

CHAPTER 1

Introduction: The Scope of Paleopathology

Anne L. Grauer

The field of paleopathology, quite simply, entails the study of ancient disease. However, nothing is “quite simple” within this scientific discipline. As noted by Buikstra (2010), defining the term “ancient” can be as complex as defining the term “disease.” In part, this is due to our preconceived notions about these terms. “Ancient,” for instance, conjures thoughts of prehistoric or early historic life, dating hundreds to thousands of years ago. The term “disease” is often used to imply harmful changes caused by invading pathogens. Within paleopathology, however, the terms “ancient” and “disease” hold more nuanced, and even contested meaning. For instance, determining what material will be paleopathologically examined often relies upon the origin of the sample and/or the question being posed, rather than the date the individual(s) died. In many states throughout the U.S., human remains are considered “old” and are recovered archaeologically, rather than forensically (or under the auspices of funeral directors), when they are deemed to be over 100 years old. Hence, large numbers of human remains from as recently as the late 19th and early 20th centuries have been studied by paleopathologists. These are hardly “ancient” by most definitions. Yet, the information gained from these skeletal remains about human disease in the past is enormous.

The term “disease” is similarly complex. The colloquial use of the word, which often alludes to “infection,” ignores the complex processes and body changes that a wider definition of “disease” would encompass. If discrete pathogens (such as viruses or bacteria) are viewed as the sole cause of disease, then paleopathological investigation would be limited to exploring remnants of the body’s immunological response. Indeed, understanding what triggered an immune response in the past, how the

response was triggered, and/or variation in the responses between individuals and populations are important goals which provide great insight into the past. But they are also extremely limiting. The term “disease” within paleopathology (and the medical community) is broader and more encompassing. Stedman’s Medical Dictionary (26th edition, 1995) defines disease, in part, as “an interruption, cessation, or disorder of body functions, systems, or organs ... A morbid entity characterized usually by at least two of these criteria: recognized etiological agent(s), identifiable group of signs and symptoms, or consistent anatomical alterations...” (p. 492). Adopting this definition leads researchers to evaluate many types of conditions affecting the human body, including those with potential sociocultural etiologies, such as malnutrition, interpersonal violence, and deliberate body modification. Thus, paleopathological focus might begin with recognition of bony changes that are quantified and qualified: that is, recognition of “consistent anatomical alterations”; but continues with the exploration of singular or multifactoral causes of these alterations and the ramifications of the conditions on our understanding of human life. It is with these broad perspectives and goals that paleopathologists view the past.

A BRIEF HISTORY OF PALEOPATHOLOGY

As Dorothy Salisbury Davis, the 20th-century crime fiction writer quipped, “History’s like a story in a way: it depends on who’s telling it.” Chronicling the development of paleopathology is no exception. Individual perspectives shape the scope, direction, and intent of the discourse, resulting in many crafted explanations and interpretations. Within this volume a number of researchers look back to the roots, and follow the development of particular aspects of our field. Alongside their visions of the past, are histories told by a number of other researchers, including Moodie (1923), Williams (1929), Wells (1964), Janssens (1970), Jarcho (1966a), Brothwell and Sandison (1967), Buikstra and Cook (1980), Angel (1981), Ubelaker (1982), Buikstra and Beck (2006), Grauer (2008), and Buikstra (2010). The multiple interpretations reflect the complex and multidisciplinary nature of paleopathology.

To many, the inception of paleopathology can be found in the 19th century, with physicians and anatomists such as Rudolf Virchow (1821–1902), Frederic Wood Jones (1879–1954), and Grafton Elliot Smith (1871–1937) developing interests in recognizing disease in ancient human bone and mummies. Their training and expertise in human anatomy, identification of disease, and diagnosis, allowed them to make associations between the presence of lesions on bone (and in mummified tissues) and potential causes. In particular, Sir Marc Armand Ruffer (1859–1917), a professor of bacteriology and the first director of the British Institute of Preventive Medicine (argued to be the true “pioneer of palaeopathology” by Sandison (1967)), published numerous articles on disease in Egyptian mummies. His careful approach, which relied on comparisons of clinical manifestations of disease to lesions found in ancient remains, paved the way for histological and radiographic investigation into ancient disease within paleopathology today.

As the early 20th century took hold, a new approach towards understanding disease in the past developed, much to the credit of Earnest Hooton (1887–1954). While most of the work conducted on human skeletal remains in North America was

intertwined with agendas within physical anthropology (that is, heavily focused on metric analyses and the recording of human physical variation), Hooton set off in a new direction. Trained in the classics, he examined the presence of disease in wider context. His unit of analysis moved from the individual to the population. Along with publishing his detailed metric and morphological data on Native American remains from Pecos Pueblo (Hooton 1930), he incorporated a broader body of data into his work: archaeological data. The presence of pathological conditions such as trauma, dental disease, and osteoarthritis, for instance, were inventively viewed across space and time, and interpreted alongside the effects of a changing environment, food preparation, diet, and the presence of infectious disease. As promising as Hooton's synthesis appeared, however, it was not until decades later that his approach was rigorously adopted by others.

