ceramics, architecture, and texts is rare or nonexistent, and why zooarchaeology originally allied more closely with paleontology in these countries.[15] With the influx of new theoretical ideas from processualism and new zooarchaeologists, France, Spain, Italy, and Greece have gradually developed stronger zooarchaeological agendas over the past 30 years.[16] More and more local zooarchaeologists are studying and publishing materials from their own countries as changes in heritage legislation and the rise in contract archaeology add to the need for more zooarchaeological work. Centers for zooarchaeological research have developed to accommodate and coordinate work. Several examples of these include the zooarchaeological centers at universities in Madrid (under the direction of Morales), Barcelona (under the direction of Estévez), and San Sebastion (under the direction of Altuna) in Spain; the zooarchaeological center affiliated with Instituto Português de Arqueologia in Lisbon (under the direction of Davis and Moreno-García); various branches of CNRS in France and English Heritage in Britain, many of which employ zooarchaeologists; the archaeozoology laboratory at Università di Lecce in southern Italy (under the direction of de Grossi Mazzorin); and the Wiener and Fitch Laboratories in Athens, both of which offer fellowships for zooarchaeological work in Greece. Zooarchaeologists who deal with material from classical archaeological sites are employed among several museums and universities in other European countries, including the Netherlands, Belgium, Germany, Austria, Switzerland, and Hungary.

Since the 1980s, zooarchaeological research within classical archaeology has grown rapidly. It is rarely the case now that animal bones are discarded during excavation, although sampling measures have been instituted at some sites to deal with the enormous quantities of bones retrieved. Detailed reports that include data on such things as ageing and sexing, diet, animal paleopathology, and husbandry tactics have become routine in the discipline. Investigations of bone materials are increasingly conducted by zooarchaeologists who

[15] Mónton 2003, 68.

[16] The input of North African and Near Eastern countries on zooarchaeological research in the classical context has generally been minimal, although there is more interest in animal use in prehistoric periods in these areas (e.g., Neolithic in the Near East or Dynastic periods in Egypt). Overall, the paucity (or lack) of local zooarchaeologists to train students, combined with a strong cultural-historical perspective for classical archaeology in these areas, provides little opportunity for faunal research, esp. among classical sites.

specialize in the Classical period. European, especially British, research generally led zooarchaeological advancements in the classical context, at least initially. Development of zooarchaeology for classical archaeology has been slower in North America, in part stalled by traditional academic divides and research philosophies between classics departments (which generally sponsor Greek and Roman archaeological projects) and anthropology departments (which typically train zooarchaeologists). Today, however, multidisciplinary ventures, the accumulation and rapid sharing of massive amounts of data, and the blurring of traditional academic boundaries have all promoted a spirit of collaborative and synthetic work. Now, osteologists and biologists are infiltrating classics, and vice versa. Recent excavations of classical sites are likely to be directed by individuals trained in another discipline, such as anthropology, than they are to be directed by those with a classics degree. Excavation participants and students come from a wide range of academic disciplines.

OSTEOLOGICAL RESEARCH IN CLASSICAL ARCHAEOLOGY: CURRENT CONTRIBUTIONS OF THE DISCIPLINE AND CATEGORIES OF RESEARCH

Both human and nonhuman skeletal analyses might appear under three general categories. At one level are the individual site reports, including some for classical sites, in which the basic data are presented and discussed. Some zooarchaeological or human osteological site reports draw comparisons with other contexts when discussing observed patterns, but rarely is the comparative scope in these instances sufficiently broad to allow for a detailed synthesis, and in most cases it is not the author's intention to undertake such a grand venture within the confines of an individual site report. Nevertheless, these reports are instrumental in providing and tabulating data for a particular site, outlining and discussing trends or patterns exhibited in those data, and communicating information about special characteristics or specimens within the osteological sample examined. Without them, more specialized studies that focus on unique or intriguing specimens or topics from a single site, or larger syntheses that pool and examine data from a range of sites, would be impossible.

Specialized reports, by contrast, examine a particular topic or facet, such as diet reconstruction, paleopathology, size variation, taphonomy, and environmental reconstruction. The scope of these examinations may be broad (across many sites) or narrow (at a single site), and research can involve a range of techniques and tests not typically incorporated into standard osteological reports. For example, a researcher may choose to undertake stable isotope analyses to determine aspects of ancient diet at a site, or conduct histological tests of bone tissues across sites to examine population or taxonomic variation. Such specialized studies can be incorporated into individual site reports, thereby blurring the boundaries between them.

The large syntheses assess data from many sites to discover cultural and/or environmental patterns. They tend to incorporate as many lines of data analysis as possible, and thus often amalgamate findings from individual and specialized site reports. Indeed, many of the specialized reports take a synthetic stance, drawing on data from a range of sites to predict, determine, and/or explain patterns for the particular topic under consideration.

Within each category, there is great variation in the detail presented for classical sites. Some osteological reports are little more than short synopses or charts of skeletal findings, while others comprise entire volumes. A similar range can characterize the specialized reports, although these tend to be more problem-oriented, in some cases testing a particular hypothesis or determining the applicability or validity of a certain technique. Larger syntheses generally are, by their nature, encompassing and detailed, although this is contingent on the quality of the contributing database, the range of issues addressed, and the degree to which nonosteological materials and information are incorporated into the work.

Human Osteology, Category 1: Individual Site Reports

Within the past two decades, individual site reports on human osteological materials at classical sites have become much more uniform in the way data are presented and discussed. In large part, this is due to global organization of physical anthropologists and the publication of standards volumes and field guides that outline methods of data collection and reporting.[17] In the case of cemetery excavations, a major contributor of human osteological data for the classical context, site reports generally now include the following: (1) a catalogue of the burials, usually with plans, photographs, or sketches of the tombs and skeletons (if preserved and available), and lists of the elements recovered from each burial context; (2) notes on grave orientation and the position of the skeletons within; (3) general discussion of the condition of the materials; (4) methods of excavation, preservation, and storage of

[17] Two key volumes in this regard are Buikstra and Ubelaker 1994; Brickley and McKinley 2004.

the bones, generally with some attention to taphonomic conditions of the excavated materials; (5) age and sex estimations and paleodemography examinations; (6) metrical data and stature estimations; (7) assessment of nonmetric or discrete traits, such as skeletal features that are scored on a presence/absence basis or graded along some relative scale; and (8) analysis of dental and skeletal pathological lesions.

The purpose of the catalogue and uniform recording and presentation method is to establish a standardized and complete account of each burial to ensure comparability among sites. That this can lead to a fairly lengthy and somewhat repetitive account that might be deemed valuable only to physical anthropologists and related specialists, however, is problematic, especially given the costs of publication. The situation is worsened in many cases because the small sample sizes do not lend themselves to in-depth analyses of population demographics, health, or burial practices. Many authors, moreover, find themselves apologizing for not being able to posit broad patterns to characterize the entire ancient population of the classical sites under examination and offer preliminary observations derived from their sample as a substitute.

There are numerous examples of site reports that discuss human osteological remains recovered from classical sites. Not all, however, report data on the eight categories listed above, but in most cases this is a result of the historical context in which these reports were drafted, and their research angles. Therefore, craniometrics dominated earlier reports, and many researchers did not provide information on issues such as taphonomy or excavation methodology. Today, however, most reports tend to include information for each of the categories listed above. The collective pool of human osteological site reports for the classical context is impressive, certainly more than 500 (a large proportion of which were written by Angel). It is not my intention to list all these reports.[18] However, in my opinion, there are several important classical sites that warrant specific mention here because of their rather large skeletal sample sizes, the contextual importance of their materials, or the detailed and innovative osteological investigations undertaken. These are:

1. Poundbury, United Kingdom (Roman).[19]
2. Osteria dell'Osa, Italy (Etruscan/Iron Age).[20]
3. Pompeii and Herculaneum, Italy (Roman).[21]
4. Portus Romae, Isola Sacra, Italy (Roman).[22]
5. Metaponto area, Italy (Hellenistic).[23]
6. Paphos, Cyprus and Corinth, Greece (Hellenistic/Roman).[24]
7. Kylindra, island of Astypalai, Greece (Late Archaic/Early Classical).[25]
8. Kerameikos, Athens, Greece (Iron Age/Archaic/Classical).[26]
9. Lerna, Greece (Neolithic/Bronze Age).[27]
10. Kenchreai, Greece (Roman).[28]
11. Troy, Turkey (Bronze Age).[29]

Human Osteology, Category 2: Specialized Site Reports

Specialized reports on human osteology have increased considerably in the last two decades as classical archaeologists have become more receptive to osteologists, who in turn have been eager to maximize the potential inherent in the rich database of skeletal finds from ancient sites. Although studies concerning population origins and migrations are still conducted using osteological materials from classical sites, the focus today is less on craniometrics and race distinction and more on the use of DNA evidence and investigations of metric and nonmetric traits to determine patterns of inheritance and population movements. Paleopathology is another important topic, while the examination of paleonutrition and paleodiet at ancient sites has been recently enhanced through the application of techniques such as stable isotope analyses. The impact these current methods have had on classical archaeology deserves individual attention.

Paleopathology in the Classical Context. Paleopathology, the study of diseases in ancient people, is a rapidly developing field.[30] The subject aligns itself within a huge body of scholarship examining broader issues of health, disease, and medicine and the social and biological factors surrounding these topics.[31] As dis-

[18] See the bibliographical list of human osteological and zooarchaeological reports on the *AJA* Web site (http://www.ajaonline.org), under "Supplemental Data."
[19] Molleson and Farwell 1993.
[20] Becker and Salvadei 1992.
[21] D'Amore et al. 1982; Lazer 1997; Capasso 2001; Bisel and Bisel 2002.
[22] Guesa et al. 1999; Rossi et al. 1999; Bondioli and Macchiarelli 2005.
[23] Henneberg and Henneberg 1990, 1998, 2002.
[24] Fox Leonard 1997.
[25] Hillson 2002.
[26] Baziotopoulou-Valavani 2002.
[27] Angel 1971.
[28] Rife et al. (forthcoming).
[29] Angel 1951.
[30] The historical development of paleopathological research in the classical context is outlined elsewhere (Grmek 1989; Roberts et al. 2005).
[31] There are numerous works on the broader subjects of health, disease, and medicine in antiquity. Some recent volumes include Hope and Marshall 2000; Cruse 2004; King 2005. Not all of these works, however, include the analysis of archaeological skeletal remains in their investigations.

eases can be investigated from multiple angles, paleopathological research attracts a variety of specialists, including anatomists, biologists, and osteologists (who might concentrate on determining the biological nature of pathogens or charting and curing the physical symptoms diseases manifest) to ancient historians and archaeologists (who might focus on the social and cultural ramifications of a disease or trace its incidence and prevalence in an ancient society). While the interplay of all these fields helps build a more intricate picture of ancient health and disease, the core of paleopathological research in archaeology remains the analysis of recovered skeletal materials from sites.

