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A Companion to Biological Anthropology

Edited by Clark Spencer Larsen

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A Companion to Biological Anthropology

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Dedicated to biological anthropologists and
Companion to Biological Anthropology authors and friends

Phillip L. Walker (1947–2009)
Robert W. Sussman (1941–2016)
Gary D. James (1954–2020)

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One of the first things I learned when I started taking anthropology courses in my freshman year at my undergraduate *alma mater*, Kansas State University, and reinforced ever since, is the remarkable biocultural and behavioral resiliency of humans, their ability to address challenges, to develop solutions to these challenges, and to adapt. For me, working on this book with all the authors reinforced that sense of resiliency. Everyone involved in the book made it possible to meet the challenges of the past several years. I cannot imagine a more collaborative and committed group than all who I have worked with from the beginning to the end of the book project.

Thank you everyone!

Foreword

Leslea J. Hlusko

In this second edition of *A Companion to Biological Anthropology*, Larsen and colleagues have compiled 36 beautifully written chapters that introduce the reader to the latest science, essential concepts, and perspectives spanning the discipline. I have been a biological anthropologist for over 20 years and still found myself enthralled by the interconnections across these chapters. I would love to invite the authors over for dinner and an evening of brainstorming. How interesting it would be to have Sattenspiel and Orbann talking about modern pandemics alongside Stone's knowledge of ancient pathogens. It turns out that we have been living with diseases such as tuberculosis and plague for thousands of years longer than scientists originally thought. This certainly changes one's perspective on how and when the Covid19 pandemic will "end." Let's also bring in Amorim's expertise on ancient DNA, O'Rourke's deep knowledge of human populations, and Beall's classic examples of human environmental adaptation. What a conversation we would have about how pandemics and environmental adaptation shaped the last 100,000 years of human evolution. But it does not stop there. Imagine we also invite Kuzawa and Manis to bring to the conversation their interdisciplinary perspective on today's obesity and cardiovascular disease, which, of course, also calls for invitations to Dufour and Piperata, as nutritional variation is essential to understanding all these observed trends. We also want to consider the role inflammatory response plays in health, well-being, and adaptation, so let us invite Crespo to the dinner. Keep in mind that all of this varies over the course of a lifetime and across species, so we need the life history perspective of Crews and Bogin and the biodiversity perspectives of McGraw, Silcox, and López-Torres. We are going to need a very large dinner table indeed, and we have only just begun the guest list!

Many of the chapter topics are classic, such as taxonomy and adaptation, but the methods applied today are innovative and new. This edition of the *Companion* also includes research genres that were only a pipe dream a decade or two ago, but now, with technological advances, they represent entirely new subdisciplines such as ancient DNA, the microbiome, epigenetics, and genome-wide association studies. The level of technological sophistication within our science always impresses me, but the true heart of biological anthropology is in the meaningful interconnections the anthropologist makes between biology, social science, and humanity.

The past decade has been a watershed moment for the discipline's humanity in ways that extend far beyond the science. The scholarly community pushed to the forefront concerns about who is doing the science and how it is being done. In Chapter 2, Little and Buikstra provide perspective on this, noting that the founders of the discipline in the eighteenth and nineteenth centuries primarily considered race as a valid taxonomic category within humans. This research helped to justify racism within the Unites States and the inequity that continues to exist today (Blakey 1996, 2021; Fuentes 2012). Because of this history, biological anthropologists are, perhaps, especially aware of the social impact of their science. Although there have always been biological anthropologists pushing against racist tropes (e.g., Cobb 1936; Juan Comas 1961; Marks 1995; Jackson 2000; Fuentes 2012), the recent disciplinary shift towards antiracism is notable (as defined by Kendi 2019). I want to highlight some of the recent major events.

In 2021, the flagship association for biological anthropologists in the United States completed the years-long process of changing its name from the American Association of Physical Anthropologists (AAPA) to the American Association of Biological Anthropologists (AABA), distinguishing between the origins of the science that focused on racial distinctions ("physical") and the more interdisciplinary and biological approach employed today. Alongside this name change came a more coordinated effort to communicate the antiracist implications of the science to the public. Pages of peer-reviewed research journals were dedicated to articles about the broader context, advice, and calls-to-action. In 2020, the journal *Human Biology*, the official publication of the American Association of Anthropological Genetics (AAAG), published a special issue on *Race, Racism, and the Genetic Structure of Human Populations* (Malhi 2020). In 2021, the *American Journal of Biological Anthropology* dedicated an issue to the interpretation and communication of biological variation and race (Raff and Mulligan 2021), including an article on how White nationalists use anthropological genetics research to justify their racism (Panofsky et al. 2021),