This is not to imply that work within paleopathology remained stagnant in the mid 20th century. On the contrary, Møller-Christensen, working with Danish material and particularly interested in leprosy, brought to paleopathology rigorous criteria for diagnosis coupled with a population approach (e.g. Møller-Christensen 1961). Similarly, Calvin Wells, publishing prolifically for two decades starting from the 1950s, provided paleopathologists with a large body of work that systematically evaluated the presence of a wide variety of skeletal conditions, and provided a benchmark from which other researchers could measure their rigor. The work of Ackerknecht (1953, 1965) offered a synthesis of many paleopathologists' work, as he sought to highlight the field's contributions to our understanding of the past.

During these same decades a division within paleopathology, as practice in North America and in Europe, took root (Roberts 2006; Mays 2010). In Europe, researchers tended to have medical backgrounds and focused on the presence of disease in particular individuals, leading to the publication of descriptive case studies. In North America, researchers were commonly trained in physical anthropology, and employed an anthropological approach to their inquiry. They had access to large samples of skeletons derived from archaeological excavations. Both trajectories had their flaws. Both came under fire in the 1960s. Brothwell and Sandison (1967), for instance, speaking to the "European approach" posited that "the time has come for some form of palaeopathological stock-taking and pooling of recently collected data" (Brothwell and Sandison 1967:xiv). Their volume sought to provide the field with a compendium of skeletally recognized conditions and diseases. Here, insights into the antiquity and geographical scope of skeletal lesions, as well as radiographic, histological, and photographic documentation were provided. On the other side of the Atlantic, Jarcho (1966b) was calling for a "revival of paleopathology" in the U.S. He criticized the direction that field had taken, which contributed to weak methodological work, the unsystematic collection of data, and the increasing marginalization of paleopathology from both the medical and archaeological communities.

In the decades that followed, substantial strides were taken within paleopathology. Great efforts were made to strengthen diagnostic criteria of diseases. This included providing careful descriptions of lesions in dry bone and firm clinical foundations for differential diagnosis (see Steinbock 1976; Ortner and Putschar 1981; Aufderheide and Rodriguez-Martin 1998; Ortner 2003). Methods to standardize data recording were offered by Ragsdale (1992), who argued for the careful use of description and classification of disease, and by Buikstra and Ubelaker (1994) and Brickley and

McKinley (2004) who sought to devise comprehensive and systematic means of recording osteological data. Theoretical strides were also made. Slowly, paleopathological attention moved away from questions such as “what disease is this?” and “when was this disease first found in humans?” to questions of “how” and “why”. Huss-Ashmore et al. (1981), Armelagos et al. (1982), and Cohen and Armelagos (1984), for instance, offered ways in which paleopathological investigation could shed light on human nutrition and subsistence strategies, and how subsistence strategies could impact the presence of disease. Brothwell (1982), while exploring the promise of the field of environmental archaeology, offered provocative ways in which understanding details of complex urban environments might lead to a new understanding of host–pathogen relationships.

Throughout these decades new questions regarding the history of human disease were posed. Why, for instance, do some populations suffer from conditions that others do not? Why has the presence of some diseases seemingly changed over time? How might a wide range of variables affect the presence of diseases and disease processes? How might differences in human social interaction affect the host–pathogen relationship? Perhaps, it can be argued, the most profound changes within paleopathology have not come from focusing on populations rather than individuals, but rather have arisen with the influence and inclusion of different theoretical paradigms. These have recently been adopted in efforts to answer questions, and were borrowed from and expanded upon from other fields.

NEW DIRECTIONS IN PALEOPATHOLOGY

The multidisciplinary and multifocal approaches which characterized the history of paleopathology remain today and serve, in part, as sources of potential and tension within the field. As in the past, researchers today are not uniformly trained to be paleopathologists. They can be trained in medicine, dentistry, archaeology or physical anthropology, and choose to focus (sometimes only occasionally) on paleopathological questions and the examination of skeletal or mummified remains. Increasingly, however, making a productive contribution today to paleopathology not only requires superb familiarity with bone and/or preserved tissue, it requires a firm knowledge of microbiology, physiology, biochemistry, medicine, archaeology, history, and human culture, to name a few. Hence, the formulation of new questions within paleopathology has required even more of researchers, as they seek new means of obtaining answers. Recent efforts, for instance, to diagnose disease more accurately and to place it into an evolutionary context have led researchers to adopt technologically sophisticated techniques, such as tissue imaging and genetic testing. Similarly, efforts to understand environmental variables contributing to health and disease in the past are using sophisticated biochemical tests to explore stable isotopes and trace elements in bone. The technical knowledge needed to complete the requisite techniques, let alone to allow reasonable interpretation of the results (or manage the financial expense), has encouraged researchers to become more specialized and/or to seek to collaborate with specialists who may or may not be familiar with paleopathology at all. The promise of new information fuels a growing tension between the specialist and the generalist. Hence, it can be argued that the singular term “paleopathology” truly masks the variation and complexity within the field.

