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Paleopathological Research in Continental China: Introduction to the Special Section

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We set out to assemble this special issue of IJPP with three goals in mind: (1) to familiarize Anglophone readers with research on paleopathology conducted by Chinese scholars; (2) to enhance interest in paleopathological research among Chinese scholars, and to foster the use of differential diagnosis as the key mode of paleopathological analysis; and (3) to initiate integration of pathological analysis of human skeletal collections with historical records documenting early medical practices, epidemics, development and age-related diseases, and demographic records.

The collection of papers that follows present new data, from a range of time periods and geographic and social contexts, that we feel reflect the diversity, dynamism, and enormous scope of archaeology in China today. Themes such as infectious disease history, interpersonal violence, and comorbidity as a methodological issue are addressed by multiple papers. However, as the special issue developed, we also came to a slow appreciation of structural constrains that made our original goals difficult to attain within the current state of our discipline, of which the language barrier represents only a minor issue.

The following sections are intended to contextualize this special issue, and help readers understand the intrinsic and extrinsic factors that influence paleopathological research in China and its interactions with similar research in other parts of the world.

1. Historical overview

1.1 Development of paleopathology within China

In the inaugural note to the first issue of the *Acta Anthropologica Sinica* (*Renleixue Xuebao* 人类学学报), Wu Rukang (1982) noted that through the first half of the 20th century, in "semi-colonial China," research on biological anthropology represented disjointed efforts that were primarily limited to collecting metric data. In addition, at that early date, the majority of Chinese scholars conducting research on biological anthropology were either trained in the US and Europe, or arrived to the field as medical professionals interested in human skeletons. For instance, a prominent Chinese paleontologist, Yang Zhongjian (杨钟健), was trained by von Ferdinand Broili and Max Schlosser at Munich University (Smith 1931; Lucas 2001:26). Following the end of the 2nd World War, Yang almost single-handedly resurrected Chinese paleontology (Lucas ibid). His collections and research eventually became the foundation of the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing (IVPP), which he directed for many years.

Similarly, Wu Dingliang (吴定良) (1893 – 1969), who is often viewed as a founder of biological anthropology in China, was trained at Columbia University and later in London. He received rigorous training in statistics with Karl Pearson (Woo TL and Pearson 1927; Pearson and Woo TL 1935), and collaborated with Geoffrey Morant (Woo TL and Morant, 1932, 1934) and Ethel Elderton (Elderton and Woo TL 1932). In line with the skeletal research carried out in Europe at that time, Wu Dingliang focused his studies on developing craniometric racial classifications, publishing a study entitled "Preliminary Classification of Asiatic Races Based on Cranial Measurements" (Wu Dingliang and Mo Rende, 1932). Returning to China in 1935, Wu Dingliang assumed a position as a researcher at the Institute of History and Linguistics of the Academia Sinica, where he continued his craniometric studies (Wu Dingliang 1940, 1956, 1960; Woo TL 1941), conducting research on the human skeletal remains from the Shang Dynasty capital of Yinxu (Duan, 1989), and also expanded his analysis to physical variation of living humans (Woo TL 1942; 1957a, 1957b). He moved to Fudan University in 1952 as a chair of the newly founded anthropology department, where he trained many students, including Wu Rukang (吴汝康) and Han Kangxin (韩康信).

Perhaps the most crucial step in the development of biological anthropology in China happened in 1982, when a group of IVPP scholars, led by Wu Rukang, in collaboration with the Chinese Academy of Sciences, established *Acta Anthropologica Sinica*, a quarterly periodical largely dedicated to biological anthropology. Until that date, the only periodical journal for publishing research on human skeletal remains was *Acta Archaeologica Sinica*, a journal with a primary focus on archaeology after the Paleolithic, where biological anthropology papers typically augmented archaeological studies and presented descriptive analysis of cranial shapes, aiming to trace biological ancestry (i.e. 'racial affinity') and reconstruct migration in early China (e.g. Chia and Yen, 1963; Han et al., 1974; Han, 1975; Physical 1975; Yan, 1962). Studies of human skeletons were also published as parts of excavation reports, typically towards the end or as appendices, and were also predominantly focused on analysis of complete crania, as the postcranial skeleton was rarely preserved in anthropological collections of that time.

Wu Rukang's inaugural note to *Acta Anthropologica Sinica* (1982), quoted above, was terse, yet defined the development of biological anthropology in China for the years to come. In the first paragraphs of the note, Wu firmly positioned anthropology (*renleixue* 人类学) as an integral part of natural sciences, stating that the subject of anthropology is the human body and that humans evolved from nonhuman mammals through a long process of natural evolution. He notes that anthropology has a close connection to social disciplines, because in their process of evolution humans relied on social and cultural adaptations to natural environments. Hence, although anthropology was described as intertwined with social sciences, it was also "not able to escape the dragon of natural history." The scope of the journal was defined by Wu as encompassing six specific topics:

1. Research on morphology, physiology, ecology, and origins and evolution of humans and non-human primates;
2. Archaeological research on Paleolithic human sites;
3. Research on living environment and pathology of early humans;

4. The study of physical variation among living human beings, and principles of growth and development;
5. Applied anthropological research; and
6. The application of new methods related to anthropological research (such as dating and statistical analysis).

