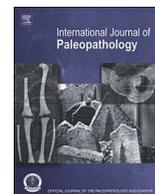




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Introduction: Scientific rigor in paleopathology

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ABSTRACT

This introductory chapter to the Special Issue on “Scientific Rigor in Paleopathology” serves to orient and introduce the chapters that follow through a detailed consideration of paleopathology as a 21st century intellectual field. In this vein, we first make the significant point that paleopathology is a profoundly interdisciplinary endeavor, encompassing aspects of the biomedical science, the humanities, and the social sciences. Thus, we suggest that no one practitioner can personally command the range of skills necessary for a 21st century paleopathologist. To maintain rigor in differential diagnosis, we emphasize collaborations and consider key concepts that illustrate the basic knowledge from each of these fields that any paleopathologist should command. We then address the manner in which disease diagnosis should proceed as a scientific endeavor. To illustrate scientific rigor in differential diagnosis, we present two case studies drawn from 1970s contributions by Cook and by Buikstra. Finally, we introduce Chapters 2-6, which address differential diagnosis in contexts ranging from specific conditions (scurvy, trepanation) to broader field-wide considerations (paleoparasitology, historical paleopathology, imaging, animal paleopathology).

1. Introduction

The primary motivation for this Special Issue on “Scientific Rigor in Paleopathology” in the *International Journal of Paleopathology* is the senior author’s experience as Editor-in-Chief of the *IJPP* since its inception. In addition, both Buikstra and Cook admit to a much longer history of concern for rigorous, reproducible, and scientific differential diagnoses (Buikstra, 1976; Buikstra and Cook, 1980; Cook, 1976). We have invited Bolhofner, a practitioner who has more recently entered the field, to offer insights from the next generation of scholars who study ancient disease.

So, what do we mean by “rigor” in paleopathology? This is not the “rigor mortis” of the newly dead, but rather the need to carefully follow protocols and to exercise objectivity in drawing conclusions. Much is implied here, including not attempting to render a diagnosis beyond the available data. It does mean, however, considering all possible alternatives when constructing a differential diagnosis. Similarly, in evaluating the qualitative information available from historical sources, the researcher must be equally objective in searching out all possible relevant evidence rather than selectively choosing a facile example that supports a favored explanation. Whether scientific or humanistic, quantitative or qualitative, rigorous approaches consider all viable alternatives and thus avoid bias introduced by prematurely narrowing one’s search, whether for a historic example or a diagnosis.

This introductory chapter will address a number of important issues. We begin by considering Paleopathology as a 21st century intellectual field. Here, we make the significant point that paleopathology is a profoundly interdisciplinary endeavor that encompasses aspects of the biomedical sciences, the humanities, and the social sciences. Rather than being “pathology light,” that is, a biomedical approach severely limited by the nature of the archaeological record, paleopathology embraces the long term study of people and their diseases. In emphasizing the intimacy of co-evolutionary history, we are reminded of an observation attributed to Hippocrates: “It is more important to know what sort of person has a disease than to know what sort of disease a person has” (Xplore, Inc.). While this statement, viewed in historical context, specifically alludes to the ancient Greek medical belief that good health requires a balance across competing internal forces within individuals (Grmek, 1983/1989), it is also an enduring message that underscores the significance of *people* in the study of ancient disease.

Recognizing that no one practitioner can personally command the range of skills necessary for a 21st century paleopathologist, we further emphasize collaboration and teamwork in advancing the field, and we also briefly consider key concepts that illustrate the basic knowledge that any paleopathologist should command in both the biomedical and the social sciences, as well as the humanities. The acquisition of this knowledge is extremely important in training the next generation of paleopathologists.

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Having established the nature of 21st century paleopathology, we then address the manner in which disease diagnosis should proceed as a scientific endeavor. Two case studies drawn from contributions by Cook and by Buikstra are reframed to serve as examples. The first, a pattern-matching approach by Cook (1976), illustrates the manner in which one can diagnose frequently occurring skeletal changes at a population level by carefully combining clinical and prevalence information. The second, Buikstra's (1976) model for the differential diagnosis of a relatively rare but severely debilitating condition, engages a key diagram in the process of elimination that forms the core of her model. The final section (4.0) introduces Chapters 2–6, which address differential diagnosis in contexts ranging from specific conditions (scurvy, trepanation) to broader field-wide considerations (paleoparasitology, historical paleopathology, imaging, animal paleopathology).

2. Paleopathology in the 21st century: defining and studying “one of the very rarest of things” (Shufeldt, 1892: 679)

In his 1892 essay in *Popular Science Monthly*, auspiciously entitled “Notes on Paleopathology,” R. W. Shufeldt proposed the term “paleopathology” (from the Greek, ancient + a suffering) to describe “all diseased or pathological conditions found fossilized in the remains of extinct or fossil animals” (Shufeldt, 1892: 679). He also emphasized that in his experience, primarily with bird remains, fossilized bones showing evidence of disease was “one of the very rarest of things.”

The manner in which we define the field of paleopathology affects the way in which we structure research and the questions we ask. This first definition of paleopathology by Shufeldt appears all encompassing; he goes on (p. 683) to discuss healing in modern turkey vultures and a Pliocene fossil specimen provided by paleontologist E. D. Cope, perhaps a medium sized goose. He concludes with a uniformitarian generality that the “interesting fossil specimen, then, goes to provide that the union of fractures of the shafts of the long bones in the vertebrata during the later Tertiary times was identical with what now occurs in the case of existing forms (Shufeldt, 1892: 683). His detailed observations, his uniformitarian assumptions, and his vision of a broad field of paleopathology establish important principles for subsequent scholarship. Therefore, Shufeldt must be recognized as a progenitor of the field of paleopathology, however much we may wish to balance Shufeldt's terminological and uniformitarian prescience with his questionable personal proclivities (see Cook, 2012).