Productively contributing to paleopathology does not solely rely on technology. It can also be achieved through the development and implementation of new theories and approaches. Interestingly, for all the past published reflections on the field of paleopathology, few have delved into the theoretical premises upon which the discipline has been built. Taking it a step further, it could be argued that the topic is staunchly ignored. There are a number of ways that this oversight can be interpreted. First, perhaps one could argue that paleopathological research is an a-theoretical endeavor—meaning that there are no underlying assumptions being made or that multiple interpretations of data are not possible. This seems a bit preposterous. One of the key tenets upon which paleopathologists build their arguments is that disease processes occurring today are similar to those in the past, i.e. that pathogenesis does not change over time. We clinically identify the presence of a disease in modern humans, and assert that finding the same indicators on tissue samples from the past indicates that the identical pathogen or disease process was responsible. This is, in fact, a key reason why clinical case studies have been so important to paleopathological research. But recent work on the genera *Mycobacterium* (e.g., Monot et al. 2009) and *Treponema* (e.g., Hardham et al. 1997), calls this assumption into question, as the evolutionary paths of these pathogens are complex. If we argue that pathogens are capable of genetically changing over time, which might alter how they affect their hosts, then we must grapple with the assumption made in paleopathology that they do not.

An alternative interpretation is that exploring theoretical underpinnings is relatively new to paleopathology. Although paleopathology today is considered a scientific endeavor, its early practitioners were men of medicine, with their strengths resting in the application of biological knowledge to healing, not scientific research. But a huge component of paleopathology has incorporated scientific analyses of archaeological data for at least forty years. Shouldn't it have been inevitable that we also adopt archaeological theory? We haven't. Paleopathologists have been selective in their use of archaeological theory, opting consistently to apply the "processual approach" in spite of archaeology's (and other fields such as anthropology, evolutionary biology, and genetics) ensuing labile and provocative paradigms. The processual approach, stemming from a labeled "New Archaeology", germinated in the works of Willey and Phillips (1958), and more specifically tackled issues of mortuary analysis with publications by Binford and Binford (1968), Saxe (1970), and Binford (1971). The premise of the processual approach was that through rigorous and quantitative scientific investigation of mortuary remains, researchers could begin to piece together social dimensions of the past. Social dimensions, such as status, were viewed as predictable and recognizable responses to human environmental adaptation. The approach was deemed "positivist" and "deterministic" by opponents, who argued, in part, that developing scientific and statistical correlations between material artifacts within space and time did not equal "objective truth" about the past (e.g. Hodder 1982; Shanks and Tilley 1982; Earle and Pruecel 1987; and Hodder and Hutson 2003).

In spite of the new archaeological paradigms developed since the 1960s and 1970s, and the rise of the bioarchaeological approach in human skeletal analysis (see Armelagos and Van Gerven 2003, and Buikstra and Beck 2006 for comprehensive reviews), paleopathologists tend to be content with the processual approach. High frequencies of skeletal lesions associated with nutritional deficiency, growth disruption, trauma, or degenerative joint disease, for instance, within a population,

are posited to reflect a “less healthy” group. Individuals of lower social status are expected to have greater frequencies of pathological lesions, and the presence of pathological lesions predictably suggest lower status. The argument is circular and leaves little room for multifactorial cause, complex social interactions, individual choice, and/or change over time due to human action. Even as early as 1970, Gabriel Lasker, quoting his mentor Eliot Chappell, feared that this approach would render physical anthropology (and hence paleopathology) “the handmaiden to human history” (Lasker 1970:2).

While changes in archaeological theory didn’t sway most paleopathologists to entertain alternative interpretations of their data, the publication of *The Osteological Paradox* in 1992 by Wood et al., and the ensuing dialogue between researchers (see Goodman 1993; Storey 1997; Wright and Chew 1998) certainly did. Wood et al. brought to light the ramifications of demographic nonstationarity (that population size does not remain constant over time and is especially sensitive to changes in fertility), selective mortality (that populations under investigation represent those who died, not those who were living), and hidden heterogeneity (that individuals vary in their susceptibility to disease). The authors show how datasets can be reinterpreted. For instance, they argue that individuals displaying pathological lesions do not necessarily represent the “sickest” individuals, but rather might indicate immunological strength, as the manifestation of lesions within the skeletal system requires the individual to live through the disease episode, rather than to die immediately from it. These concepts, alongside a growing emphasis on exploring the cultural context of disease (see, for instance, Huss-Ashmore et al. 1981; Angel et al. 1987; Larsen 1997; Goodman and Leatherman 1999) crystallized the need within paleopathology to explore disease processes, and to develop more complex interpretations of disease in the past (Wright and Yoder 2003).

Whether we have adequately met the challenge of developing new directions within paleopathology is debatable. On one hand, overly simplistic interpretations of the presence of skeletal lesions are still amplified through the microphones at professional meetings and appear in print. On the other, as seen in a wide variety of publications and within the chapters of this volume, the field of paleopathology has matured. Researchers such as Sofaer (2006), Geller (2008), Knudson and Stojanowski (2008), and Agarwal and Glencross (2011) offer provocative new ways to integrate social theory with skeletal analyses. Likewise, recently published work exploring the association between epistasis (the interaction between two or more genes) and pathological conditions (Carlborg and Haley 2004; Vieira 2008), epigenetics (which explores the external influences on gene behavior) and disease (Jones and Baylin 2002), and the evolution of disease (Frank 2002; Crespi 2010), to name a few, directly and indirectly offer paleopathologists tantalizing new prospects for skeletal analysis and interpretation.

WHAT IS A “COMPANION”?