Probably because of the prominent role of the IVPP in establishing the journal, and because the initial editorial board was primarily comprised of paleoanthropologists, articles on the first two topics in the list initially appeared in greater numbers in the journal and were featured as the first articles in the lineup of each issue. For studies that focused on interpreting the human skeleton, the existence of *Acta Anthropologica Sinica* meant a notable reorientation of research questions. The focus of skeletal research shifted from being subservient to archaeological interpretations towards addressing topics salient to human biology, such as morphological changes related to health and age, dental variation and oral health, isotopic analysis of early diets, and skeletal markers of disease (e.g., Mo and Peng, 1983; Zeng et al., 1983; Zhang, 2003).

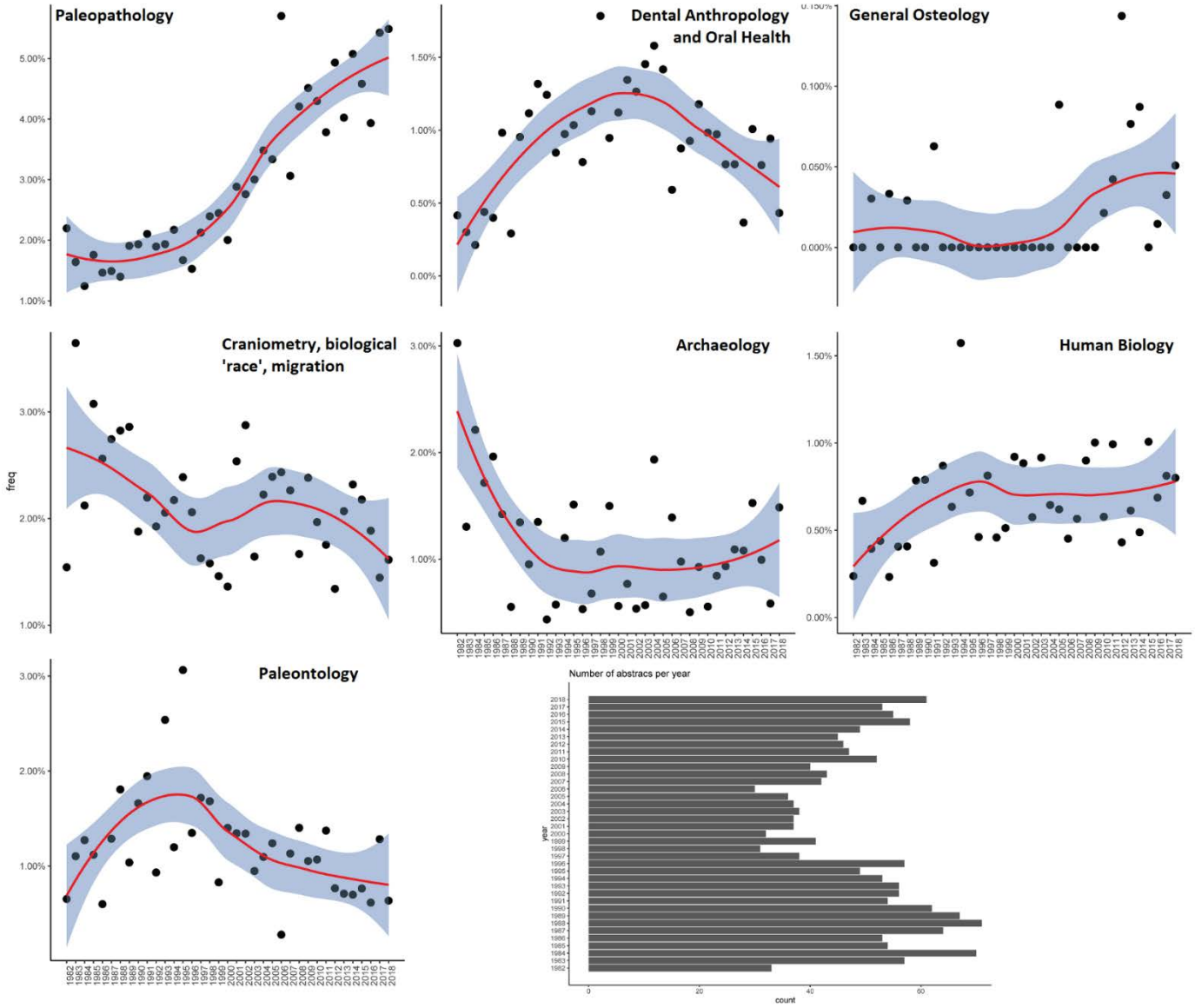
1.2 Temporal changes in research topics of papers published in *Acta Anthropological Sinica*

Thirty-seven years of *Acta Anthropologica Sinica* (AAS) publications allow us to analyze how the focus of anthropological research in China shifted over time. By no means is AAS the only venue for publication of biological anthropology research in China, as many studies continue to be published in *Acta Archaeologica Sinica* and in other anthropology- and health-related journals, as well as in the form of stand-alone monographs and as part of excavation reports. Nevertheless, changes in the publication topics in AAS can serve as a sensor of shifting research interests within a rapidly evolving discipline.

To evaluate the changes in biological anthropology research published in AAS, we created a database of all AAS abstracts available on the AAS webpage. We used R packages *rvest* and *xml2* to extract bibliographic information. The raw data were filtered to exclude a variety of editorial-related entries such as "News and Activities," book reviews, "Notes," and other entries with missing abstracts, limiting our dataset to 1834 out of 1995 citable objects containing abstracts for further analysis.