Changes have also been taking place within the discipline. As Antón et al. (2018) reported that 87 percent of members of the then-AAPA identified as white (an astonishing bias of representation for a discipline aimed at understanding variation), two new cross-institutional training programs had already been developed to reach a broader cohort of students: IDEAS (Increasing Diversity in Evolutionary Anthropological Sciences, Malhi et al. 2019) and SING (Summer Internship for INdigenous peoples in Genomics Consortium, Bardill et al. 2018; Claw et al. 2018). While individual scholars have long made the case that with more diverse perspectives comes a richer science (e.g., Cobb 1936; Jackson 2000; Jackson et al. 2016, 2014; TallBear 2014), over the last few years there has been a flurry of symposia, peer-reviewed journals, and edited volumes dedicated to the topic (e.g., the *American Anthropologists*' Vital Topics Forum: How academic diversity is transforming scientific knowledge in biological anthropology, Bolnick et al. 2019; see also Athreya and Ackermann 2019; Poor and Matthews 2020).

Biological anthropologists are also working to improve academic culture. For example, Clancy, Nelson, and colleagues conducted surveys to quantify sexual harassment in the field (Clancy et al. 2014; Nelson et al. 2017), an important step towards addressing it, and in February 2022, the *American Journal of Human Biology* published a special issue on the theme of #Hackademics: Hacks Towards Success in Academia (Ocobock et al. 2022), articles born out of a series of podcasts from the *Sausage of Science* (https://www.humbio.org/podcasts) that then became fodder for a webinar series hosted by AABA (https://bioanth.org/meetings-and-webinars/aabas-monthly-webinar-series/the-hackademics-series-hacks-for-succeeding-in-academia).

However, there is still much to do and many conversations to be had. As biological anthropologists developed best practices for data-sharing (Turner and Mulligan 2019), colleagues raised the need to more deeply engage with Indigenous data sovereignties (Tsosie et al. 2020). Recent reflections on the ethics of our science have aimed to open up additional discussions (MacClancy and Fuentes 2013; Turner et al. 2018). The new science of ancient DNA raises a swath of ethical issues (Alpaslan-Roodenberg et al. 2021; Tsosie et al. 2021; Wagner et al. 2020), and now, engagement with the descendant communities is considered an essential component of ethically sound research on human DNA, especially within biological anthropology. While the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 provided a framework for managing the human remains of Indigenous people housed in museum collections (Nash and Colwell 2020), biological anthropologists are now returning to a conversation started by one of the founders of the discipline, W. Montague Cobb, who first noted the disproportionate representations of human remains kept in museum collections, including African Americans (Cobb 1933; Jackson et al. 2016; and see Blakey and Watkins 2022). Biological anthropologists are now much more cognizant of the fact that these biases are primarily the result of social and cultural marginalization (de la Cova 2019).

These academic shifts are hard to capture within a volume like *A Companion of Biological Anthropology*, but this groundswell of change is shaping the biological anthropology of today even more so than did the technological advances of the past decade. While I am in awe at the evolution of biological anthropology since the publication of the 1st edition of the *Companion*, I am already looking forward to where seeing where we will be when it is time for the 3rd edition.

NOTE

1 The official name of the professional organization was changed from the American Association of Physical Anthropologists to the American Association of Biological Anthropologists in 2021. The Association's journal name was changed from the *American Journal of Physical Anthropology* to the *American Journal of Biological Anthropology* in 2022 and its annual publication from the *Yearbook of Physical Anthropology* to the *Yearbook of Biological Anthropology* in 2022.

REFERENCES

Alpaslan-Roodenberg, S., D. Anthony, H. Babiker, et al. "Ethics of DNA Research on Human Remains: Five Globally Applicable Guidelines." *Nature* 599 (2021): 41–46.

Antón, S. C., R. S. Malhi, and A. Fuentes. "Race and Diversity in U.S. Biological Anthropology: A Decade of AAPA Initiatives." *American Journal of Biological Anthropology* 165 (2018): 158–180.

Athreya, S., and R. R. Ackermann. "Colonialism and Narratives of Human Origins in Asia and Africa." In *Interrogating Human Origins: Decolonisation and the Deep Human Past*, edited by Martin Porr and Jacqueline Matthews, 72–95. Routledge, 2019.

Bardill, J., A. C. Bader, N. A. Garrison, D. A. Bolnick, J. A. Raff, A. Walker, and R. S. Malhi. "Summer Internship for INdigenous Peoples in Genomics (SING) Consortium. Advancing the Ethics of Paleogenomics." *Science* 360, no. 6387 (2018): 384–385.