There is a wide range of books published on the topic of paleopathology designed to guide and inform the novice and advanced reader. Superb compendia such as *Human Paleopathology* (Ortner 2003) and *The Cambridge Encyclopedia of Human*

Paleopathology (Aufderheide and Rodriguez-Martin 1998) provide us with resources to undertake differential diagnosis and a glimpse into the antiquity of particular conditions. Other books, such as *Biological Anthropology of the Human Skeleton* (Katzenberg and Saunders 2000), and *Advances in Human Palaeopathology* (Pinhasi and Mays 2008), offer the reader foundations in specific topics germane to the field. While books such as *The Archaeology of Disease* (Roberts and Manchester 2005), *Bioarchaeology: Interpreting Behavior from the Human Skeleton* (Larsen 1997), *The Backbone of History: Health and Nutrition in the Western Hemisphere* (Steckel and Rose 2002), and *Health and Disease in Britain* (Roberts and Cox 2003) offer syntheses of a large volume of data generated over decades by many researchers. Equally important are contributions made by authors delving into particular diseases, such as in *The Myth of Syphilis* (Powell and Cook 2005), *The Bioarchaeology of Tuberculosis* (Roberts and Buikstra 2003), *Tuberculosis Past and Present* (Palfi et al. 1999), *Developmental Defects of the Axial Skeleton in Paleopathology* (Barnes 1994), and *The Bioarchaeology of Metabolic Bone Disease* (Brickley and Ives 2008). Publications focusing on specific themes, such as *The Bioarchaeology of Children* (Lewis 2007), *Sex and Gender in Paleopathological Perspective* (Grauer and Stuart-Macadam 1998), *In the Wake of Contact: Biological Responses to Conquest* (Larsen and Milner 1994), and *Disease and Demography of the Americas* (Verano and Ubelaker 1992), also provide important, and often thematic, insight into the past. And lastly, but certainly not least, there are monographic publications which explore health and disease within singular individuals or within particular populations, such as *Bones in the Basement: Postmortem Racism in Nineteenth-Century Medical Training* (Blakely and Harrington 1997), *The Archaeology of Individuals* (Stodder and Palkovich 2010), and *The Skeletal Biology of the New York African Burial Ground* (Blakey and Rankin-Hill 2009).

This book is offered as a complement to those above: a volume to read alongside the vast periodical literature and growing collection of books which provide great breadth and depth to our field. Each contributor to this volume has been asked to provide a “snapshot” of a topic, and to expose issues and controversies together with their vision of a particular aspect of paleopathology. Their voices are varied, but their own: ranging from dense and detailed, to more casual and introspective. They reflect the discourse in our field. The result, we hope, is a compendium highlighting the breadth and promise of paleopathology.

Parsing paleopathology into discrete topics is not simple. Is it possible to discuss a particular disease without talking about the biological and physiological processes taking place within the host? Is it possible to avoid overlapping content between chapters when skeletal responses to change and the mechanical properties of bone are so limited and rarely unique to a single disease? Can full discussion of theories or approaches take place without incorporating examples that might be discussed elsewhere in the volume in different contexts? And all this begs the question of whether we agree on the classification of diseases in the first place, since many metabolic and endocrine diseases can be classified as growth disorders; and erosive joint disorders, suspected to be triggered by infectious pathogens, can be arguably classified as infectious disease. Distinctions, which might appear at first to be absolute, begin to blur and overlap within the pages of this volume. Inevitably, however, celebrating the overlap allows each contribution to stand independently, while enticing

conversation and discourse when information is supplementary or contradictory to that provided in other chapters.

This volume begins with broad brushstrokes. The use of human skeletal and mummified remains within paleopathology cannot be undertaken without introspection into the social and political ramifications of material, as Lambert points out in Chapter 2, “Ethics and Issues in the use of Human Skeletal Remains in Paleopathology.” But the types of questions that paleopathologists seek to answer also need our attention. They are neither identical between researchers, nor uniform through time. As discussed above, paleopathology can be characterized by its ability to unite many threads into a common cloth. Researchers from a variety of fields, with a variety of backgrounds come together to ask questions. All questions center on disease in the past.

Hence, Part I of this book seeks to highlight these varied views. Zuckerman, Turner, and Armelagos in Chapter 3, “Evolutionary Thought in Paleopathology and the Rise of the Biocultural Approach,” provide a detailed account of evolutionary thought within paleopathology, emphasizing the complex interactions between humans and their environment that inform the biocultural approach. They argue that in spite of the promise of this approach, it remains underutilized, if not neglected. Buzon in Chapter 4, “The Bioarchaeological Approach to Paleopathology,” highlights the role and concomitant issues that bringing archaeological techniques and data pose for paleopathology. From issues regarding sampling and recovery of specimens, to the interpretation of social identity via archaeological analysis, paleopathology has much to gain by fully integrating archaeology into the study of disease. In Chapter 5: “The Molecular Approach in Paleopathology,” Gosman goes beyond paleopathologists’ usual discussion of basic bone biology and into new ways molecular biology might impact our interpretation of pathological lesions on skeletal remains. His message is sobering, as he argues that skeletal interpretations made by paleopathologists are often far too simplistic. Katzenberg in Chapter 6, “The Ecological Approach: Understanding Past Diet and the Relationship Between Diet and Disease,” entices the reader to look beyond the usual anthropocentric interpretations of disease in the past, which have humans as the both the instigator and victim of change, towards an ecological approach—an approach where numerous environmental variables impact one another, many outside humans’ direct control. Boldsen and Milner in Chapter 7, “An Epidemiological Approach to Paleopathology,” guide the reader through the perils and requisite premises of interpreting disease beyond its presence in individuals and on to a population level. Their straightforward approach, coupled with many examples, effectively highlights the key role that paleoepidemiology plays in our understanding of disease in the past. Cast in a promising light, Chapter 8, “The Promise, the Problems, and the Future of DNA Analysis in Paleopathology Studies,” by Spigelman, Shin, and Bar-Gal, captures the ways in which DNA analyses have begun to answer questions germane to paleopathology, while simultaneously outlining imperative protocols that must be met in order for the work to provide genuine results. Zimmerman in Chapter 9, “The Analysis and Interpretation of Mummified Remains,” summarizes a wide body of data to draw attention to the contributions that mummified remains have made to our understanding of disease. In Chapter 10, “The Study of Parasites Through Time: Archaeoparasitology and Paleoparasitology,” Dittmar, Araujo, and Reinhard chronicle the work of parasitologists from around the