Based on all terms appearing in these abstracts, we created Document_term matrices for each year, using R package *chinese.misc*; stop words and word segmentation were performed with *jiebaR* package. Using glossaries that appear in the Chinese translations of *The Archaeology of Disease* and *The Human Bone Manual*, we created thematic term lists, based on our general understanding of the correspondence between terms and specific area of study. We analyzed 212 terms that appeared in AAS abstracts more than once and which we categorized into seven distinct areas of research focus that can be published in AAS, including (1) paleontology, (2) physical anthropology of living people, (3) research of biological affinity of human populations (i.e. 'biological races' in early terminology) and migration, (4) general research on the human skeleton, (5) archaeology, (6) dental anthropology and oral health, and (7) paleopathology (Supplement 1). The classification of terms was exclusively based on the authors' understanding of the term affinity and not based on a formal analysis of term affinity with a particular type of

study, and hence should be treated as preliminary. Term list frequencies were plotted as a function of the publication date. A loess method was used to fit the term frequency data (alpha=0.75, second degree polynomial, least-square), with standard error as confidence bands (Fig. 1).



Frequencies of terms used in AAS reflect considerable changes in the topical focus of the publications in this journal. Early publications in AAS appear to include many terms related to archaeology: at that time, the existing archaeology journals published by the Chinese Academy of Social Sciences were focused on archaeology from the Neolithic onwards. However, the frequency of archaeology terms in AAS steeply declined from the initial issues, as later archaeology journals would accept Paleolithic archaeology papers, and so the majority of papers on archaeology found their publication homes elsewhere than in AAS. Terms related to paleopathology steeply increased in frequency over time, with a particularly rapid growth after

the mid-1990s. Conversely, terms pertaining to research on "racial craniometry," biological affinity, and human migration gradually declined, particularly after the early 2000s, whereas research on general osteology and human biology appears to remain steady after the initial increase in the early 90s. Of particular interest are the changes in term frequency related to paleontology and dental anthropology. Both areas of focus seem to increase in frequency during the 90s, but show a steady decline afterwards. Given the great general interest in these areas of biological anthropology, it seems likely that the recent decline of the related terms in AAS may be shaped by the shift of the relevant publications to different venues. Publications on human paleontology have always been coveted by popular media, and following the facilitation of international research exchange, publications on the Chinese fossil record have been widely published in high-impact Anglophone journals including Nature, Science, PNAS, and the PLOS group (Li et al., 2017; Liu et al., 2010; Liu et al, 2015; Shang et al., 2007; Shen et al., 2009). Publication in these Anglophone venues is fostered by Chinese academic institutions as well, in order to increase the impact of Chinese scientific research. Perhaps because the popular media has afforded less interest to paleopathology, the boundary between publications in English and Chinese remains more impermeable.

Similar trends were found by Dongya Yang and colleagues in a multi-journal analysis of publication trends in Chinese bioarchaeology over the last few decades. As Dr. Yang stated in his recent oral address (2019), the field of paleopathology has been rapidly developing and expanding over the last ten years, and integration of archaeological and historical context has been increasing. He recommended that in the future, Chinese scholars should develop a set of standards for performing skeletal analysis of excavated materials, and international collaboration is also needed to break down the separation between distinct academic traditions.

1.3 Lessons learned in the preparation of the Special Issue

An overview of the table of contents of this special issue will betray a dearth of papers whose lead authors come from Chinese academic institutions. This may surprise readers who are familiar with the intensity of archaeological research, wealth of early medical texts, and overall volume of publications in top-tier peer-reviewed Anglophone journals by authors from Chinese institutions. For the time being, the Anglophone and Chinese traditions of academic writing in paleopathology appear to be so drastically different as to hamper communication between scholars residing on the two sides of the academic divide. Therefore, we feel that this special issue is best seen as a first step for starting the dialogue and bringing paleopathological research conducted in China into focus for international readers.

As the guest editors of the special issue we were confronted with the challenges of encouraging submissions from Chinese scholars whose academic homes were located in China, obtaining external reviews for the publications, and receiving completed revisions based on reviewer comments. Some of these difficulties are very likely due to the difference between bioarchaeology in Europe and America, where paleopathology is seen as a central research

focus, and China, where it is still considered peripheral to the major concerns of the field. In addition, career advancement at many Chinese institutions, as in institutions around the world, is tied to publishing in high-ranking journals, specifically those indexed in journal lists such as the Social Sciences Citation Index (SSCI). Because the field of paleopathology is relatively new in China, it tends to be pursued by junior scholars, for whom career advancement is a matter of academic survival. It is therefore understandable that Chinese scholars may not prioritize publishing in foreign subfield-specific journals that either are not indexed in SSCI, such as the *International Journal of Paleopathology*, or that otherwise do not meet their institutions' requirements. These institutional policies may deter some potential engagement of Chinese scholars with international paleopathology.

Another major obstacle to Chinese authors publishing in Anglophone journals is the differences in writing style, internal organization of papers, and manner in which research questions and broader significance are framed in the two different publishing traditions. We have found that often, by the time a paper from China (or other non-Anglophone regions) is submitted to an Anglophone journal, it is already too late to make the changes that would be required for the paper to meet the stylistic requirements of the journal. Peer reviewers are not given the time or tools to work with Chinese authors to alter their papers, nor is this an expected part of their role. One possible solution is for new Anglophone venues, or types of submissions in existing venues, to be created to accommodate research conducted and written in other traditions. At the least, an abstract should be included in the language of the region about which a paper is written. Another partial solution is to hold workshops or exchanges to work with authors of Chinese and other non-Anglophone traditions to prepare their work for submission to Anglophone journals. These could be conducted through professional organizations and international meetings, funding agencies, research and teaching institutions, or interpersonal networks of researchers. In other words, more upstream solutions are needed to bring the two academic worlds into closer conversation.