Following Shufeldt's definition, the term “paleopathology” began appearing in dictionaries, such as *Funk and Wagnall's Standard Dictionary* (1895, cited also in Jarcho, 1966; Ubelaker, 1982; Aufderheide and Rodríguez-Martín, 1998). In the early 20th century, Sir Marc Armand Ruffer and the American Roy Lee Moodie published general compendia on ancient health (Ruffer, 1921; Moodie, 1923), which are widely cited. Ruffer extended the study of ancient disease to include mummified tissues, while Moodie's work encompassed plants, animals, and humans, thus defining the field in the broadest of terms.

In 1967, Brothwell and Sandison, as paleopathologists and editors of a volume entitled, *Diseases in Antiquity*, lamented that “the past three decades have seen but small advances” in paleopathology (1967: xi). Similarly, medical historian Saul Jarcho (1966:24) lamented that, “[t]he usual pattern has been for the archaeologist to select from his trophies those in which he is able to recognize gross disease and to submit them to a physician. The resultant paleopathologic observations are attached as an addendum or appendix to the archaeological report (Jarcho 1966:24). The subsequent delay in publication and failure to index or otherwise elevate and integrate discussions of ancient medical conditions stimulated Jarcho's dismay, and he called for a “revival of paleopathology” (Jarcho 1966:28).

Following somewhat disgruntled statements of concern (Brothwell and Sandison, 1967; Jarcho, 1966, see also Cook and Buikstra, 1980; Grmek 1983/1989), paleopathology enjoyed increased visibility, including the development of two international and several national/

regional professional organizations, two international journals, international training seminars, and professional meetings held across Europe, eastern Asia, and the Americas (Buikstra and Roberts, 2012). While many recent texts continue to define paleopathology as the study of ancient disease (Aufderheide and Rodríguez-Martín, 1998:xv; Ortner, 2003:8), definitions are being broadened to reflect viewpoints drawn from the social sciences and the humanities. Perspectives drawn from the social sciences have, for example, encouraged some scholars to define paleopathology both in terms of disease evolution and human adaptation, thus emphasizing the dynamic interaction between humans, disease and the environment (Campillo, 1992-1994, 2001; Grauer, 2012; Herrin, 2011; Roberts and Manchester, 2005; Rodríguez Cuenca, 2005; Suby, 2012).

Thus, 21st century paleopathology should be profoundly interdisciplinary, occupying a space where the biomedical and social sciences join the humanities. In a field so diverse, we argue that paleopathologists should formally define a core knowledge base essential for practitioners and for training future generations of scholars. Scanning a list of medical specialties drawn from web-based searches (e.g. <http://www.aamc.org/cim/specialty/exploreoptions/list/>) leads one to the obvious conclusion that no one person can command the biomedical knowledge necessary for developing truly innovative research in paleopathology, which now includes relatively specialized, intricate fields ranging from molecular oncology to bioinformatics. Further, various social scientific and humanistic specialties are required for answering “big picture” questions about long-term histories. Such questions include, “are cancers truly diseases of the industrialized world,” to “how important were animal vectors (or climate change) in the development of infectious diseases in the past, and has their significance decreased or increased over time and with domestication?” It is clearly the social scientist and the historian who will provide contextual data crucial for such investigations. If we are to achieve informed perspectives, teamwork and organization are essential for bringing the necessary biomedical technologies, knowledge, and theories together with those drawn from across the social sciences and humanities.

In this vein, as we advocate for rigor in paleopathology, we must recognize that the humanist, the medical scientist, and the social scientist may not immediately agree upon a working definition of “rigor.” Similarly, the medical doctor, while benefitting from the results of many scientific studies and scientific tests, may not necessarily actually “be” a scientist or employ scientific principles in daily practice. In medical practice, matching symptoms and test results through sometimes intuitive methods that involve critical thinking and creativity may actually link the medical doctor more closely with humanists and humanistic approaches than to scientists, especially those following an expressly hypo-deductive research design wherein hypotheses are formally stated and tested.

The Venn diagram illustrated in Fig. 1 illustrates the overlap and specialization of the relevant disciplines. We could argue about the relative contributions from the various fields, but the more important questions is, “what is the core knowledge that each paleopathologist or student of paleopathology should command?”

Certainly, understanding basic bone biology, with emphasis upon both normal and abnormal processes is essential for paleopathological research. Clinical knowledge of bone pathology, drawn from both contemporary and historical sources, is also essential. Excellent texts (e.g., Aufderheide and Rodríguez-Martín, 1998; Ortner, 2002; Roberts and Manchester, 2007) should be considered entry points for extensive reviews of the appropriate clinical literatures. Similarly, Baker and Brothwell (1980) and Bartosiewicz (2013) are appropriate references for animal paleopathologists.

We argue, however, that the texts of paleopathology, no matter how detailed, are only introductions to the relevant clinical literatures; they in themselves are not sufficient, nor are their illustrations adequate to illustrate a full range of possible disease expressions, especially considering how variable disease expression can be throughout the life

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