world and make evident the theoretical interdependency between many branches of science, such as archaeology, evolutionary biology, microbiology, ecology, and the social sciences. Chapter 11, “More Than Just Mad Cows: Exploring Human–Animal Relationships Through Animal Paleopathology,” by Upex and Dobney, effectively argue for the much-warranted, but often overlooked need to include the analysis of faunal remains in paleopathological investigations. Through these analyses, complex interactions between human and animal hosts and pathogens are better understood, and the dynamic relationship between humans and animals becomes more readily appreciated. Lastly, it is fitting to end the section dedicated to approaches and perspectives with introspection into how paleopathology’s past might inform its future. Hence, in Chapter 12, “How Does the History of Paleopathology Predict Its Future?” Powell and Cook provide the reader with a perspicacious look into controversies and paths that serve as this field’s greatest obstacles, but may render its greatest promise.

Equally germane to the field of paleopathology is discussion centered on methods and techniques by which we amass data and develop interpretations. Part II of this book seeks to address these issues. At the cornerstone of these discussions rests a set of issues involving the recognition and classification of disease. Offering one means of classification and a discussion on cellular processes that precede our ability to diagnose the presence of disease, Ragsdale and Lehmer, in Chapter 13 “A Knowledge of Bone at the Cellular (Histological) Level is Essential to Paleopathology,” argue that studying mechanisms of disease may be more critical to paleopathology than attempts at diagnosis. Likewise, Ortner in Chapter 14, “Differential Diagnosis and Issues of Disease Classification,” conveys a similar message but hinges his arguments on the role that both cause and pathogenesis play in our ability to classify disease, which ultimately, he argues, influences paleopathologists’ interpretations of the significance of finding a disease in the past.

Other key variables have become important to wrestle within paleopathology; in particular, the determination of age-at-death and sex in skeletal remains. Milner and Boldsen, in Chapter 15 “Estimating Age and Sex From the Skeleton: A Paleopathological Perspective,” review the techniques used to make these determinations, grapple with the biases, and present the need for careful paleodemographic analysis within paleopathological studies. In Chapter 16, “The Relationship Between Paleopathology and the Clinical Sciences,” Mays argues that case studies and clinical research play an important role in paleopathology and that tension between qualitative and quantitative analysis is unlikely to end soon; perhaps to the benefit of paleopathology. Another key resource in paleopathology is historical documents. Mitchell in Chapter 17, “Integrating Historical Sources with Paleopathology,” critically evaluates potential biases and brings the social dimensions of human disease to the forefront. While advances in imaging techniques have greatly assisted paleopathological investigation, Wanek, Papageorgopoulou, and Rühli in Chapter 18, “Fundamentals of Paleoimaging Techniques: Bridging the Gap Between Physicists and Paleopathologists,” seek to disclose both the positive and negative aspects of using particular techniques. In Chapter 19, “Data and Data Analysis: Issues in Paleopathology,” Stodder draws our attention to complexities of data collection and the ramifications that small decisions, either made or ignored, can have on paleopathological research.