2. Major Themes in the Special Issue

2.1 Paleoepidemiology: skeletal lesions and parasitic load related to tuberculosis infection

Two papers in this special issue present the differential diagnosis of possible skeletal tuberculosis cases from early China. The paper by Okazaki and colleagues presents a case of likely spinal tuberculosis lesions in an adult female from the Neolithic Songze period (3900-3200 BC) in the Yangtze River Delta of southern China. This case is consistent with the hypothesis that the spread of tuberculosis in certain regions of East Asia was facilitated by the adoption of wet rice agriculture, and specifically the shift to concentrated, sedentary settlements. The second paper, by Li and colleagues, also presents a case of likely spinal tuberculosis lesions in an adult male, this time from the much later Han period (202 BC – 220 AD) in North China. The individual was likewise from a densely settled region, which may have facilitated the spread of the disease.

Until the publication of this special issue, the only plausible case of spinal tuberculosis documented in early China was one described in a partial and partially cremated skeleton attributed to the Longshan period (ca 2500-1900 BC) (Pechenkina et al., 2007). Skeletal specimen M7 from the Longshan culture Meishan site displayed a single focal resorptive lesion of a lower thoracic vertebra, leading to an angular deformity of the spine, as seen on a radiograph. The associated calvarium displayed a cluster of microscopic resorptive lesions, suggesting that the pathogenic process had spread to cranial bones as well. Another case of early tuberculosis was identified after examination of a female cadaver from Mawangdui, a Western Han burial (ca 200 BC), based on calcified foci in her left lung (Hunan Medical Institute, 1980). Ancient DNA analysis carried out on fifteen human skeletons without apparent skeletal pathology, excavated from Cheshi Qianguo period tombs (200 BC-AD 200) in the Xinjiang Uighur Autonomous Region in northwest China, identified Mycobacterial DNA in three specimens (Fusegawa et al., 2003). However, the primers used in the procedure were specific not only for *Mycobacterium tuberculosis* but also for *M. bovis* and for *M. microti*, the latter of which typically infects rodents. Consequently, the possibility of post-depositional contamination of the analyzed samples with DNA from rodent Mycobacterium cannot be excluded. Additionally, pulmonary tuberculosis was reported in a dissection of a Ming Dynasty mummy from Shanghai (He et al., 2003).

Somewhat in contradiction with the paucity of skeletal evidence for tuberculosis in early China, a phylogenetic analysis of global tuberculosis (Comas et al., 2013) suggests that the initial strain of Mycobacteria arrived in China with early anatomically modern humans sometime between 42,000 and 32,000 ya. Based on the same study, it was inferred that the emergence of the highly virulent Beijing strand of tuberculosis took place around 6,000-11,000 ya with early farming, then expanded considerably between 5,000 and 3,000 ya. This corresponds to the case presented by Okazaki et al. in the current special issue, as well as the Longshan case presented by Pechenkina et al. (2007). Arrival of tuberculosis in the Japanese archipelago during the Yayoi period, before 2000 years ago, and multiple cases of TB in Japan thereafter, as suggested by skeletal evidence (Suzuki, 2013), are also consistent with the estimated date for the spread of the Beijing TB strand. The relative absence of skeletal tuberculosis from Chinese skeletal collections dating to between 3000 and 2000 ya is difficult to explain, though it may simply be due to a lack of paleopathological analysis of the skeletons at the time they were excavated. Entering the Bronze Age, there is a plethora of analyzed skeletons and once again, few have been found to display signs of TB infection, though the presence of TB in the Han period (Li et al., this special issue) indicates that the disease was not absent in the intervening millennia. More thorough examination of skeletons from the Neolithic period onward with an eye for TB lesions is likely needed.

Alternatively, could nutritional factors and parasitic loads explain the absence of evident skeletal tuberculosis in China? Wilbur and colleagues (Wilbur et al., 2008) propose that the relative availability of iron and protein can largely explain the distribution of spinal tuberculosis in skeletal collections from the past. According to their model, in protein-deficient individuals, tuberculosis tends to progress to the fulminant form, leading to massive tissue destruction and rapid death, whereas insufficient dietary iron or a shortage of bodily iron due to chronic parasitic

infection curbs the proliferation of Mycobacteria. Consequently, only individuals from populations that have sufficient dietary iron for the infection to progress, coupled with sufficient availability of protein for an individual to survive the infection for an extended period of time, develop characteristic bone lesions.

Stable isotope research suggests that availability of dietary protein should not have constituted a problem for the majority of Neolithic and Bronze Age communities in China (e.g., Atahan et al. 2011; Dong et al., 2013; Guo et al. 2011; Hu et al. 2006; Zhang et al., 2010; Zhang et al., 2011), though females seem to have had less access to animal products during the Bronze Age (Dong et al., 2017). Given the inconsistencies in scoring skeletal indicators of anemia on human crania, it is difficult to evaluate the prevalence of acquired anemia across China, yet there seems to have been a trend of increase in such indicators toward the end of the Neolithic, i.e. the Longshan period, and during the Bronze Age (Pechenkina et al., 2007; Pechenkina et al., 2013b). Therefore, we can tentatively propose that increasing rates of anemia, perhaps caused by heavy parasitic loads, in turn caused the infrequency of skeletal lesions from latent tuberculosis. More systematic research on the distribution of skeletal lesions, combined with sampling of microbial DNA from skeletal remains, would be necessary to sharpen the emerging outline of the epidemiology of early tuberculosis in China.