Although cases of skull trauma register in some late 19th- and early 20th-century studies of materials from Greek and Roman sites, there was no thrust to become more systematic about documenting paleopathological conditions on the whole suite of archaeological skeletal remains (not just crania) until the work of Angel in Greece in the late 1930s. Macroscopic and microscopic examination of human bones can provide information not only on serious diseases and traumatic injuries evident in ancient populations but also on small, almost normal factors, such as work- and age-related stresses, the state of bodily development, and nutritional deficiencies.

This research has developed considerably in the last few decades. While there is still a need to document interesting case specimens, research efforts today have progressed beyond singular discoveries to investigate larger issues associated with the incidence and prevalence of diseases in ancient populations over diverse regional and chronological contexts. Additionally, paleopathological conditions are increasingly investigated in relation to a range of demographic and environmental variables—gender, lifespan, height, body build, nutrition, physical environment, and atmospheric pollution. The research has become much more encompassing and multidisciplinary in its quest to understand ancient disease, its origins, causes, symptoms, whom it affects, and why.

There is not sufficient space here to mention all the relevant literature, let alone detail each example. This topic is perhaps one of the most productive in the field of classical osteoarchaeology. The current list of paleopathological conditions examined in the classical context runs an impressive gamut from traumatic injuries to congenital deformities to infectious and noninfectious diseases. Rather than document cases for each disease or pathogen, I have chosen here to highlight some thematic clusters on which paleopathological research in the classical context has focused.

1. Lead poisoning. Questions about lead exposure in antiquity, especially Roman antiquity, as a consequence of use in water pipes, in the winemaking process, and as an atmospheric pollutant have prompted a stream of paleopathological research. Topics have ranged from recognition of lead poisoning among representative case studies[32] to broader syntheses of the degree of exposure to lead in antiquity and how this may have varied because of social status, age, occupation, or location[33] to methodological studies assessing and refining the procedures used for detecting lead poisoning in ancient skeletal remains.[34] While there is general agreement that ancient Romans in particular were at a greater risk of lead poisoning than many other cultures past or present, more detailed maps of the variation of lead poisoning need to be constructed. Such maps should go beyond simply identifying high-risk areas or population segments in jeopardy of lead poisoning on the basis of artifactual evidence, such as lead pipe exposure or noted proximity to mining operations, and consider more skeletal data to assess actual levels of lead incorporated into the body.
2. Case studies of unique, sensational, or intriguing conditions. Many studies concern examples of fairly unusual ailments or special treatments of conditions. Most of these occur in low frequencies among populations and represent interesting, serendipitous case studies. Included in this category are studies of developmental defects, such as dwarfism,[35] possible neurofibromatosis,[36] dyschondrosteosis,[37] and hyperparathyroidism,[38] as well as examples of surgical treatments of skeletal and dental injuries or illnesses[39] and the controversial topic of ritual human sacrifice.[40]
3. Stressors. Included in this category are studies of skeletal lesions or features, including cribra orbitalia, cribra cranii, enamel hypoplasia, porotic hyperostosis, Harris lines, some types of vertebral lesions, and associated bone chemical and

[32] E.g., Waldron and Wells 1979; Capasso 1995.

[33] E.g., Steinbock 1979; Waldron 1982; Patterson et al. 1987; Capasso 1995.

[34] E.g., Waldron 1982; Wittmers et al. 2002.

[35] Roberts 1987.

[36] Murphy 2004.

[37] Waldron 2000.

[38] Cook et al. 1988.

[39] E.g., Mariani-Costantini et al. 2000; Weaver et al. 2000; Baggieri 2003; Cruse 2004; Lascaratos et al. 2004.

[40] E.g., Isserlin 1997; Ottini et al. 2003.

physiological changes that are symptomatic of compromised or stressed skeletal health. While overall these markers are considered good indicators of health and nutritional status, causes for them are numerous and range from infectious diseases, such as tuberculosis, brucellosis, anemia, thalasemmia, malaria, and leprosy, among others, to malnutrition and physiological traumas. Many of these skeletal lesions and features are nonspecific to a particular disease or stressor, so diagnosis is often difficult or impossible on the basis of osteological data alone. Nevertheless, this stressors category accounts for a sizeable portion of human osteological research in the classical context, largely a factor of its near ubiquity among samples analyzed. This is not to say that all members of a specific ancient population were equally compromised. Indeed, there is great variability in the incidence and prevalence of these skeletal markers of stress among ancient populations temporally, spatially, and culturally across the world of antiquity. While most individual skeletal reports (at least the more current ones) for classical archaeological sites present paleopathological data, particular attention has focused on anemia.[41] Anemic lesions are frequently symptomatic of diseases such as malaria and thalassemia, two illnesses of specific importance in Mediterranean areas. Consequently, researchers have concentrated on the anemia/malaria and anemia/thalassemia connection in efforts to assess the occurrence and spread of these diseases in antiquity.[42] Detailed skeletal studies or discussion of other infectious diseases reported from classical archaeological sites include cases of brucellosis and tuberculosis at Herculaneum[43] and leprosy from an adult male skeleton from the fourth- to third-century B.C.E. necropolis of Casalecchio di Reno, Bologna, Italy.[44] While there is still much research required before broad paleodemographic assessments for these diseases in antiquity can be formulated, collective results from the studies above have indicated cases where an assumed disadvantaged or otherwise stressed fraction of a population (e.g., children, women, slaves, poorer workers) showed higher frequencies of skeletal stress markers. Certainly, there is great potential in exploring the impact that these socioeconomic, age, gender, and cultural variables had upon ancient health and nutrition.

4. Degenerative bone and joint diseases and activity markers. Cases of degenerative bone and joint disease, such as osteoporosis and osteoarthritis, are common in many populations past and present, frequently among the elderly. Although many of the individual site reports for ancient Greek and Roman skeletal material outline examples of these paleopathological conditions, larger syntheses of the overall incidence and prevalence of these conditions across ancient populations are lacking. A similar argument can be made concerning skeletal activity markers. Again, examples of these, such as squatting facets on tibiae, are typically reported in site studies but with less attention on the causative behaviors involved in their formation and the cultural factors that affect those behaviors. There are exceptions, however. One study noted a significantly higher frequency of auditory exostoses (i.e., lumps of bone in the outer ear canal) in samples of male crania from the Roman imperial cemetery at Isola Sacra (on the Mediterranean coast near Rome) compared with females from the same site and in relation to both males and females from the inland Roman rural cemetery site of Lucus Feroniae.[45] Investigators attributed the bias to differing social habits, with the middle-class males in the Isola Sacra sample frequenting thermal baths more often than either Isola Sacra females or the Lucus Feroniae population (mostly composed of slaves or freedmen farm laborers).
5. Dental disease, health, and nutrition. Although teeth tend to survive well in the archaeological record and there is a significant amount of research on dentition, the extent of dental disease in the classical world is not well known. As expected, there is much variation in dental health in ancient populations based on factors such as age, gender, diet, economic status, and geographic region. The relatively low rates of dental caries, periodontal disease, calculus (tartar), and related dental ailments among some ancient populations (notably some Romano-British groups) compared to some modern populations suggest diets of predominantly coarse bread, vegetables, and some meat.[46] Similar generalized accounts of dental health have been drafted for other an-

[41] E.g., Stuart-Macadam 1985; Robledo et al. 1995; Ricci et al. 1997; Salvadei et al. 2001; Facchini et al. 2004.
[42] Ascenzi 1979; Sallares 2002.
[43] Capasso 1999, 2002; Canci et al. 2005.
[44] Mariotti et al. 2005.
[45] Manzi et al. 1991.
[46] Thornton 1991; Cruse 2004, 182.

cient populations, but again, results overall show much variability. For example, high frequencies of caries, abundant calculus, and low frequencies of tooth wear characterize diets limited in hard fibrous foods and high in consumption of carbohydrates among a sample of 67 adults from the Roman necropolis of the Imperial period (first–fourth century C.E.) of Quadrella, Molise, Italy.[47] By contrast, dental evidence from the first- to third-century C.E. cemeteries at Lucus Feroniae and Isola Sacra, Italy, show lower frequency rates for these dental conditions, suggesting comparably improved diets.[48] Further work has indicated that the transition from the Roman period to the Middle Ages in central Italy witnessed a general deterioration of the state of health and quality of life, probably the result of a chronic state of malnutrition characterized by a greater consumption of carbohydrates and poorer hygienic/sanitary conditions.[49] Overall, there is still much more work to be done to determine broader patterns of dental health across the entire classical world, and to understand the connections these have with the range of cultural and environmental factors affecting diet and behavior.

Stable Isotopes and Diet. Archaeologists employ a series of direct and indirect methods to reconstruct ancient diets, including faunal and botanical analyses, pollen and phytoliths, residues from vessels, coprolites, inferences from skeletal pathology, dental wear patterns, and recordings from ancient texts and iconography. In most cases, however, these techniques only provide data on items consumed, with less about their quantified dietary contribution. Zooarchaeological analyses can provide good quantitative estimates for the meat component of the diet, but generally, as with the other categories listed above, these data almost always pertain to groups of people and usually consider diets over relatively broad time spans.

The use of stable isotopes in archaeological dietary reconstruction counters some of these problems by providing direct evidence of foods that were consumed. The basic premise of the procedure relies on scientifically measuring the difference in the ratios of stable carbon (^{12}C, ^{13}C) and nitrogen (^{14}N, ^{15}N) isotopes, variations of which relate to environments in which humans live and foods they ingest.[50] First applied to human skeletal remains in the 1970s, this technique has been used to investigate topics such as the introduction and spread of maize agriculture, the determination of levels of marine vs. terrestrial foods in the diet, the assessment of proportion of legumes to nonlegumes, and the existence of dietary difference in age, sex, and status categories both within and between cultures, as well as across space and time.