Part III seeks to tackle particular conditions and diseases that have garnered much attention in paleopathological research. The section begins with a discussion of the presence and interpretation of trauma, offered by Judd and Redfern in Chapter 20. The authors make particular note of the controversies centering on the classification, recording, and interpretation of the deceptively complex suite of skeletal changes referred to as “trauma.” In Chapter 21, “Developmental Disorders in the Skeleton,” by Barnes, the reader is informed that variability exists in every part of the human skeleton, with the concept of “disorder” being created at times artificially in an effort to derive meaning from human variation. Kozłowski and Witas in Chapter 22, “Metabolic and Endocrine Diseases,” offer the reader insight into these widely encompassing disease classifications which, within paleopathological research, often focus on the association between nutritional deficiencies and disease. In Chapter 23, “Tumors: Problems of Differential Diagnosis in Paleopathology,” Brothwell, through the use of a case-study approach, addresses how bone preservation and lesion interpretation affect the diagnosis and eventual understanding of tumors in the past. Roberts in Chapter 24, “Re-Emerging Infections: Developments in Bioarchaeological Contributions to Understanding Tuberculosis Today,” takes a holistic approach to the study of tuberculosis by placing it in historical, social, political, and economic contexts. This demonstrates the paleopathological examination of the disease to be a critical contributor to our understanding of its future trajectory in human populations. Providing a clinical and epidemiological approach, alongside a paleopathological assessment, Lynnerup and Boldsen in Chapter 25, “Leprosy (Hansen’s disease),” discuss multiple facets of this disease, which still afflicts huge numbers of people today. In Chapter 26, “Treponematoses: Past, Present, and Future,” Cook and Powell review the suite of conditions classified as treponemal disease and the debates that have developed within paleopathology concerning the evolution of syphilis. Venturing past a clinical discussion, the authors draw attention to the social dimensions which have influenced our understanding of the disease in the past and might color our views today. The growing discourse on a pathological lesion of complex etiological origin, referred to loosely as “periosteal reactions” is the primary focus of Weston in Chapter 27, “Nonspecific Infection in Paleopathology: Interpreting Periosteal Reactions.” Here, the author casts a critical eye on paleopathological interpretations of these lesions by exploring the physiological and biochemical bases of bone production. Waldron, in Chapter 28, “Joint Disease,” assists the reader in understanding the bases of classification of the disease and evaluates efforts to interpret their presence in human skeletal remains. Chapter 29, “Bioarchaeology’s Holy Grail: The Reconstruction of Activity,” by Jurmain, Cardoso, Henderson, and Villotte tackles a “hot” topic in paleopathology: can quantifiable and/or qualifiable changes to bone serve as markers for occupation, activity, or mechanical stress? Clearly, many researchers have argued “Yes”. However, these authors question both the diagnosis and interpretation of lesions used to reconstruct activity in the past, providing the reader a glimpse into the heat of the controversy. To end, the analysis of dental remains in human skeletal remains is addressed by Lukacs in Chapter 30, “Oral Health in Past Populations: Context, Concepts and Controversies in the Study of Dental Disease.” Like bone, teeth provide insight into health and disease in the past, but only, as argued by the author, if we recognize the intricacies of diagnosis and the perils of interpretation.

REFERENCES

- Ackerknecht, E. H., 1953 Paleopathology. *In* *Anthropology Today*. An Encyclopedic Inventory. A. L., Kroeber, ed. pp. 120–126. Chicago: University of Chicago Press.
- Ackerknecht, E. H., 1965 *History and Geography of the Most Important Diseases*. New York: Hafner.
- Agarwal, S. C., and Glencross, B. A., eds., 2011 *Social Bioarchaeology*. Chichester: Wiley-Blackwell.
- Angel, L. J., 1981 *History and Development of Paleopathology*. *American Journal of Physical Anthropology* 56:509–515.
- Angel, L. J., Kelley, J., Parrington, M., and Pinter, S., 1987 *Life Stresses of the Free Black Community as Represented by the First African Baptist Church, Philadelphia, 1823–1841*. *American Journal of Physical Anthropology* 74:213–229.
- Armelagos, G. J., Carlson, D. S., and Van Gerven, D. P., 1982 *The Theoretical Foundation and Development of Skeletal Biology*. *In* *A History of American Physical Anthropology, 1930–1980*. F. Spencer, ed. pp. 305–328. New York: Academic Press.
- Armelagos, G. J., and Van Gerven, D. P., 2003 *A Century of Skeletal Biology and Paleopathology: Contrasts, Contradictions, and Conflicts*. *American Anthropologist* 105(1):51–62.
- Aufferheide, A. C., and Rodriguez-Martin, C., 1998 *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.
- Barnes, E., 1994 *Developmental Defects of the Axial Skeleton in Paleopathology*. Niwot, CO: University Press of Colorado.
- Binford, L., 1971 *Mortuary Practices: Their Study and Their Potential*. *In* *Approaches to the Social Dimensions of Mortuary Practices*. J. A. Brown, ed. pp. 6–29. Washington, DC: Society for American Archaeology.
- Binford, S. R., and Binford, L., 1968 *New Perspectives in Archaeology*. Chicago: Aldine Press.
- Blakely, R. L., and Harrington, J. M., 1997 *Bones in the Basement: Postmortem Racism in Nineteenth-Century Medical Training*. Washington, DC: Smithsonian Institution Press.
- Blakey, M. L., and Rankin-Hill, L. M., 2009 *The Skeletal Biology of the New York African Burial Ground: Part I. The New York African Burial Ground: Unearthing the African Presence in Colonial New York, Volume 1*. Washington, DC: Howard University Press.
- Brickley, M., and Ives, R., 2008 *The Bioarchaeology of Metabolic Bone Disease*. Oxford: Academic Press.
- Brickley, M., and McKinley, J. I., 2004 *Guidelines to the Standards for Recording Human Remains*. IFA Paper Number 7. Southampton: BABAO.
- Brothwell, D., 1982 *Linking Urban Man with His Urban Environment*. *In* *Environmental Archeology in the Urban Context*. R. A. Hall, and H. K. Kenward, eds. pp. 126–129. Oxford: Council of British Archaeology Report No. 43.
- Brothwell, D., and Sandison, A. T., 1967 *Editorial Prolegomenon: The Present and Future*. *In* *Disease in Antiquity: A Survey of the Diseases, Injuries and Surgery of Early Populations*. D. Brothwell, and A. T. Sandison, eds. pp. xi–xiv. Springfield, IL: Charles C. Thomas.
- Buikstra, J. E., 2010 *Paleopathology: A Contemporary Perspective*. *In* *Companion to Biological Anthropology*. C. S. Larsen, ed. pp. 395–411. Chichester: Wiley-Blackwell.
- Buikstra, J. E., and Beck, L., 2006 *Bioarchaeology: The Contextual Analysis of Human Remains*. San Diego, CA: Elsevier Inc.
- Buikstra, J. E., and Cook, D. C., 1980 *Palaeopathology: An American Account*. *Annual Reviews in Anthropology* 9:433–470.
- Buikstra, J. E., and Ubelaker, D. H., 1994 *Standards for Data Collection from Human Skeletal Remains: Proceedings of a Seminar at The Field Museum of Natural History Organized by Jonathan Haas*. Research Series No. 44. Fayetteville: Arkansas Archaeological Survey.