The current special issue also contains a paper by Yeh and colleagues that presents both paleoparasitological and textual evidence for the presence of roundworms, Asian schistosoma, and tapeworms in historical periods in China. The authors argue that a plethora of environmental and methodological factors have limited our knowledge of ancient parasites, and that historical texts offer a way to correct for the underrepresentation of parasites in the archaeological record. The recovery and identification of parasite eggs from prehistoric periods would also go a long way towards resolving the question of whether parasitic load and the resultant anemia might account for the paucity of tuberculosis lesions in the skeletal record.

2.2 Violence and body modification

Bioarchaeology has great potential to deepen our understanding of periods and cultural phenomena of interest to Chinese archaeologists and historians, for instance, the nature of the relationship between the Chinese imperial world and the nomadic empires on its frontiers (e.g. Eng, 2016; Eng and Zhang, 2013). This issue includes a paper by Dittmar and colleagues that addresses prehistoric violence in Northwest China, at a large cemetery of the early Bronze Age Qijia culture (2300-1500 BC) that was occupied during a period of increasing social complexity, as well as climate change. The cemetery has a markedly high rate of interpersonal, fatal violence: 11.4% of adults examined presented with violent cranial trauma, much of it perimortem and most of it found on males. Very few other cemeteries in China have undergone quantitative analyses of trauma, but of those that are available from the region, Mogou has one of the highest rates. The paper explores the possible ramifications of this violence in its archaeological context, and considers whether the ongoing climate change of the time may have been a contributing factor.

The special issue also contains three of the earliest papers to be published on the osteology of a form of gender-based violence, namely, women's foot binding. Before these papers, there were only a few publications (Hou, 2013; Zhao et al., 2017; Zhu et al., 2017) addressing the skeletal

remains of women whose feet were bound in historical China, despite the extensive literary, historical, cultural, and economic research on the practice. The exact method of binding, how it varied between families, regions, and time periods, and the impact it had on women's physiologies are known only from fragmentary descriptions or from very late instances of the practice (as in public health and medical studies of elderly women with bound feet in the late 20th century). The three papers in this issue (Berger et al., Lee et al., and Zhao et al.) present a total of over 50 individuals with bound feet from the Ming and Qing dynasties across three northern provinces. They demonstrate the wide range of variation within and between communities in the method of binding, the increase in prevalence through time, the development of the later form of foot binding (the "lotus" style), and the impacts on the rest of women's bodies of a lifetime of this extreme form of body modification. They also explore the dimensions of class and ethnicity that interacted with gender in the spread of the practice. Effectively doubling the published research on historical skeletons of women with bound feet, these papers are hopefully the beginning of a trend towards greater attention to this phenomenon in the bioarchaeological record of China.

2.3 Differential diagnosis and comorbidity

Pechenkina and colleagues present a differential diagnosis of a cranial lesion they identify as a hemangioma. This is a vascular malformation, underreported in the paleopathological literature because of its benign nature. It is nonetheless an important condition to consider in differential diagnoses, as it can be confused for a number of other conditions. Similarly, Sun et al. present an intriguing case of a cemetery in which a quarter (8/31) of juvenile skeletons present with endocranial lesions. These appear to be evidence of multiple dietary deficiencies, based on lesions elsewhere on the skeleton. The authors make a convincing case that factors in the sociocultural environment can cause or mediate comorbidity, even when physiological connections between the lesions are not direct or evident, and need to be considered.

Finally, Hardy and colleagues present an individual with severe knee osteoarthritis, and propose extra-articular lesions caused by pressure resorption as a potential new diagnostic criterion for this condition. As a soldier-farmer resident of a military outpost during the Warring States period (475-221 BCE), the individual in question may have had a number of physical duties that would have exacerbated his severe joint disease.

1. Future development of paleopathology of China: Building a global bioarchaeology

Although the 21st century witnessed a surge of research on human skeletons in China, paleopathological research there has not reached its full potential. A majority of skeletal studies carried out in China aim to either trace residential and long-range mobility of past populations, or reconstruct diet and subsistence strategies. Relative to the number of skeletons that have been studied or are potentially available for study in China, very few studies based on differential diagnosis have been published on Chinese data. As a consequence, there is little understanding of the spread of infectious diseases in ancient China and how contacts with adjacent populations shaped the epidemiology of this part of the world. There are also very few reports on the

presence of metabolic disorders, malignancies, degenerative disorders, etc. Given the enormous quantity of archaeological material excavated each year by Chinese archaeologists, as well as China's size, geographic and population variation, and connections with other regions that are both rooted in deep time and exceedingly complex, paleopathology as a field has a great deal to gain from the work of Chinese scholars and their foreign collaborators.

Furthermore, paleopathological research in China, as elsewhere in the world, can benefit from a greater attention to archaeological context and interpretation. The early history of bioarchaeology in China is parallel in some ways to the European academic tradition of the 20th century, in which biological anthropology was firmly situated within biological disciplines, whereas archaeology was traditionally hosted by history departments. Especially from 1949 to around 1980, physical anthropology was mostly focused on morphology and paleoanthropology (Berger and Pechenkina, 2018). Consequent differences in research interests and approaches between archaeologists and biological anthropologists posed an obstacle for collaboration. Happily, with the development of bioarchaeology in China since the 1980s, this has been rapidly changing. Most early career bioarchaeologists in China today are trained and employed in archaeology departments and take part in archaeological excavations, thereby conducting truly interdisciplinary bioarchaeological research. Our hope is that this cross-disciplinarity will continue to develop, both in Europe and in China.