While the procedures have been known for some time, stable isotope analyses have only recently been applied to osteological samples from classical sites. Published reports include representatives from the first- to third-century C.E. cemetery of Isola Sacra, Italy, from the Roman-period cemetery of Poundbury, England, and from two Greek colonial sites: the seventh- to second-century B.C.E. settlement at Metaponto, southern Italy, and the fifth- to second-century B.C.E. site of Apollonia, on the Black Sea coast of Bulgaria.[51] In each case, investigations focused on determining the relative importance of marine vs. terrestrial resources in the diet and exploring any variations in these commodities with respect to age, sex, and burial type. Results in all cases reaffirmed traditional arguments, as drawn solely from literary sources, of a dietary dominance of terrestrial foods in these ancient Greek and Roman samples; however, not without differences. According to researchers, the Apollonia colonists consumed a mixed diet of terrestrial and marine foods that showed little or no variation by age, sex, or burial type.[52] The Isola Sacra sample, by contrast, showed greater variation. Many of the skeletons here, notably older males, were more enriched in ^{15}N, inferring perhaps an age- and sex-related importance of marine foods in the diet. Age-related dietary differences further appeared in this sample in that some older individuals showed depleted levels of ^{13}C, suggesting increased consumption of olive oil and possibly wine, while subadults (older than five years) appear to have consumed an almost exclusively terrestrial diet.[53]

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[47] Bonfiglioli et al. 2003.

[48] Manzi et al. 1999.

[49] Manzi et al. 1999.

[50] For further details of the principles and procedures involved in stable isotope analyses and dietary reconstruction, see Schwarcz and Schoeninger 1991; Katzenberg 2000; Tykot 2004. Basically, nitrogen levels record variations in the trophic ladder; herbivores thus have lower ^{15}N levels than those animals (including humans) who eat them. There are also variations in nitrogen levels between marine and terrestrial resources, with augmented ^{15}N levels generally found in humans who consume more fish in their diet. Carbon values relate to ingestion of C_3 and C_4 plants. Most temperate-region plants and some subtropical grasses, including wheat and barley, are C_3 plants, while maize, millet, and sorghum are C_4 plants. C_3 plants have $\delta^{13}C$ values ranging from –20‰ to –35‰. In contrast, $\delta^{13}C$ values for C_4 plants range from –9‰ to –14‰.

[51] Poundbury: Richards et al. 1998; Metaponto: Henneberg and Henneberg 2003; Isola Sacra: Prowse et al. 2004, 2005; Apollonia: Keenleyside et al. 2006.

[52] Keenleyside et al. 2006, 1205.

[53] Prowse et al. 2004, 259; 2005, 2.

In addition to providing evidence for broad dietary patterns among ancient populations, stable isotopic research has been used to assess topics such as infant feeding and weaning practices in Roman Egypt[54] and population migration patterns in the Roman Germanic provinces.[55] The latter study, however, relies not on stable carbon or nitrogen isotopes but on stable strontium (Sr) isotopes. The basic premise here is that Sr isotopic ratios in humans vary in relation to one's environment (in particular, the geochemical setting). Strontium gets incorporated into tissues such as bone and tooth enamel, which mineralize at different ontogenetic stages in the person's life. We might surmise a change in residence by comparing Sr levels in tooth enamel, which develop in childhood, with bone Sr values, which record conditions in adulthood.

DNA Analyses. Given its specificity and seemingly vast potential to provide genetic information about past populations, DNA has become a key interest for current archaeological research.While DNA studies may eventually supersede many of the current techniques of skeletal analysis and dominate osteological research in the future, the reality today is quite different. Concerns such as a lack of standardization in analytical approaches for DNA, contamination of samples, and expense of conducting work have inhibited wider application of DNA procedures on many archaeological projects. Nonetheless, it is important to note here that tests on ancient skeletal samples, including materials from Pompeii and Isola Sacra, have also contributed substantially to our understanding of procedural issues such as DNA extraction, amplification, and preservation.[56] Overall, current use of DNA in the classical context is limited, although this is probably a factor of research priorities for most DNA scientists being directed to other anthropological and archaeological concerns such as the origins of humans or migration during prehistoric times.[57] Still, the potential for using DNA to examine similar issues of genetic origins, migrations, and ancestral relationships involving ancient Greek and Roman populations is immense and revisits topics that have more traditionally been examined using craniometrics. For example, using mitochondrial DNA (mtDNA), a variety of DNA that is inherited through one's maternal lineage, researchers have concluded genetic similarity between modern and ancient populations of the Iberian Peninsula, suggesting a long-term genetic continuity in the area since pre-Roman times.[58] Results from this work further indicated that there was less genetic diversity in the ancient Iberians than that found in modern populations and that the Iberians were not expressly related to the Etruscans, a finding that supports the hypothesis of considerable genetic heterogeneity in pre-Roman western Europe. Similar investigations examine long-term genetic history of populations in Israel, Italy, and Sicily[59] but tend to focus on linkages to prehistoric populations in these areas as opposed to chronological ties with classical antiquity. The techniques of mtDNA in tracing ancestry can also be applied at a microlevel. For example, mtDNA extracted from four skeletons in an Etruscan tomb shared sufficient sequencing patterns to suggest that they were members of a family group, consisting of two parents and their son and daughter.[60]

DNA research also contributes to investigations in the fields of paleopathology and forensic and archaeological studies. Again, however, the bulk of the research on these topics has concentrated on prehistoric cultures or medieval and more modern groups. Nevertheless, some important works focus on ancient populations. In the area of forensic work, investigations of DNA sequences specific to X and Y chromosomes (i.e., those that determine one's biological sex) showed a 9:4 male/female ratio within a small sample of reputed infanticide victims from Roman Britain.[61] A similar study found a 14:5 male/female ratio among supposed infanticide victims from Roman levels at Ashkelon.[62] The male imbalance in these two cases promotes questions about some traditionally held notions of female infanticide in antiquity.

Finally, in the field of DNA research on classical sites, mention should be made of its application in disease diagnosis. Recognizing the pathogens responsible for carrying or causing diseases through investigation of their DNA has great potential in paleopathological research, considering that many diseases (e.g., the plague, smallpox, cholera, diptheria, measles, ma-

[54] Dupras et al. 2001.

[55] Schweissing and Grupe 2003.

[56] Among these applications in classical archaeology, studies using skeletal material from Isola Sacra have provided some suggestions on amplification protocols for ancient mitochondrial DNA (mtDNA), when tiny, unavoidable bits of modern human DNA exist as contaminants in samples (Yang et al. 2003). Successful DNA extraction from skeletons in Pompeii has contributed to our understanding of the dynamics of burial conditions on DNA preservation (Cipollaro et al. 1999).

[57] For a short review of the major contributions and lines of DNA research in archaeology, see Cipollaro et al. 2005.

[58] Sampietro et al. 2005.

[59] Sicily: Rickards et al. 1992; Italy: Barbujani et al. 1995; Israel: Nebel et al. 2001; Vernesi et al. 2004.

[60] Cappellini et al. 2004.

[61] Mays and Faerman 2001.

[62] Faerman et al. 1998.

laria, and many tumors) will not expressly affect the skeleton, or will instead leave only nonspecific indicators of stress (e.g., Harris lines, porotic hyperostis, enamel hypoplasia, and similar nonspecific markers) that cannot be linked conclusively to a single disease. DNA research on children's bones recovered from the Late Antique cemetery at Lugnano di Teverina, Italy, identified strains of *Plasmodium falciparum,* the most virulent of the four species of human malaria, lending support to the hypothesis that a widespread outbreak of an especially lethal form of malaria plagued this area in the fifth century C.E.[63] DNA tests also proved instrumental in identifying ancient strains of the organism causing typhoid fever present in the dental pulp extracted from several ancient skeletons in the Kerameikos cemetery, Athens. The results shed light on the pathogenic nature of the plague that killed vast numbers of Athenians between 430 and 426 B.C.E.[64]

Metric and Nonmetric Traits. Although DNA evidence is helping to track population affinity patterns in ancient populations, the question is also being investigated through the use of metric and nonmetric data. Cranial measurements are still used in assessing population variability,[65] but they are now only part of a larger suite of metric and nonmetric data collected from all areas of the skeleton that can provide information.[66] Greater attention has lately focused on the dental record as a means to assess population affinities, perhaps because of the durability of teeth (and resultant potential for large, significant sample sizes) and the range of both metric and nonmetric variables that can be measured or scored using dentition. In one study, analyses of dentition showed a Roman urban sample collected from the Isola Sacra necropolis to be less variable metrically and less sexually dimorphic than a rural sample, as represented by the dental remains from the cemetery at Lucus Feroniae.[67] Moreover, assessment of discrete traits in these dental samples revealed less variability in the Lucus Feroniae sample, suggesting a more homogenous gene pool as compared to the Isola Sacra cemetery occupants. In another example, researchers found no evidence on the basis of dental metric or nonmetric data to support a hypothesis that the Apennine Mountains in central-southern Italy provided a significant geographical barrier for population migration to either side during the first millennium B.C.E.[68]

Human Osteology, Category 3: Larger Synthetic Analyses

The impressive collection of individual site reports and specialized studies for human osteological material from classical sites contrasts with the current scarcity of broad syntheses that pool data from these examples to investigate larger-scale patterns in human health, diet, demography, and behavior during antiquity. Certainly, there are synthetic-style articles and books examining individual topics or small collections of them,[69] but generally these issues have been tackled using other lines of evidence, such as ancient textual references or non-osteological archaeological materials, with select skeletal data included where obtainable or when illustrative of concepts argued. Excellent local analyses that focus on skeletal data from a single site, however, are available. The works on the skeletal remains from excavations at Poundbury, Isola Sacra, Herculaneum, Metaponto, Lerna, Corinth, and Troy are noteworthy in this respect. They include a range of osteological tests and analyses in their attempts to describe and examine the skeletal material. While some of these site reports also include comparative data from other sites (e.g., Isola Sacra compared to Lucus Feroniae, Paphos compared to Corinth), the scale of comparison is restricted to no more than a handful of sites in most cases, and if more sites are included, only select aspects are addressed (e.g., craniometric data or stable isotope values).