- Carlborg, O., and Haley, C. S., 2004 Epistasis: Too Often Neglected in Complex Trait Studies? *Nature Reviews Genetics* 5:618–625. doi:10.1038/nrg1407.
- Crespi, B. J., 2010 The Origins and Evolution of Genetic Disease Risk in Modern Humans. *Annals of the New York Academy of Sciences* 1206(1):80–109.
- Earle, T. K., and Preucel, R. W., 1987 Processual Archaeology and the Radical Critique. *Current Anthropology* Vol. 28(4):501–538.
- Frank, S. A., 2002 *Immunology and Evolution of Infectious Disease*. Princeton, NJ: Princeton University Press.
- Geller, P. L., 2008 Conceiving Sex: Fomenting a Feminist Bioarchaeology. *Journal of Social Archaeology* 8:113–138.
- Goodman, A., 1993 On the Interpretation of Health from Skeletal Remains. *Current Anthropology* 34(3):281–288.
- Goodman, A., and Leatherman, T., eds. 1999 *Building a New Biocultural Synthesis: Political-Economic Perspectives on Human Biology*. Ann Arbor, MI: The University of Michigan Press.
- Grauer, A. L., 2008 Macroscopic Analysis and Data Collection in Palaeopathology. *In Advances in Human Palaeopathology*. R. Pinhasi, and S. Mays, eds. pp. 57–76. Chichester: John Wiley and Sons.
- Grauer, A. L., and Stuart-Macadam, P., eds., 1998 *Sex and Gender in Paleopathological Perspective*. Cambridge: Cambridge University Press.
- Hardham, J. M., Frye, J. G., Young, N. R., and Stamm, L. V., 1997 Identification and Sequences of the *Treponema pallidum* flhA, flhF, and orf304 Genes. *DNA Sequence* 7:107–116.
- Hodder, I., ed., 1982 *Symbolic and Structural Archaeology*. Cambridge: Cambridge University Press.
- Hodder, I., and Hutson, S., 2003 *Reading the Past: Current Approaches to Interpretation in Archaeology*. 3rd edition. Cambridge: Cambridge University Press.
- Hooton, E. A., 1930 *The Indians of Pecos Pueblo: A Study of their Skeletal Remains*. New Haven, CT: Yale University Press.
- Huss-Ashmore, R., Goodman, A., and Armelagos, G. J., 1981 Nutritional Inference From Paleopathology. *In Advances in Archaeological Method and Theory* Volume 5. M. Schiffer, ed. pp. 395–474. New York: Academic Press.
- Janssens, P. A., 1970 *Paleopathology: Diseases and Injuries of Prehistoric Man*. Ida Dequeecker, trans. New York: Humanities Press.
- Jarcho, S., ed., 1966a *Human Paleopathology*. New Haven: Yale University Press.
- Jarcho, S., 1966b The Development and Present Condition of Human Palaeopathology in the United States. *In Human Paleopathology*. S. Jarcho, ed. pp. 3–30. New Haven, CT: Yale University Press.
- Jones, P. A., and Baylin, S. B., 2002 The fundamental Role of Epigenetic Events in Cancer. *Nature Reviews Genetics* 3, 415–428. doi:10.1038/nrg816.
- Katzenberg, M. A., and Saunders, S. R., 2000 *Biological Anthropology of the Human Skeleton*. New York: Wiley-Liss.
- Knudson, K. J., and Stojanowski, C. M., 2008 New Directions in Bioarchaeology: Recent Contributions to the Study of Human Social Identities. *Journal of Archaeological Research* 16:397–432.
- Larsen, C. S., 1997 *Bioarchaeology: Interpreting Behavior from the Human Skeleton*. Cambridge Studies in Biological Anthropology 21. Cambridge: Cambridge University Press.
- Larsen, C. S., and Milner, G. R., 1994 *In the Wake of Contact: Biological Responses to Conquest*. New York: Wiley-Liss.
- Lasker, G., 1970 *Physical Anthropology: Search for General Processes and Principles*. *American Anthropologist* 72:1–8.
- Lewis, M. E., 2007 *The Bioarchaeology of Children: Perspectives from Biological and Forensic Anthropology*. Cambridge: Cambridge University Press.