Chinese paleopathology can also draw on textual records that go back very far in time, and encompass massive troves of data on health, medicine, demography, and environment. The wealth of historic medical literature in this part of the world provides a unique opportunity for integrating paleopathological observations with historic documents describing early ideas on hygiene, treatments, and disease occurrence. Integrating these two areas of research will require close collaboration between historians and other textual scholars, and archaeologists and paleopathologists.

As in archaeology and anthropology more broadly, bioarchaeology has also grappled in recent decades with the process of decolonization (Bruchac 2014; DeWitte 2015; Martin et al 2013). This has been done particularly in the context of ethics of research on human remains, the rights of descendant communities, and the agency of indigenous communities in research. Approaches to this endeavor range from legal frameworks such as NAGPRA, to "autoethnography" of the researcher (Robertson 2018). Less has been written about the decolonization needed to decenter Euro-American perspectives and erode Euro-American dominance in the intellectual discourse of the discipline, and to make its professional and publishing institutions more truly international (Baker and Agarwal 2017). In this special issue, we hope to take a small step towards combatting the under-representation of Chinese paleopathology in the global field.

Biological anthropology and bioarchaeology have their own trajectory of development within China (Berger and Pechenkina, 2018; Pechenkina, 2012). Nonetheless, as paleopathology is founded on an understanding of human biology and epidemiology, it is very well-suited to comparative research. In order to bring the various global research trends into productive conversation, the critical tasks now are to standardize methods of data recording and differential diagnosis, and make data from around the world accessible through multilingual publications and

meetings. We should aim to reinforce the global nature of the field and increase teaching, student participation, and research exchanges both in and out of China.

2. Conclusion

Prof. Zhu Hong, long-time director of the Research Center for Chinese Frontier Archaeology at Jilin University, once wrote in the preface to a physical anthropology textbook (2004), “For a long time, in Western developed countries, in archaeological research and teaching, physical anthropology has been an indispensable element; and in recent years, due to the involvement of molecular biology research methods, more and more insightful people in the [Chinese] archaeological community are recognizing its importance and paying it close attention.” In 2019, we have witnessed a decade and a half of the further development of bioarchaeology in China, including of paleopathology. We are confident that the current increasing attention to paleopathology and more complete curation and examination of human bones from archaeological contexts will lead to more clarity on paleoepidemiology in China, and that the rapidly expanding skeletal datasets, as well as international exchange and collaboration, will continue to increase our knowledge of ancient human health.

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References Cited

Atahan, P., Dodson, J., Li, X.Q., Zhou, X.Y., Hu, S.M., Bertuch, F., Sun, N., 2011. Subsistence and the isotopic signature of herding in the Bronze Age Hexi Corridor, NW Gansu, China. Journal of Archaeological Science. 38(7), 1747-1753.

Baker, B.J., Agarwal, S.C., 2017. Stronger Together: Advancing a Global Bioarchaeology. Bioarchaeology International. 1(1–2): 1-18.

Berger, E., Pechenkina, K., 2018. Bioarchaeology of China: Bridging Biological and Archaeological Inquiries. In O'Donnabhain, B., Lozada, M.C. (Eds.), Archaeological Human Remains (Vol. 2): Legacies of Imperialism, Communism and Colonialism. New York, Springer, pp. 25-43.

Bruchac, M.M., 2014. Decolonization in Archaeological Theory. Encyclopedia of Global Archaeology. C. Smith. Springer, New York, pp. 2069-2077.

Chia, L.P., Yen, Y., 1963. Human skeletal remains unearthed at Hsi T’uan Hill, Chilin (Xituan Shan rengu de yanjiu baogao). Acta Archaeologica Sinica. 1963(2): 101-109.

Comas, I., Coscolla, M., Luo, T., 2013. et al. Out-of-Africa migration and Neolithic coexpansion of Mycobacterium tuberculosis with modern humans. Nat Genet. 45(10):1176–1182.

DeWitte, S.N., 2015. Bioarchaeology and the Ethics of Research Using Human Skeletal Remains. History Compass. 13(1): 10-19.

Dong, Y., Morgan, C., Chinenov, Y., Zhou, L.G., Fan, W.Q., Ma, X.L., Pechenkina, K., 2017. Shifting diets and the rise of male-biased inequality on the Central Plains of China during Eastern Zhou. Procedings of the National Academy of Sciences. N.p.

Duan, S.Q., 1989. Distinguished anthropologist of China—Professor Wu Dingliang (Woguo jiechu de renleixue jia—Wu Dingliang Jiaoshou). Shijie Kexue (World Science). 1989(06): 57-58.

Elderton, E.M., Woo, T.L. [Wu, D.L.], 1932. On the normality or want of normality in the frequency distributions of cranial measurements. Biometrika. 24: 45–54.

Eng, J., Zhang, Q.C., 2013. Conflict and trauma among nomadic pastoralists on China's northern frontier. In Pechenkina, K., Oxenham, M. (Eds.), Bioarchaeology of East Asia: Movement, Contact, Health. University Press of Florida. Gainesville, FL, pp. 213-245.

Eng, J., 2016. A bioarchaeological study of osteoarthritis among populations of northern China and Mongolia during the Bronze Age to Iron Age transition to nomadic pastoralism. Quaternary International. 405: 172-185.

Fusegawa, H., Wang, B.H., Sakurai, K., Nagasawa, K., Okauchi, M., Nagakura, K., 2003. Outbreak of Tuberculosis in a 2000-Year-Old Chinese Population. Kansenshogaku zasshi (The Journal of the Japanese Association for Infectious Diseases). 77(3):146-9.