Larger synthetic volumes that examine human osteological patterns beyond the site up to the regional and provincial levels are required for the classical context. Key survey articles and comprehensive lists of skeletal reports from classical archaeological sites for areas such as Sicily, Greece, and North Africa provide an important foundation for this type of synthetic work.[70] However, there is still more that can be done to collate and assess individual site skeletal data sets to investigate and outline broader patterns, trends, and anomalies that may exist. Becker's detailed review of studies of human skeletal remains and human biology from Sicily from the Paleolithic to modern times is a solid contribution in this direction.[71] A further initiative along these lines is the massive Global History of Health in Europe project that amalgamates osteological data from tens of thousands of excavated skeletons to investigate demographic and health patterns over the past 10,000 years.[72] Practical concerns, such as

[63] Sallares and Gomzi 2000; Sallares 2002.
[64] Papagrigorakis et al. 2006.
[65] E.g., Lalueza Fox et al. 1996, albeit incorporating multivariate statistical procedures in this assessment, rare among earlier craniometric examinations.
[66] E.g., Rubini et al. 1997 (on Etruscan biology).
[67] Manzi et al. 1997.
[68] Coppa et al. 1998.
[69] E.g., Grmek 1989; King 2005.
[70] Sicily: Becker 1995–1996, 2000; Greece: Roberts et al. 2005; North Africa: MacKinnon 2007.
[71] Becker 2002.
[72] http://global.sbs.ohio-state.edu.

small sample sizes, taphonomic troubles, poor preservation, insufficient retrieval of materials, and lack of contextual data, coupled with more problematical questions such as the degree to which the interred skeletal population is representative of the original population, are all valid complications that have hindered or stalled attempts to construct larger objective syntheses of skeletal materials from classical sites. If the effects of these factors on the integrity of individual skeletal samples are unknown, how then can samples from different sites be compared reliably? The increasing pool of skeletal remains from classical sites will mitigate this problem, and there will certainly be more opportunities for larger synthetic research using human osteological data in the future.

Zooarchaeology, Category 1: Individual Site Reports

The dissemination of zooarchaeological research consists of individual site reports, specialized reports, and synthetic analyses, with individual site reports composing the bulk. There are many of these,[73] although the quality among them varies considerably, depending on date of publication, research focus, nature of the sample, and other factors. Earlier reports tend to provide less information, often being simply a list of animal taxa represented at the site, with less attention devoted to quantifying the material and interpreting any patterns displayed. Most current reports, however, extend well beyond this level. Generally, zooarchaeological reports for the classical context now contain (1) notes about bone recovery techniques, sampling strategies, and any associated biases these factors may have had; (2) an assessment of taphonomic conditions affecting the sample; (3) quantification of the remains (by animal taxa and skeletal elements), most commonly through methods such as NISP (number of identified specimens), MNI (minimum number of individuals), and systems of weighing (bone weight and/or calculated meat weight); (4) age and sex determination of the specimens and demographic profiles constructed from these data; (5) osteometric data and their assessment in issues such as taxonomic or sex determination, breeding improvements, and related issues involving size changes; (6) an examination of butchery marks, fragmentation patterns, and food preparation schemes that affect the bones; and (7) analyses of dental and skeletal pathological lesions. Combined, these data are then used to reconstruct the roles and contributions of animals to the culture(s) under investigation at the site and to examine topics such as dietary analysis and husbandry techniques. Depending on the context and site, the data may be used to reconstruct aspects of the ancient environment as well.

Reference lists of zooarchaeological site reports for classical archaeology are published elsewhere.[74] As with human osteological site reports, the quality varies depending on sample size, nature of deposits, allocated publication space, the foci of the investigation, historical and methodological context for research, and other factors. Detailed zooarchaeological site reports in classical archaeology did not appear with any regularity until the 1970s with the publication of influential works for sites such as:

1. Exeter, England (Roman to Medieval).[75]
2. Lerna, Greece (Neolithic to Late Helladic).[76]
3. Manching, Germany (Roman).[77]
4. Bourse (Marseille), France (Roman).[78]
5. Sidi Khrebish, Benghazi (Berenice), Libya (Roman).[79]

The number of zooarchaeological site reports for classical archaeological projects rose tremendously in the 1980s and afterward. Many of these were incorporated as chapters in site volumes, or published/archived as separate reports in other formats.[80] Increasingly since the 1980s, however, entire books devoted to zooarchaeological remains from classical sites have been published, a format that has allowed for detailed studies. Several key volumes and monographs have included studies of:

1. Samos, Greece (Archaic).[81]
2. Sagalassos, Turkey (Roman/Late Antique).[82]

[73] I would estimate 1,000 for classical archaeology, the bulk from Roman sites.

[74] E.g., King 1999 (for Roman archaeology). Payne 1985; Reese 1994, 2005 (for Greek archaeology).

[75] Maltby 1979.

[76] Gejvall 1969.

[77] Boessneck et al. 1971.

[78] Jourdan 1976.

[79] Barker 1979.

[80] Included in this category are (1) unpublished theses and dissertations on zooarchaeological materials from classical sites, an increasing class of reports; (2) reports submitted to (and sometimes published by) archaeological contract agencies and heritage foundations, such as English Heritage in the United Kingdom (e.g., the Ancient Monuments Laboratory Series), many of which are excellent; (3) Internet-published reports, such as those for the site of Sagalassos on *Archaeology* Magazine's Interactive Dig component (http://www.archaeology.org/interactive/sagalassos), or zooarchaeological conference presentations, reports, and related research and data shared on the BoneCommons Web site (infra n. 148) and the Open Context service (infra n. 149), both of which are sponsored by ICAZ and the AAI.

[81] Boessneck and von den Driesch 1988.

[82] De Cupere 2001.

3. Tác-Gorsium, Hungary (Roman).[83]
4. Augusta Raurica, Austria (Roman).[84]
5. Lutecia, Paris, France (Roman/Late Antique).[85]
6. Colchester, England (Roman/Medieval).[86]
7. Lincoln, England (principally Late Roman/Late Saxon).[87]
8. Castillo de Doña Blanca, Spain (Iron Age).[88]
9. San Giovanni, Italy (Roman/Late Antique).[89]

As zooarchaeological methodology standardized throughout the 1980s to the present, so did the level of consistency in how zooarchaeological site reports were structured. Zooarchaeologists have emphasized the importance of this, especially in clearly stating the methods used in analysis and by presenting data to allow evaluations and interpretations by other specialists. Consistency in methodology and data presentation, moreover, allows archaeologists and other scholars to understand the potential and limitations of the bone remains and to use, with some measure of reliability, the data from various sites to draft larger synthetic accounts of ancient life.

Although zooarchaeological reports for classical sites have progressed immensely in the past few decades in terms of the quality and quantity available, there are still concerns to address. Meaningful zooarchaeological descriptions and interpretations rely on information concerning site type, excavation results, and recovery methods. Analysis of a zooarchaeological assemblage devoid of context descriptions, preliminary site phasing, and information about the integrity of layers and features is limited in its scope compared to one where these data are provided to, or can be accessed by, the project zooarchaeologist. With these data, chronological and spatial groups of bones can be examined, resulting in far more valuable and meaningful interpretations of assemblages. Baker and Clark provide a checklist of essential data, including site details, excavation information, recovery techniques, and associated artifactual material, that should be provided by the archaeologist to the animal bone analyst.[90]

Zooarchaeology, Category 2: Specialized Site Reports

Animals have had a great impact on human culture throughout time. In the context of the classical world, for example, animals factor into numerous cultural domains: subsistence, economics, social structure, politics, religion, trade, and psychology, to name a few. They are practical in supplying renewable and nonrenewable resources for our diet, economic benefit, and general well-being, but they are also symbolic of aspects such as status, wealth, control, companionship, and reverence in their roles as property, pets, or ritual offerings. The analysis of animal bones from archaeological sites, therefore, can shed light on numerous aspects of ancient cultural behavior. Animals also factor into the realm of biology and can inform us about the natural world of antiquity. In this manner, their analysis sets a physical context for ancient human life—the geographical, climatic, ecological, environmental, and seasonal setting in which classical cultures operated.

The interplay of all these biological, cultural, and environmental components shapes human behaviors. Factors such as socioeconomic status, geographic location, trade, ethnicity, rainfall, geography, religion, personal preference, and vegetation—in other words, a vast array of cultural and natural variables—shape peoples' decisions about diet. Consequently, materials such as zooarchaeological remains, which inform us about ancient diets, can provide information about those factors (cultural and natural) that influenced dietary choice. Animal bones, then, are powerful cultural reconstructive tools. The scope can be expanded if one considers the potentially limitless ways in which animals, their products, their resources, and their services contribute to our biological, economic, social, psychological, and spiritual well-being.

Zooarchaeology has been tied most traditionally to reconstructions of ancient diets and animal husbandry practices, topics that have received much attention and thus warrant more discussion here. Two further issues to highlight are butchery practices and ritual use of animals. It should be appreciated that this list is just a selection of topics and that zooarchaeological work in classical archaeology spans a great range of research.

Ancient Diet. Most of the bone remains recovered from classical archaeological sites derive from animals that have been consumed. The frequency of the various taxa represented can therefore give an idea of the contribution of each to the ancient diet. The proportions of different cuts of meat, as shown by the relative percentages of bones associated with these cuts, afford more specific information.

Dietary analysis using zooarchaeological remains is a huge topic in classical archaeology. Although assump-

[83] Bökönyi 1984.
[84] Schibler and Furger 1988.
[85] Oueslati 2006.
[86] Luff 1993.
[87] Dobney et al. 1995.
[88] Roselló and Morales 1994.
[89] MacKinnon 2002.
[90] Baker and Clark 1993, 54–5.

tions that the basic diet for most ancient Greeks and Romans was largely vegetarian are justified,[91] zooarchaeological data (and stable isotopic data from human remains) affirm that meat was also eaten. Moreover, zooarchaeological studies are adding to this picture by detailing variations in the meat component of the diet that are coincident with a host of cultural, geographical, environmental, and chronological factors. Several key topics are discernible. Increasing attention has focused on determining regional and/or temporal variation in the meat diet across cultures of antiquity. Studies tend to concentrate on dietary contributions of the main domestic food species: cattle, sheep, goats, and pigs. Most reports from classical archaeological sites contain some discussion of the dietary role of these domesticates. Turning to larger dietary assessments from zooarchaeological data, however, the Roman period dominates. King's empire-wide survey of dietary patterns as based on comparisons of mammal bones from Roman archaeological sites stands as a valuable aid in demarcating general temporal and regional trends in meat consumption during Roman antiquity.[92]

Another topic of interest in dietary reconstruction using zooarchaeological data addresses variation as a factor of cultural parameters. Here, dietary differences between categories such as rural and urban, civilian and military, and rich and poor are examined.[93] Certainly, many of these categories are not as dichotomous as presented above, resulting in a complex range of socioeconomic and settlement aspects to address. There are also larger issues of production, marketing, trade, ethnicity, religion, and personal choice that affect access to foodstuffs and ultimately influence a person's diet.[94] For example, there is a general impression, gleaned from ancient literary references especially, that ancient Romans did not consume horse meat. Zooarchaeological data provide support for this dietary taboo in many areas of the empire but also indicate exceptions. The location, placement, and angle of chopping and cutting marks on horse bones from some sites in the Roman Netherlands, especially those sites with stronger "native" ties, or those located north of the *limes*, suggest butchery for consumption.[95] Consequently, zooarchaeological research highlights the variation among these sites and enforces a need to examine the pattern of Roman horse meat taboos at a more refined level, as opposed to generalizing across larger regions and cultures.