- Mays, S. A., 2010 Human Osteoarchaeology in the UK 2001–2007: A Bibliometric Perspective. *International Journal of Osteoarchaeology* 20:192–204.
- Møller-Christensen, V., 1961 Bone Changes in Leprosy. Copenhagen: Munksgaard.
- Monot, M., Honoré, N., Garnier, T., Zidane, N., Sherafi, D., Paniz-Mondolfi, A., Matsuoka, M., Taylor, G. M., Donoghue, H. D., Bouwman, A., et al., 2009 Comparative Genomic and Phylogeographic Analysis of *Mycobacterium leprae*. *Nature Genetics* 41:1282–1289.
- Moodie, R. L., 1923 Paleopathology: An Introduction to the Study of Ancient Evidences of Disease. Urbana: University of Illinois Press.
- Ortner, D. J., 2003 Identification of Pathological Conditions in Human Skeletal Remains. Second Edition. San Diego, CA: Academic Press.
- Ortner, D. J., and Putschar, W. G. J., 1981 Identification of Pathological Conditions in Human Skeletal Remains. *Smithsonian Contributions to Anthropology*, No. 28. Washington, DC: Smithsonian Institution Press.
- Palfi, G., Dutour, O., Deak, J., and Hutás, I., 1999 Tuberculosis Past and Present. Szeged, Hungary: Golden Book Publisher, and Tuberculosis Foundation.
- Pinhasi, R., and Mays, S., 2008 Advances in Human Palaeopathology. Chichester: John Wiley and Sons.
- Powell, M. L., and Cook, D. C., 2005 The Myth of Syphilis: The Natural History of Treponematoses in North America. Gainesville: University of Florida Press.
- Ragsdale, B. L., 1992 Task Force on Terminology: Provisional Word List (March 1992). *Paleopathology Newsletter* 78:7–8.
- Roberts, C. A., 2006 A View From Afar: Bioarchaeology in Britain. *In* *Bioarchaeology: The Contextual Analysis of Human Remains*. J. E. Buikstra, and L. Beck, eds. pp. 417–439. San Diego, CA: Elsevier Inc.
- Roberts, C. A., and Buikstra, J. E., 2003 The Bioarchaeology of Tuberculosis: A Global View On a Reemerging Disease. Gainesville: University of Florida Press.
- Roberts, C. A., and Cox, M., 2003 Health and Disease in Britain: Prehistory to the Present Day. Gloucester: Sutton Publishing.
- Roberts, C. A., and Manchester, K., 2005 The Archaeology of Disease. 3rd edition. Stroud: Sutton Publishing.
- Sandison, A. T., 1967 Sir Marc Armand Ruffer (1859–1917) Pioneer of Palaeopathology. *Medical History* 11(2):150–156.
- Saxe, A. A., 1970 Social Dimensions of Mortuary Practices. Ph.D. dissertation, University of Michigan.
- Shanks, M., and Tilley, C., 1982 Ideology, Symbolic Power and Ritual communication: A Reinterpretation of Neolithic Mortuary Practices. *In* *Symbolic and Structural Archaeology*. I. Hodder, ed. pp. 129–154. Cambridge: Cambridge University Press.
- Sofaer, J., 2006 The Body as Material Culture. A Theoretical Osteoarchaeology. Cambridge: Cambridge University Press.
- Steckel, R. H., and Rose, J. C., 2002 The Backbone of History: Health and Nutrition in the Western Hemisphere. Cambridge: Cambridge University Press.
- Stedman's Medical Dictionary. 26th edition, 1995 Baltimore MD: Williams and Wilkins.
- Steinbock, R. T., 1976 Paleopathological Diagnosis and Interpretation. Springfield, IL: Charles C. Thomas.
- Stodder, A. L. W., and Palkovich, A. M., 2010 The Bioarchaeology of Individuals. Gainesville: University Press of Florida.
- Storey, R., 1997 Individual Frailty, Children of Privilege, and Stress in Late Classic Cop'an. *In* *Bones of the Maya: Studies of Ancient Skeletons*. S. Whittington, and D. Reed, eds. pp. 116–126. Washington, DC: Smithsonian Institution Press.
- Ubelaker, D. H., 1982 The Development of American Paleopathology. *In* *A History of American Physical Anthropology, 1930–1980*. F. Spencer, ed. pp. 337–356. New York: Academic Press.

- Verano, J. W., and Ubelaker, D. H., 1992 *Disease and Demography in the Americas*. Washington, DC: Smithsonian Institution Press.
- Vieira, A. R., 2008 Unraveling human Cleft Lip and Palate Research. *Journal of Dental Research* 87:119–125.
- Wells, C., 1964 *Bones, Bodies and Diseases: Evidence of Disease and Abnormality in Early Man*. London: Thames and Hudson.
- Willey, G. R., and Phillips, P., 1958 *Method and Theory in American Archaeology*. Chicago: University of Chicago Press.
- Williams, H. U., 1929 Human Paleopathology, With Some Original Observations on Symmetrical Osteoporosis of the Skull. *Archives of Pathology* 7:839–902.
- Wood, J., Milner, G., Harpending, H., and Weiss, K., 1992 The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples. *Current Anthropology* 33:343–370.
- Wright, L. E., and Chew, F., 1998 Porotic Hyperostosis and Paleoepidemiology: A Forensic Perspective on Anemia Among the Ancient Maya. *American Anthropologist* 100:924–939.
- Wright, L. E., and Yoder, C. J., 2003 Recent Progress in Bioarchaeology: Approaches to the Osteological Paradox. *Journal of Archaeological Research* 11(1):43–70.