Guo, Y., Hu, Y.W., Zhu, J.Y., Zhou, M., Wang, C.S., Richards, M.P., 2011. Stable carbon and nitrogen isotope evidence of human and pig diets at the Qinglongquan Site, China. Science China Earth Sciences. 54(4), 519-527.

Han, K.H., Lu, C.W., Chang, C.P., 1974. The Neolithic human skeletons unearthed at Ta-tun-tzu in P'i-hsien, Kiangsu Province (Jiangsu Pixian Dadunzi Xinshiqi shidai rengu de yanjiu). Acta Archaeologica Sinica. 1974(2): 125-141.

Han, K.H., 1975. A study of the two Bronze Age human skeletons unearthed at Cheng-chia-wa-tzu in Shenyang (Shenyang Zhengjiawazi de liang ju Qingtong shidai rengu). Acta Archaeologica Sinica. 1975(1): 157-164.

He, H.Q., Zhang, F.Q., Xu, Y.Q., 2003. Investigation of one ancient corpse of Ming Dynasty (Yi li Ming Dai gu shi de yanjiu). Jiepouxue Zazhi (Chinese Journal of Anatomy). 26(4): 389-391.

Hou, K., 2013. Shanxi Yuci Gaoxiao Xin Xiao Qu Ming Qing Muzang Rengu Yanjiu (The Research on the Human Skeletons From the Ming and Qing Dynasties Tombs Excavated in New Campuses of Universities in Yuci, Shanxi). MA thesis, Archaeology and Museology. Jilin University, Changchun.

Hu, Y.W., Ambrose, S.H., Wang, C.S., 2006. Stable isotopic analysis of human bones from Jiahu site, Henan, China: implications for the transition to agriculture. Journal of Archaeological Science. 33(9), 1319-1330.

Hunan Medical Institute. (1980). Study of an ancient cadaver in Mawangtui Tomb No. 1 of the Han Dynasty (Changsha Mawangdui yihao Han mu gushi yanjiu). Wenwu Chubanshe, Beijing, pp. 1-9.

Li, Z.Y., Wu, X.J., Zhou, L.P. Liu, W., Gao, X., Nian, X.M., Trinkaus, E., 2017. Late Pleistocene archaic human crania from Xuchang, China. Science. 355(6328): 969-972.

Liu, W., Jin, C.Z., Zhang, Y.Q., Cai, Y.J., Xing, S., Wu, X.J., Cheng, H., Edwards, R.L., Pan, W.S., Qin, D.G., An, Z.S., Trinkaus, E., Wu, X.Z., 2010. Human remains from Zhirendong, South China, and modern human emergence in East Asia. Proceedings of the National Academy of Sciences. 107(45): 19201-19206.

Liu, W., Martinón-Torres, M., Cai, Y.J., Xing, S., Tong, H.W., et al., 2015. The earliest unequivocally modern humans in southern China. Nature. 526(7575): 696-699M.

Lucas, S.G., 2001. Chinese fossil vertebrates. New York: Columbia University Press. Matthew WD. 1915. Climate and evolution. Annals of the New York Academy of Sciences 24: 209–14. Wu D. 1960. Comparative study of the ape-man supraorbital torii. Gu Jizhui Dongwu yu Gu Renlei (Vertebrate Paleontology and Paleoanthropology). 2: 22–24.

Martin, D.L., Harrod, R.P, Pérez, V.R., 2013. An Ethos for Bioarchaeologists. Bioarchaeology: An Integrated Approach to Working with Human Remains. Springer, New York, pp. 23-55.

Mo, S.T., Peng, S.L., 1983. Attrition of upper and lower molars with relation to ate in Southern Chinese skulls (Huanan ren lugu shang, xia he jiuchi mohao yu nianling bianhua de guanxi). Acta Anthropologica Sinica. 2(4): 368-374.

Pearson, K., Woo, T.L. [Wu, D.L.], 1935. Further investigation of the morphometric characters of the individual bones of the human skull. Biometrika. 27: 424–65.

Pechenkina, K., Benfer, R., Ma, X.L., 2007. Diet and health in the Neolithic of the Wei and Middle Yellow River Basins, Northern China. In Cohen, M.N., Crane-Kramer, G.M.M. (Eds.), Ancient Health: Skeletal Indicators of Agricultural and Economic Intensification. University Press of Florida, Gainesville, FL, pp. 255-272.

Pechenkina, K., Ma, X.L., Fan, W.Q., 2013. Trajectories of health in early farming communities of East Asia. In Pechenkina, K., Oxenham, M. (Eds.), Bioarchaeology of East Asia: Movement, Contact, Health. University Press of Florida, Gainesville, FL, pp. 444-481.

Pechenkina, K., 2012. From morphometrics to holistics: The emergence of paleopathology in China. In Buikstra, J.E., Roberts, C. (Eds.), The Global History of Paleopathology: Pioneers and Prospects. Oxford University Press, Oxford, UK, pp. 345-360.

Physical Anthropology Section of IAAS., 1975. Studies on the human skeletal remains of the Upper Hsia-chia-tien culture unearthed at Ning-ch'eng and Ch'ih-feng (Chifeng, Ningcheng Xiajiadian sheng ceng wenhua rengu yanjiu). Acta Archaeologica Sinica. 1975(2): 157-169.

Robertson, H., 2018. Decolonizing Bioarchaeology: An Autoethnographic Reflection. New Proposals: Journal of Marxism and Interdisciplinary Inquiry. 9(2): 19-33.