The contribution of nondomestic animal taxa in the ancient diet represents another key topic of interest. All manner of wild taxa can be assessed in this category, including not only hunted mammals and birds but also fish and mollusks. Dietary contribution, hunting and fishing techniques, and issues related to the introduction and extinction of wild animals throughout antiquity might be measured as well.[96]

Finally, a more recent line of research has focused on the social context of marketing, dining, and feasting, either in a ritual setting or otherwise. The communal aspect of many animal sacrifices in antiquity prompts queries about the distribution of meat among the audience of worshipers, which are questions zooarchaeological data are helping to answer.[97] Moreover, in the absence of refrigeration or other convenient methods of preserving meat, some element of public sharing, feasting, or marketing probably followed the slaughter of a large animal (e.g., a cow), given the significant amount of meat such a beast would provide. The social context of activities involved in capturing and hunting animals has also been addressed using zooarchaeological data.[98]

While meat consumption dominates dietary reconstructions involving zooarchaeological remains, it is important to remember that other edible and nonedible and renewable and nonrenewable resources can be exploited from many animals as well. The contributions of commodities such as milk (and cheese), marrow, bone grease, animal oils, fats, and, in some cultures, blood to the diet are important to address, and often can be examined using zooarchaeological data.[99] There is a huge body of scholarship investigating the use of nondietary resources provided by animals, including bone, antler, ivory, wool, hair, fur, hides, feathers, skin, sinews, shell, and other products, among classical cultures. Again, zooarchaeological work has contributed significantly to our understanding of these topics.[100]

Animal Husbandry. Much work has addressed aspects of animal husbandry in antiquity, incorporating a

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[91] Ancient textual references, paleobotanical data, stable isotopic research, and ethnographic analogy provide good support for a predominantly vegetarian diet among most of the ancient populace.

[92] King 1999.

[93] E.g., Clark 1987; King 1999; Lauwerier 1999; MacKinnon 2004.

[94] E.g., Crabtree 1990.

[95] Lauwerier 1999.

[96] E.g., Ervynck et al. 1999.

[97] E.g., Hägg 1998; Halstead and Isaakidou 2004.

[98] E.g., Hamilakis 2003.

[99] E.g., Mulville and Outram 2005.

[100] Bone, antler, and ivory working: Greep 1983; wool: Ryder 1983; murex shell purple-dye production: Reese 1980; tanning and hide processing: Serjeantson 1989; Leguilloux 2004.

range of data: zooarchaeological, enthographical, historical, ancient literary, epigraphical, and iconographical.[101] Zooarchaeology has contributed to this issue in classical archaeology through its reconstructions of herd compositions, animal sizes, and demographic patterns across sites. It should be stressed, however, that in large measure, zooarchaeologists somewhat indirectly arrive at these productive aspects of the ancient economy. As Baker and Clark reinforce:

> It may be suggested that all samples of animal bones will reflect consumption rather than production (the exception to this being the find of complete carcasses of animals which had been raised but had died of disease, as a result of which they were considered unfit for human consumption). In other words, consumption is a logical corollary to production, and unless the system is interrupted for whatever reason, we must perforce view production through the filter of consumption. However, from a careful and critical assessment of the data resulting from consumption, some information upon the associated production system(s) may be gleaned.[102]

The greatest attention in husbandry reconstructions for classical antiquity has focused on important consumed domesticates: cattle, sheep, goats, and pigs. Ancient herders relied on numerous husbandry tactics: raising small numbers of livestock or maintaining large herds; providing feed to stall-kept animals; having animals pasture on near and/or distant lands; keeping animals year-round within the vicinity of the farm; involving them in extensive nomadic or transhumant journeys, often coordinated with seasonal schedules; generalizing with a range of livestock and its resources; and specializing in one type of animal or exploiting one chief resource. Nevertheless, these are only a few of the husbandry schemes employed by ancient herders and farmers. There is simply too much temporal and regional variability in animal husbandry strategies across the classical context to outline them in detail here.

Animal husbandry practices are often intricately tied to sociocultural and environmental variables. Consequently, recognition of changes in husbandry patterns as revealed in the zooarchaeological record raises questions about the underlying causes behind these. Zooarchaeologists generally use age and sex data to determine herd composition and exploitation strategy for a taxon and then compare species' frequency values to see if herders are specializing in one or more types of animals or products from these animals. Mortality and sexing profiles for sheep and goats among Roman sites in central Italy, for example, show a particular attention to the production of meat, with most animals killed around two to three years of age, at their maximum weight. This contrasts with data from medieval faunal assemblages, where there are generally higher proportions of animals killed after three years of age, a pattern typically indicative of greater exploitation of wool. Increasing population sizes and densities in central Italy during Roman times certainly factored in the shift toward more intensive pig breeding in the area, especially in the second and third centuries C.E.[103] Pigs are prolific breeders and can often be kept at lower production costs than other domesticates, such as cattle and sheep.

While age, sex, and distribution patterns help zooarchaeologists reconstruct herd profiles and, in turn, the husbandry schemes humans chose for these animals, other areas where zooarchaeological data are instrumental concern our understanding of breeding improvements and the spread of different varieties of livestock across regions in antiquity. Traditionally, these issues have been examined using osteometrical data. Bone measurements allow zooarchaeologists to predict overall animal size and, through different ratios calculated by comparing various dimensions, assess variations in shape. Where domestic livestock are concerned, more attention in the classical context has focused on changes in animal size (and generally height), as opposed to changes in shape. The bulk of this research has concentrated on Roman times. Zooarchaeological data confirm a size increase in cattle, sheep, goats, and pigs across the empire coincident with Roman colonization.[104] The largest representatives tend to originate in Italy, suggesting that this area saw the first dramatic overall improvements in breed size.[105] But results among other Roman provinces are inconsistent when tracing any gradual migration of these breeds out of Italy. The situation of improved breeds entering Italy from Greece or Eastern Europe prior to Roman times is also unclear.

Another zooarchaeological aspect important to understanding ancient husbandry practices is animal paleopathology. Recognizing and documenting these conditions assists in reconstructing the general state of health or specific causes of death among individuals and populations. In some cases, the condition is

[101] E.g., White 1970; Barker and Grant 1991; Isager and Skydsgaard 1992; Topyln 1994; Bartosiewicz and Greenfield 1999; MacKinnon 2004; and many others.

[102] Baker and Clark 1993, 60.

[103] De Grossi Mazzorin 2004, 40.

[104] Bökönyi 1974; Thomas 1989; Audoin-Rouzeau 1991a, 1991b; Lepetz 1996; Peters 1998; Columeau 2002.

[105] MacKinnon 2004.

unique, such as a fracture that was deliberately or accidentally inflicted. This might help reconstruct living conditions for the animal or provide information about how it was treated. In other cases, the pathological disorder might be more widespread, suggesting chronic illness, perhaps even an epidemic. Although pathological conditions are generally noted in zooarchaeological reports for classical sites, with some case studies considered in depth,[106] less attention has focused on larger chronological and geographical syntheses of animal paleopathologies across the ancient world. The investigations of skeletal changes, including pathological conditions, in draft cattle represents an important step forward in this respect.[107] However, there are many other pathological conditions that should be similarly assessed, such as dental calculus—a common condition noted in site reports but one for which no larger synthesis detailing its incidence and prevalence among ancient animals currently exists.

Butchery. The basic processes involved in the slaughter, dressing, and butchery of an animal are generally uniform and do not vary significantly among cultures. Nevertheless, a range of components, such as tools used, the level of organization, and the efficiency and skill on the part of the butcher, can vary among individuals and cultural groups.

The study of butchery is essentially twofold. First, zooarchaeologists can analyze patterns, noting the distribution and frequency of various bones that are associated with different cuts and qualities of meat. Second, they can examine the chop, saw, and cut marks on the bones to reconstruct the procedures, technology, and scale of operations associated with slaughter and butchery.

While butchery techniques are often discussed in the context of an individual zooarchaeological site report, this topic of research is also quite active in terms of more specialized studies. Much of this work on classical sites relies on ethnoarchaeological and experimental work to recognize and trace patterns, which can help us understand butchery procedures among ancient populations.[108] A large part of current zooarchaeological research on butchery in antiquity is focusing on the effect of urbanization on procedures, assessing topics such as the skill level of the butcher and the variability in procedures coincident with the type and age of the animal involved, the intended consumer, the available toolkit, and other aspects.[109] For example, the use of modern butchery procedures to replicate distinctive marks from Roman zooarchaeological specimens indicated that Romano-British urban butchers were not employing crude and unskilled practices in carcass dismemberment but instead were maximizing the speed of operations so that as many carcasses as possible could be butchered in a set period of time.[110]

Ritual Use of Animals. Animals figured prominently in many ancient rituals. Greek and Roman pagan religions involved numerous animal sacrifices as well as the superstitious use of animal products. Despite this prevalence, however, it is not always easy to recognize such applications in the archaeological record, let alone decipher their significance. Traditionally, animal bone deposits have been considered special, significant, or symbolic if one or more of the following conditions are met: (1) a state of completeness, (2) the presence of skulls, (3) the placement of animals in association with other objects of ritual significance, or (4) when the context of deposition has been considered unusual.[111] In practice, however, it is often quite complicated or even impossible to distinguish this sort of variability from that created by differential function in usage or differential preservation/recovery. Moreover, new lines of questioning have challenged the perceived dichotomy between apparently ritualized or sacred deposits involving animals and the disarticulated and butchered bone fragments that are commonly viewed as economic and dietary waste.[112] The notion that every deposit with animal bones, even the most mundane, may be symbolically encoded reinforces the need to examine critically and in greater depth the spatial context and associations of all forms of material culture from an archaeological site.

Despite the complications in assessing ritual behavior from animal bone remains, some clues have helped in our understanding of these practices for the classical context. Most obvious might be a secure connection with sacrificial altars, burials, or other types of ritualized areas where animals (or parts of them) may have been offered or honored in sacrifice. Classical archaeological sites produce such deposits with faunal remains, collectively yielding a wealth of data about

[106] E.g., Davies et al. 2005.
[107] Bartosiewicz et al. 1997.
[108] E.g., Peck 1986; Grant 1987; Rodet-Belarbi and Yvinec 1990; Burke 2000.
[109] Peck 1986; Seetah 2005a, 2005b.
[110] Seetah 2005b.
[111] Grant 1989, 1991; Wilson 1992.
[112] The growing consensus within the zooarchaeological community is to label "special" bone deposits as Associated Bone Groups (ABGs), following the recommendations of Hill 1995, 1996. Unlike the term "special," the ABG designation does not presuppose any unique or exceptional purpose for these groups a priori.

the use of animals in ritual aspects of antiquity. Four important categories might be discerned: (1) pit and ditch deposits in Britain and Gaul;[113] (2) deposition in sacred wells, or *bothroi*, typically in Greek and Hellenistic contexts;[114] (3) animal burials in tombs and graves, either alone or in association with human remains;[115] and (4) sacrifices (often burnt ones) from altar, temple, or sanctuary contexts.[116] Although there is variability regionally and chronologically in the classical world, some overall patterns emerge in each of these categories. Dogs and horses appear more frequently among pit, ditch, and sacred well deposits, and consumed domesticates, such as cattle, pigs, sheep, and goats, dominate most burnt-animal sacrifices, while dogs, birds (esp. domestic fowl), and pigs factor more prominently in graves. The designation of birds and pigs as grave goods or food offerings may be argued in many of these cases, while the association of the dog with protection and/or companionship in the afterlife has been more widely posited.

Zooarchaeology, Category 3: Larger Synthetic Analyses

The blurring of academic boundaries coupled with a demand to organize and manage the ever-increasing database of faunal information that has accumulated, especially over the past 30 years, has led to the publication of a variety of zooarchaeological syntheses for various regions of the ancient world. The bulk of these pertains to Roman sites, given the vast geographic extent of the empire. Spatially, however, zooarchaeological syntheses for Roman Britain and the Roman northwestern provinces, including Gaul and Germany, predominate.[117] Only recently have similar syntheses been attempted for other areas of the Roman empire, including Italy and Galicia.[118] Roman provinces in Iberia, North Africa, Greece, and the eastern Mediterranean are currently in need of similar zooarchaeological syntheses. The same is also true, in large part, for the entire ancient Greek world. Although Payne and Reese have published extensive bibliographies of animal bone reports for ancient sites (Neolithic to Frankish) for Greece and the Aegean region,[119] a larger synthesis of the data from these sites is not yet published. Nevertheless, synthetic-style articles have tackled more focused issues, including burnt-animal sacrifice and ritual feasting, for the ancient Greek context.[120]

To some degree, the relative abundance of zooarchaeological syntheses for classical antiquity, compared with similar ventures for the human osteological component, reflects the size of the database available. Animal bones are frequent finds among many classical archaeological sites, and there are more site reports on this material than for human osteological remains from the same time period. Zooarchaeologists, therefore, have felt more secure about postulating geographic and temporal trends in their data, given the wide pool of sites available and the statistically significant sample sizes retrieved from many of them. The reason the Roman period dominates over other chronological periods may relate to the large and diverse geographic extent of the Roman empire. At its maximum, the empire encompassed a large part of continental Europe and the British Isles, including many countries that have had a long history of archaeological excavation and research or have institutions, agencies, and legislation in place to promote and finance such work. All these factors have helped in the accumulation of zooarchaeological data.

The regional nature of the Roman empire may also have contributed to the relative abundance of zooarchaeological syntheses for this period. Zooarchaeologists are in a good position to assess the impact of romanization on provincial landscapes, economies, diets, and other cultural and natural issues involving animals. Roman provinces comprise relatively straightforward geographic packages from which to examine these changes using zooarchaeological data. In the case of Roman Britain, for example, zooarchaeological data register a gradient toward higher average cattle and pig percentages in the following sequence: rural settlements, villas, secondary urban centers, urban sites, military sites, and legionary sites.[121] This trend argues for a preeminence of urban, military, and le-

[113] E.g., Meniel 1992; Wilson 1992; Richardson 1997.

[114] E.g., D'Errico and Moigne 1985.

[115] E.g., Preston Day 1984; Sorrentino 1989; Lauwerier 1993; Reese 1995.

[116] E.g., Leguilloux 1999; Halstead and Isaakidou 2004; Hamilakis and Konsolaki 2004; Reese 2005.

[117] For zooarchaeological syntheses of sites in Roman Britain and the Roman northwestern provinces in general, see King 1978, 1984; Luff 1982; Thomas 1989. For the Netherlands, see Lauwerier 1988. For the Roman Germanic provinces, see Peters 1998. For Roman Gaul, see Lepetz 1996; Columeau 2002. Audoin-Rouzeau (1993) and King (1999) provide more generalized, empire-wide studies of Roman animal bones.

[118] Galicia: Fernández Rodríguez 2003; Italy: MacKinnon 2004.

[119] Payne 1985; Reese 1994.

[120] For ritual feasting, see, e.g., Hamilakis 1998; Dietler and Hayden 2001; Dabney et al. 2004. For burnt-animal sacrifice, see Isaakidou et al. 2002; Halstead and Isaakidou 2004.

[121] King 1999, 180.

gionary sites as centers of social groups emulating romanized dietary patterns and influencing the spread of these standards across the empire.[122]

OSTEOLOGICAL RESEARCH IN CLASSICAL ARCHAEOLOGY: FUTURE TRENDS AND DEVELOPMENT

Osteoarchaeologists who work on classical sites are in a good position, given the current public fascination with bones (from media attention to forensics in particular) and with antiquity. Archaeological activity will continue, and bones will inevitably be recovered from these excavations. Nevertheless, it is important for the future of the discipline that osteoarchaeologists working in classical archaeology take a proactive role in connecting the osteological side with the archaeological component and make this interconnected montage appeal not only to researchers in both disciplines (osteology and classical archaeology) but also to the general public. Below are some strategies I believe might help to achieve this.

Methodological Dialogue Between Human and Other Animal Osteology

Despite that both human osteologists and zooarchaeologists study skeletal materials, there is surprisingly little methodological dialogue between the two fields. Neither works totally within a vacuum, however. Information exchange does occur. I would argue that human osteologists have made the greatest advancements in overall research in their fine-tuned analyses of skeletal features indicating criteria such as age, sex, stature, activity, disease, pathology, and other physical traces. Many of these characteristics are scored and recorded with the help of different statistical formulas, sequences, or other systems. Human osteology guidebooks or standards volumes often provide a checklist of what data to collect and how to record these.[123] Currently, no such parallel volume exists for zooarchaeological analysis.[124] There are several zooarchaeological textbooks that detail methodologies, as well as a variety of bone atlases that illustrate specimens, and numerous articles and publications that describe new methods to extract information from animal bones.[125] However, the disparate nature of these sources inhibits the application of a universal set of standards to zooarchaeological examination. Zooarchaeologists can learn from human osteologists in this regard. For classical sites, the implementation of a standards volume in zooarchaeological practice would ensure that complete sets of data are recorded and would facilitate greater intersite comparisons among samples.

While zooarchaeologists can benefit from borrowing more rigid and universal recording codes from human osteologists, human osteologists can gain from zooarchaeological research in aspects such as taphonomy and quantification. Ethical standards generally prohibit taphonomic experiments using human remains. In many cases, a pig or some other mammal has stood in their place for forensic research. There is a large literature base on the effects of post-depositional agents such as wind, water, vegetation, and carnivores on zooarchaeological assemblages,[126] but less on these taphonomic forces as they pertain to human remains in particular. Much tends to be extrapolated and generalized for vertebrate animals overall, a classification that encompasses humans and other mammals. Certainly there are cases where taphonomic forces may act similarly on human and other animal bones, but such generalities can be misleading. One key aspect where greater dialogue can exist between human osteologists and zooarchaeologists concerns the topic of burning and cremation on classical sites. Cremation in classical antiquity has been chiefly studied from a sociocultural and ritual standpoint, with investigators predominantly chronicling temporal and geographical changes in practices of cremation or inhumation among ancient cultures and discussing the underlying reasons for these shifts.[127] However, there is a practical side to the issue of burning and cremation in the classical context that warrants greater analysis. Stages of physical and chemical changes to bone from fire damage can be recorded,[128] but cremated human and animal remains are often separated in analyses, whereas their combined study could shed light on the mechanics of burning. Much is often assumed about fire construction, fuel sources, and duration and temperature of burning that could be answered more effectively through a more detailed, integrated investigation of burned human and animal remains.

Another zooarchaeological issue that could benefit the research of human osteologists is quantification. The commingled nature of many zooarchaeological deposits necessitates complex statistical analyses to determine minimum and maximum sample size

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[122] King 1999, 180.

[123] The volume by Buikstra and Ubelaker (1994) is commonly used in this respect.

[124] There have been, however, several pleas for standardization of data reporting in zooarchaeology (e.g., Clason 1972; Grigson 1978; Driver 1983), and the issue is often addressed in the meetings and discussion forum of ICAZ.

[125] E.g., Schmid 1972; Davis 1987; Hillson 1992; Reitz and Wing 1999; O'Connor 2000; and many others.

[126] E.g., Lyman 1994.

[127] E.g., Toynbee 1971; Morris 1987, 1992; Lungu 2002.

[128] Shipman et al. 1984; Lyman 1994.

parameters and taxonomic representation. Human osteologists often count MNIs and can perform more involved tests with paleodemographic reconstructions, but a greater exchange of quantification techniques between human osteology and zooarchaeology would be beneficial to both disciplines and might be especially informative in cases of mass burials with commingled remains.

There are several other issues where greater exchange between zooarchaeology and human osteology would be particularly beneficial for classical archaeology. The first is dietary reconstruction using stable isotope techniques. Stable carbon and nitrogen isotope analyses are becoming routine in deciphering ancient dietary patterns, such as the proportion of meat, fish, legumes, and other plant resources consumed. The Apollonia and Isola Sacra cases represent two applications of these techniques. Customarily, in stable isotope research, investigators conduct analyses on nonhuman animal bones from ancient sites (preferably from the same temporal and geographic context as the human remains examined) to establish baseline carbon and nitrogen values for each area under consideration. With these baseline values in place for each region, one area's graph can be fit over another to compare the two populations more reliably. As bone isotopic values on several nonhuman animal species are already needed to evaluate the human isotopic values, the next step in this type of research may be to implement these stable carbon and nitrogen isotopic techniques more assiduously on zooarchaeological remains to decipher dietary patterns for the animals themselves. In the case of domestic herbivores, such as cattle and sheep, such information could help to determine herd origin, trade patterns, husbandry schemes, and feeding operations that incorporate grasses, legumes, or other crops. A herd fed predominantly on legumes will register different nitrogen and carbon values than a herd that consumed exclusively grass or wheat, for example. A similar scenario could apply to omnivorous animals such as pigs. In this situation, the addition of any meat to their diet could also be measured using nitrogen values. The ancient texts speak of varying the taste of an animal's meat through its diet, and isotopic analyses might be a good method to examine the occurrence and distribution of such practices.