Shang, H.S., Tong, H.W., Zhang, S.Q., Chen, F.Y., Trinkaus, E., 2007. An early modern human from Tianyuan Cave, Zhoukoudian, China. Proceedings of the National Academy of Sciences. 104(16): 6573-6578.

Shen, G.J., Gao, X., Gao, B., Granger, D.E., 2009. Age of Zhoukoudian Homo erectus determined with 26Al/10Be burial dating. Nature. 458(7235): 198-200.

Smith, G.E., 1931. Sinanthropus—Peking Man, its discovery and significance. Scientific Monthly. 33: 193–211.

Suzuki, T., 2013. Tuberculosis and Population Movement across the Sea of Japan from the Neolithic Period to the Eneolithic. In Pechenkina, K., Oxenham, M. (Eds.), Bioarchaeology of East Asia: Movement, Contact, Health. University Press of Florida, Gainesville, FL, pp. 125-143.

Wang, F., Song, Y.B., Li, B.S., Fan, R., Jin, G.Y., Yuan, S.L., 2013. C and N stable isotope analysis of human and animal bones at the Beiqian site. Science China Earth Sciences. 57.

Wilbur, A.K., Farnbach, A.W., Knudson, K.J., Buikstra, J.E., 2008. Diet, tuberculosis, and the paleopathological record. Current Anthropology. 49: 963–991.

Woo, T.L. [Wu, D.L.], Morant, G.M., 1932. A preliminary classification of Asiatic races based on cranial measurements. Biometrika. 24: 108–34.

Woo, T.L. [Wu, D.L.], Pearson, K., 1927. Dextrality and sinistrality of hand and eye. Biometrika. 19: 165–99.

Woo, T.L. [Wu, D.L.], 1941. On the glabella prominence of the human cranium. Anthropological Journal of the Institute of History and Philology. 1: 205–21.

Woo, T.L. [Wu, D.L.], 1942. The physical characteristics of the Pa Miao people of Kweichow and other peoples of South China. Journal of the Royal Asiatic Institute. (72) 45–53.

Wu, D.L., Mo, R.D., 1932. Yazhou Renzhong Chubu Fenxi (A Preliminary Classification of Asiatic Races Based on Cranial Measurements). Nanking: Academia Sinica.

Wu, D.L., 1940. Review of relations among frontal bone measurements and glabella prominence in Chinese crania. Guoli Zhongyang Yanjiuyuan Lishi Yuyan Yanjiusuo Jikan (Bulletin of the Institute of History and Philology, Academia Sinica). 2: 91–98.

Wu, D.L., 1956. Evolutionary changes in chin position. Fudan Xuebao, Ziran Kexue (Fudan Journal, Natural Science). 1: 159–68.

Wu, D.L., 1957a. Children's physical conditions in recent twenty years of Nanjing. Fudan Xuebao, Ziran Kexue (Fudan Journal, Science Edition). 2: 439–49.

Wu, D.L., 1957b. Children's physical conditions in recent twenty years of Danyang County. Fudan Xuebao, Ziran Kexue (Fudan Journal, Science Edition). 2: 244–53.

Wu, R.K., 1982. Preface. Acta Anthropologica Sinica. 1(1): 1.

Yan, Y., 1962. Neolithic human skeleton unearthed at Hua-hsien, Shensi (Huaxian Xinshiqi shidai rengu de yanjiu). Acta Archaeologica Sinica. 1962(2): 85-104.

Yang, D.Y., 2019. Review of research publications of human osteoarchaeology in China. Presented at "Environments and Adaptation in Ancient China: Recent Advances and Global Context." February 8, University of Michigan, Ann Arbor, MI. Presentation.

Zeng, X.L., Huang, J.F., Ling, J.X., 1983. Baoji, Huaxian Xinshiqi shidai rengu de cuo ya he jixing (Malocclusion of Neolithic human skeletons from Baoji and Huaxian). Acta Anthropologica Sinica. 2(4): 352-358.

Zhang, X.L., Qiu, S.H., Zhong, J., Zhao, X.P., Sun, F.X., 2010. Zhongyuan diqu ji chu Yangshao wenhua shiqi kaogu yizhi de renlei shiqu zhuangkuang fenxi (Studies on diet of the ancient people of the Yangshao cultural sites in the Central Plains). Acta Anthropologica Sinica. 29:197–207.

Zhang X.L., Zhao, X.P., and Cheng. L.Q., 2011. Human diets of Yangshao Culture in the Central Plains. Chinese Archaeology. 11:188–196.

Zhang, X.L., 2003. Ying yong guren de yuansu, tongweisu fenxi yanjiu qi shiwu jiegou (Study on the diet of ancient people by analyzing bone elements and isotopes). Acta Anthropologica Sinica. 22(1): 76-84.

Zhao, Y.S., Guo, L., Hao, D.H., Li, B.L., Zeng, W., 2017. Shandong diqu Qing mu zhong nvxing jumin de chanzu xianxiang (A study of the foot-binding phenomenon of Qing dynasty females in Shandong province). Acta Anthropologica Sinica. 36, 344–358.

Zhu, H., Hou, K., Wang, X.Y., 2017. Cong shengwu kaogu xue jiaodu kan Shanxi Yuci Ming Qing shiqi pingmin de liang xing chayi (Gender differences among the civilians in the Ming dynasty and the Qing dynasty in Yuci, Shanxi from the perspective of bioarchaeology). Jilin Daxue Shehui Kexue Xuebao (Jilin University Social Science Journal). 57, 117–124.