Stable strontium isotope analysis is another isotopic avenue where human osteology and zooarchaeology can benefit each other. As noted earlier, Sr isotopic ratios, measured from bones and teeth, provide clues about residence changes, particularly moves between childhood and adulthood (or immaturity and maturity, in the case of nonhuman animals). In addition to recognizing human migration patterns, the technique has potential to shed light on the mode and velocity of long-distance trade in animals and for assessing husbandry patterns and the economic schemes behind them.

Human osteology and zooarchaeology could fruitfully combine forces in paleopathological investigation, especially zoonoses. Zoonotic diseases are those that can be transmitted to humans from animals,[129] such as bovine tuberculosis,[130] brucellosis, rabies, and malaria. As herding operations increased in scale and scope during antiquity, so might the chances of pathogenic spread from animals to humans. Moreover, the introduction of foreign brood stock could have detrimental effects on herd and human health should any of these introduced animals be harboring a potentially virulent pathogen. Think of our current troubles with mad cow disease and avian flu. Up until now, much of our research on disease in antiquity has hinged on case studies of individuals, human or nonhuman, with various injuries or skeletally traceable ailments. An integrative approach connecting human and animal health might help isolate generally good and bad (healthwise) environmental or geographical contexts. Standard concerns in paleopathological research using osteological remains, nevertheless, still apply to zoonotic diseases. Many principally affect soft tissues of animals and humans, rarely leaving macroscopic traces on the skeleton. Moreover, traces may be nonspecific to a particular disease. Further complications arise when one considers that the osteoarticular form of these diseases is typically observed in only a small fraction of an animal population,[131] and that zooarchaeological remains are often heavily fragmented due to butchery and cooking practices. Still, these should not be barriers to investigation.

A final issue in which zooarchaeology and human osteology could join forces is in the analysis of discrete, epigenetic, or nonmetric traits. These skeletal traits are frequently scored on a presence/absence basis and are often linked to genetic factors and inheritance. They have been used to assess biological distance or shared ancestry among human populations but have been virtually ignored in the case of other animals. Admittedly, nonmetric traits in animals have not been recognized, studied, and scored to the extent that they

[129] Baker and Brothwell 1980; Brothwell 1991.
[130] Lignereux and Peters 1999.
[131] Five percent or less, according to Lignereux and Peters (1999), in the case of tuberculosis.

have in human osteology. Once this deficit is corrected, such traits may be used in much the same manner as in human research, but in this case the focus would be on examining the development and movement of different breeds or populations, especially of domestic livestock (as opposed to patterns of human migration and ancestry). Classical antiquity witnessed one of the first big periods of livestock breeding and diversity. Numerous varieties of domestic animals are referenced in ancient texts. Osteological research to determine, for instance, Tuscan, Umbrian, Ligurian, and Apennine breeds of cattle in Roman Italy (several of the varieties mentioned in classical literature) would add texture to our understanding of the fabric of ancient life and help trace origins, trade, marketing, and cultural choice of livestock.

Connecting Bones, Texts, Art, and Artifacts

The mention of animal breeds in the ancient texts brings up the larger issue of the integration of zooarchaeological data (and all osteoarchaeological data) with related information from ancient texts and iconography. In the case of animals, all three sources—bones, text, and art—provide information. A similar situation presents itself for humans. Whatever the term used ("integrating," "connecting," "melding"), the overall process of tying together different lines of evidence is difficult because it involves numerous compromises, balances, checks, decisions, and a host of database biases to consider. However, it is also a path that will help cement the importance of osteoarchaeology within classical archaeology. Osteoarchaeologists must be proactive in this venture and familiarize themselves more with the fields of ancient art and literature analysis, avoiding the temptation to sprinkle these data uncritically upon skeletal reports or to select only those passages or works that support the arguments in question. As historical outsiders to the field of classical studies, osteoarchaeologists must work harder to incorporate wider lines of evidence, and in so doing help redefine the questions traditionally asked in classics.

There are certainly many publications that examine Greek and Roman animals or humans on the basis of ancient textual, artistic, and/or artifactual data, a number of which are quite substantial in scope.[132] Alternatively, many osteological reports from classical sites incorporate information from these outside sources in their discussions and interpretations. Some, such as several zooarchaeological reports from Pompeii, are extremely thorough in cataloguing evidence of birds, mammals, fish, and other creatures as presented in the zooarchaeological and ancient artistic (wall painting, mosaic, sculpture) and literary databases.[133] While these works are all important to our understanding of classical cultures, most do not delve deeply into synthesizing the osteological data with the other sources of information.

I have attempted this kind of larger synthesis using osteological information in two recent publications. The first, a monograph entitled *Production and Consumption of Animals in Roman Italy: Integrating the Zooarchaeological and Ancient Textual Evidence,* compares and synthesizes the zooarchaeological and ancient textual reconstructions of key animal topics, including domestic livestock husbandry, animal butchery, resource exploitation, and the role of meat in the Roman diet in Italy. While I believe the volume provides a wealth of data on these issues and can serve as a valuable reference tool on Roman animal use, one of its chief purposes was more modest, namely, "to convince researchers to consider the value of animal bones in their reconstructions of Roman life, and to recognize the importance of integrating this material with other sources of data."[134] I believe that the olive branch for such integrative work must be extended from the osteoarchaeological camp if we wish to build a larger following and acceptance within the traditional world of classical archaeology.

My second example of connecting data concerns the integration of zooarchaeological, ancient textual, and artistic evidence for pig breeds in Roman Italy.[135] Through this work I was able to trace the existence of two varieties of pigs, a large and a smaller breed, which were raised, marketed, documented, and depicted differently depending on the media and on the contemporary social, political, and economic circumstances.

How else might bones, text, and art be integrated? Future lines of inquiry might see a more thorough analysis of animal breed differences throughout the ancient world. How did breeds differ geographically, and did this variation translate into local texts and iconographic works? Or were more universal, standard-style images and somewhat generic accounts disseminated? In addition, as imaging techniques improve, we may soon be routinely comparing facial reconstructions from skulls with painted and sculpted portraits of the deceased to assess artistic accuracy vs. artistic license in antiquity.[136]

[132] E.g., Keller 1909–1913; Thompson 1936; White 1970; Toynbee 1971, 1973; Frayn 1984; and others.

[133] Jashemski and Meyer 2002.

[134] MacKinnon 2004, 249.

[135] MacKinnon 2001.

[136] There are developments along this path. E.g., tests com-

The argument for integration need not stop solely with the connection of ancient textual and iconographic information to the osteological database. There are multiple paths of research for linking osteological remains with other archaeological materials in assessing human culture. For example, integrated modeling of Roman-Libyan agricultural systems through the examination of botanical and faunal data alongside geological, archaeological, and settlement data provided a much more dynamic account of landscape use in Roman North Africa[137] than what could be reconstructed from any one of these sources individually. In another case, the incorporation of human osteological data alongside archaeological and architectural information about cemetery placement and tomb monuments provided a more encompassing picture of mortuary landscapes and human demographic patterns of the past.[138] Refinement of room functions through a detailed examination of the spatial distribution of bones at a site and their links with architectural structures and features as well as investigations of animal residues (oils, fats, *garum*, milk) in pots represent further lines of inquiry that should be pursued.[139]

Worked bone presents another avenue for research. Often, a division is drawn between finished and unfinished worked-bone materials, the finished products being analyzed by a small-finds specialist and the unfinished pieces assessed by the zooarchaeologist. This separation ignores the fact that boneworking operates along a continuum of steps with input and output products at each stage. Considering the whole process, therefore, evaluates boneworking in its larger productive social and economic context as a craft industry.[140] A similar case of assessing an activity within its broader framework applies to the steps involved in animal slaughtering, butchery, hide preparation, and related activities in carcass and resource processing. Correlating the cut and chop marks on the bones with any tools recovered from the site might help clarify the mechanics and practicalities of animal butchery. Residue and microscropic analysis of chopping blocks, hooks, blades, knives, and other equipment can add extra information about butchery procedures and further link osteological and archaeological data. The division of archaeological artifacts, features, and materials into separate categories for discussion in site reports sets an artificial barrier to the use of these materials, a barrier that did not exist in their original living context.

While it is true that all osteological collections retrieved from sites are essentially only samples of what might have originally been deposited or what once lived, it is also true that many of these deposits from classical sites represent some of the largest collections of bones available from a single site, cemetery, or burial context, regardless of time period or culture. This is an important aspect to stress, for one can undertake a range of analytical and statistical tests on some of these larger samples that are not feasible or valid in the case of smaller ones. Some of the large cemetery contexts of antiquity, such as Poundbury, are instrumental in this respect, allowing researchers to reconstruct demographic patterns with a measure of security. Large zooarchaeological samples from sites such as Exeter (England) or San Giovanni (Italy)[141] yielded sufficient finds to undertake a variety of tests and to draft more statistically reliable accounts of results.

Better connections between osteoarchaeologists and veterinarians, medical doctors, and other specialists who work with living beings could prove very fruitful for classical archaeology. Such collaborations have already enhanced our assessment of ancient health and disease. The social, psychological, and environmental history of disease in antiquity has seen increased research lately, with connections made to issues such as sanitation, health care, social practices, and diet.[142] Biological traces of disease, some of which can be observed skeletally, provide one avenue of research in the larger issue of reconstructing human health, a topic that can be viewed from a multidisciplinary angle.

The importance of multidisciplinary research in classical archaeology reinforces the need to involve all specialists early in the project design and objectives. This is still a problem in osteological work on classical sites. While it may not always be possible or feasible to have osteologists on-site throughout an excavation campaign, it is important to involve them in the project planning, especially with issues such as sampling and recovery of materials. The tactic of bringing in an osteologist solely as a post-excavation exercise should be avoided. As Bailey explains:

> The conventional distinction between "archaeologist" and "specialist" still predominates [where] archaeologists trained in the study of cultural artifacts are the

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paring portraits from two Roman coffins from Hawara, Egypt, alongside reconstructed images based on the skulls contained inside these mummies showed a reasonable likeness between the two sources (Prag 2002).

137 Barker et al. 1996.

138 Morris 1987, 1992; MacKinnon 2007.

139 On animal residues in pots, see Mulville and Outram 2005.

140 E.g., St. Clair 2003.

141 Exeter: Maltby 1979; San Giovanni: MacKinnon 2002.

142 E.g., Jackson 1988; Allason-Jones 1999; Hope and Marshall 2000; Cruse 2004; King 2005.

> "generalists" who plan and direct field projects and synthesize results, whereas science-based collaborators are non-archaeological specialists who study non-artifacts, engage in post-excavation analysis and write specialist reports. [These] attitudes must change if there is to be any prospect of successful integration.[143]

The separation of osteological work into a specialist category of post-excavation analysis in classical archaeology has been a matter of tradition. Nevertheless, it is ironic, considering that animal bones tend to be the second most abundant of artifacts collected from classical sites (pottery generally being the most abundant). My use of the term "artifact" here is deliberate, because as cultural property, animals are just as likely to be made or modified by humans as would a ceramic vessel, a coin, or any other arguably typical artifact. They are every bit as informative of ancient culture as are traditional material artifacts—they just happen to be biological in nature. Perhaps a simple shift in our perceptions of all bones as artifacts would elevate their value within classical archaeology, setting them on par with other accepted artifacts such as ceramics. All are, in fact, materials that shed light on past human behavior. And for human skeletal remains (which should also be regarded as artifacts), these could potentially represent the actual people involved in creating and performing these behaviors.

"Humanizing" the World of Antiquity

My call is for us to humanize the world of antiquity. To increase contemporary exposure and interest in past cultures, we should individualize ancient Greek and Roman people to make their personal tales more applicable to our everyday lives. While a portion of today's population will marvel at the leaders, wars, feats, inventions, and events of antiquity, many more will probably ask questions such as, "How were the ancients like me?" Here, I believe classical osteoarchaeology can excel in answering these questions, in engaging people's emotions, desires, fears, and curiosities—basically, humanizing the world of antiquity.

How can this be done? One approach would be to use more of a narrative, storytelling perspective in osteoarchaeological analysis. Osteologists can dehumanize the cultural context we wish to reconstruct through dry, fact-filled, table- and chart-laden, impersonal-style reports. To some degree, this dehumanized approach is a by-product of New Archaeology. As the processual agenda developed and expanded, many archaeologists seemed to adopt a more scientific manner for recording and presenting data. While it is crucial to present these materials, it is equally important to do so in a way that tries to instill character, personality, and life traits in our skeletal subject matter. We want our audience to feel personally connected somehow—to tug at their feelings, needs, and interests.

Allow me to illustrate this with a zooarchaeological example. Examination of the skeleton of a small lapdog recovered from the Roman necropolis of Yasmina in Carthage, Tunisia, indicated that the animal had a suite of pathological conditions, including dental loss, extreme calculus deposition, advanced osteoarthritis at many joints, spinal complications, and a dislocated leg.[144] While these skeletal conditions are certainly fascinating from an osteological standpoint, what captured my attention most in this case was the strong connection between owner and pet that was needed to keep this animal alive for so long, given its physical state. It was the personal connection, the love that many of us have shared with a pet, that made this tale memorable. This is what I mean by humanizing things.

Case studies of individual burials and skeletons provide another good opportunity to humanize the past. Here, osteoarchaeologists can reconstruct life histories of the deceased, often adding details about their diet, health, and work stresses. Facial reconstructions, such as those performed on several ancient skulls recovered from excavations at Metaponto, add another dimension to humanizing an individual.[145] Even if there is a large element of subjectivity to these reconstructions, they certainly provoke imagination, fascination, and curiosity with the past. Moreover, relating all aspects of these life histories to the larger site or community environment should be encouraged. Dialogue between human osteologists and zooarchaeologists is vital in this regard to connect data about diet and to examine potential skeletal traces that activities such as herding, butchering, wool and hide processing, and horseback riding might leave. A similar claim can be made for issues such as urban pollution, economic and craft production, domestic and intercity violence, and the effects these variables have on ancient populations (and their skeletons). Establishing a solid foundation with individual case studies, then, can set the tone for more expansive regional and national examinations of human populations where topics such as ethnicity and multiculturalism can be addressed. The latter issues can be controversial, so it is important to consider ethnicity from a culturally relative standpoint

[143] Bailey 1991, 14.
[144] MacKinnon and Belanger 2006.
[145] Henneberg and Henneberg 1998.

without stereotyping and assigning degrees of value to cultural traits or behaviors. Ethnicity is currently a key topic in classical archaeology, especially in considering processes such as romanization or colonialization. Osteoarchaeologists can contribute to this debate not only in deciphering patterns of population migrations, marriages, and human mixing but also in determining changes in dietary patterns, animal husbandry tactics, choices of pets, and numerous other aspects of animal use, many of which vary across cultures and can contribute to one's ethnic identity. Although diet is influenced by many factors, what one consumes can be a good indicator of attachment to familial tradition or of desire to broaden the palate and accept ethnic dietary diversity. For example, zooarchaeological data often record higher frequencies of pig and/or cattle bones relative to other domesticates in assemblages from romanized sites across the empire. However, there is variation in these values depending on geographic region and type of site.[146] Nevertheless, animal bones form only part of the dietary reconstructions. Frameworks to integrate zooarchaeological data with other evidence related to eating and dining (including serving and cooking vessels, archaeobotanical remains, and food preparation schemes) provide a more holistic picture of dietary identity.[147] The addition of human osteological evidence to this pool, particularly dietary studies using stable isotope analyses, will add further data to these studies.

The act of humanizing the osteological record of antiquity in the future of bone research in classical archaeology need not be to the detriment of sound scientific examinations. Certainly, osteoarchaeological scholarship has profited from a range of scientific applications and will continue to do so. There is great potential here, and I am a staunch advocate for the incorporation of more scientific studies in classical archaeology. Nevertheless, as these applications increase in the discipline, the temptation to fragment into specialist categories of research grows. My argument to humanize the world of antiquity reinforces the need for osteologists to interpret their data in the larger framework of cultural and environmental reconstruction, never losing sight of the living animal (human and nonhuman) behind the bones studied, and the physical and cultural living world in which those beings once operated.

CONCLUSIONS

Whether one chooses to take a lumper or splitter approach to bioarchaeology and osteoarchaeology, fragmenting or combining its component parts, the consensus is that human and nonhuman bone research has advanced rapidly over the course of its implementation in classical archaeology and has much to contribute to its future. Public interest in archaeological bones and skeletons is not likely to decline in the coming years, given the current popularity of forensics. Greek and Roman cemeteries are no longer thought of solely as repositories of burial artifacts but as sources of skeletal and, even better, human information about ancient societies. Human osteological work has added much to our understanding of past lives, especially in issues such as paleopathology, health, diet, and nutrition. Human osteologists form part of numerous excavation teams today in classical archaeology. Zooarchaeological analyses are also now commonplace among most excavations of classical sites. Animal bones are invaluable as artifacts in the wealth of cultural knowledge they provide. In addition, they can inform us about ancient environments, so they often are doubly important in helping reconstruct both the natural and cultural worlds of the past.

Although recent years have witnessed an increase in opportunities for osteological work on classical sites, two major concerns affect its future. First, publication has not always kept up with this increase, and a number of osteological reports are now submitted in less publicly accessible formats, such as contracted reports to excavation directors or heritage agencies. Space and time limitations have also had an impact on the amount of information and data published, often resulting in the elimination of bone measurements from reports. Osteoarchaeological research relies on quality presentation of all key data. Certainly, the practicalities of publication place restrictions on what can be disseminated in standard print format. However, alternate systems of accessing and sharing data and research results provide a way to overcome some of these difficulties. For example, many osteoarchaeologists are taking advantage of Internet resources to present or comment upon osteological research or to archive and share raw data. The International Council for Archaeozoology (ICAZ), the global organization for zooarchaeologists, recently partnered with the Alexandria Archive Institute (AAI) to develop two initiatives in this direction: (1) BoneCommons,[148] a free resource for sharing zooarchaeological conference presentations and related research; and (2) Open Context,[149] a forum where members are welcome to publish zooarchaeological field and collections data. The Archaeological Institute of America and the *AJA*

[146] King 1999.
[147] Meadows 1994; Hawkes 1999.
[148] http://www.bonecommons.org.
[149] http://www.opencontext.org.

sponsor similar online forums for archaeological discussion in general.[150]

The second concern in osteological research in the classical context is perhaps more critical. There is still a shortage of specialists. This problem is most apparent among classical sites in the Mediterranean. Again, traditional academic divides largely perpetuate this. Students studying classical archaeology at most universities across the Mediterranean do so through classical literary and art academic departments, where there is generally little or no exposure to osteological training. Conversely, many of those with an interest in osteology among European universities specialize in prehistoric contexts, as these periods tend to be favored by established European zooarchaeologists or osteologists in their home institutions. The situation in North America is similar in many respects. While many universities in North America offer courses or programs in zooarchaeology and human osteology, few of these are taught or supervised by scholars who specialize in classical archaeology. Consequently, practical osteological exposure with Greek and Roman material for students at this introductory level is stalled. Nevertheless, greater opportunities for self-motivated students to practice osteoarchaeology in the classical context, increasing financial assistance to support such work (such as fellowships in zooarchaeology and human osteology offered by the Wiener and Fitch Laboratories in Athens), and encouragement, support, and guidance facilitated by a large, established, and active community of zooarchaeologists and human osteologists globally have helped advance the discipline in the classical context.[151]

Despite the concerns about a shortage of specialists and about the practicalities of publishing or otherwise making accessible osteological data from all classical sites, the current situation for osteoarchaeological work in the classical context is generally good. There is still much to be done, however, and I hope that the issues presented here, namely (1) the encouragement of greater methodological dialogue between human and other animal osteology; (2) the continued integration of osteological, textual, artistic, and archaeological data from the classical context; and (3) the notion to implement a more humanized narrative perspective to the world of antiquity through the analysis of osteoarchaeological data, can be tackled collectively in our discipline, and added alongside new approaches that will certainly arise as osteoarchaeology continues to develop in the classical context.

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[150] http://www.ajaonline.org/forum; http://www.archaeological.org/forums.

[151] ICAZ sponsors a conference every four years, the latest one (the 10th) was held in 2006. ICAZ also organizes a number of working groups (e.g., for fish remains, bird remains, archaeomalacology, archaeozoology, genetics, and others), whose members frequently operate additional conference venues. While many ICAZ members have analyzed materials from classical sites or classical levels within sites, only a few specialize in the zooarchaeology of ancient Greek and Roman sites. Major organizations for human osteologists include the American Association of Physical Anthropologists (AAPA), the Paleopathology Association, the Canadian Association of Physical Anthropologists (CAPA), and the British Association of Biological Anthropology and Osteoarchaeology (BABAO). Each sponsors annual conferences.

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