Blakey, M. L. "Skull Doctors Revisited: Intrinsic Social and Political Bias in the History of American Physical Anthropology, with Special Reference to the Work of Aleš Hrdlička." In *Race and Other Misadventures: Essays in Honor of Ashley Montagu in His Ninetieth Year*. Edited by L. T. Reynolds and L. Lieberman, 64–95. Lanham, Maryland: Altamira Press, 1996.

Blakey, M. L. "Understanding Racism in Physical (Biological) Anthropology." *American Journal of Biological Anthropology* 175 (2021): 316–325.

Blakey, M. L., and R. Watkins. "William Montague Cobb: Near the African Diasporic Origins of Activist and Biocultural Anthropology." *The Anatomical Record* 305, no. 4 (2022): 838–848.

Bolnick, D. A., R. W. Smith, and A. Fuentes. "How Academic Diversity Is Transforming Scientific Knowledge in Biological Anthropology." *American Anthropologist* 2 (2019): 464-464.

Clancy, K. B., R. G. Nelson, J. N. Rutherford, and K. Hinde. "Survey of Academic Field Experiences (SAFE): Trainees Report Harassment and Assault." *PloS One* 9, no. 7 (2014): e102172.

Claw, K. G., M. Z. Anderson, R. L. Begay, et al. Summer internship for INdigenous peoples in Genomics (SING) Consortium. "A Framework for Enhancing Ethical Genomic Research with Indigenous Communities." *Nature Communications* 9, no. 1 (2018): 2957.

Cobb, W. M. "Human Materials in American Institutions Available for Anthropology Study." *American Journal of Physical Anthropology* 17, no. 4 (Supplement April–June 1933): 1–45.

Cobb, W. M. "Race and Runners." *The Journal of Health and Physical Education* 7, no. 1 (1936): 3–56.

Comas, J. ""Scientific" Racism Again?" *Current Anthropology* 2, no. 4 (1961): 303–340.

de la Cova, C. "Marginalized Bodies and the Construction of the Robert J. Terry Anatomical Skeletal Collection: A Promised Land Lost." In *Bioarchaeology of Marginalized People*, edited by Madeleine Mant and Alyson Holland, 133–155. Cambridge, Massachusetts: Academic Press, 2019.

Fuentes, A. *Race, Monogamy and Other Lies They Told You: Busting Myths about Human Nature*. Berkeley: University of California Press, 2012.

Jackson, F., L. Jackson, C. Cross, and C. Clarke. "What Could You Do with 400 Years of Biological History on African Americans? Evaluating the Potential Scientific Benefit of Systematic Studies of Dental and Skeletal Materials on African Americans from the 17th Through 20th Centuries." *American Journal of Human Biology* 28, no. 4 (2016): 510–513.

Jackson, F., C. M. Lee, and S. Taylor. "Let Minority-serving Institutions Lead." *Science* 345, no. 6199 (2014): 885.

Jackson, F. L. "Anthropological Measurement: The Mismeasure of African Americans." *The ANNALS of the American Academy of Political and Social Science* 568, no. 1 (2000): 154–171.

Kendi, I. X. *How to Be an Antiracist*. New York: One World, 2019.

MacClancy, J., and A. Fuentes. *Ethics in the Field: Contemporary Challenges*. New York: Berghahn, Oxford, 2013. ISBN 978-0-85745-962-6.

Malhi, R. S. "Contributions to Anti-Racist Science: Introduction to Race, Racism, and the Genetic Structure of Human Populations Special Issue." *Human Biology* 92, no. 3 (2020): 133–134.

Malhi, R. S., S. C. Antón, and A. Fuentes. "Increasing Diversity in Evolutionary Anthropological Sciences – The IDEAS Program." *American Anthropologist* 121, no. 2 (2019): 478–479.

Marks, J. *Human Biodiversity: Genes, Race, and History*. Piscataway, NJ: Aldine Transaction, 1995.

Nash, S. E., and C. Colwell. "NAGPRA at 30: The Effects of Repatriation." *Annual Review of Anthropology* 49 (2020): 225–239.

Nelson, R. G., J. N. Rutherford, K. Hinde, and K. B. H. Clancy. "Signaling Safety: Characterizing Fieldwork Experiences and Their Implications for Career Trajectories." *American Anthropologist* 119, no. 4 (2017): 710–722.h.

Ocobock, C., C. Owens, E. Holdsworth, et al. "# Hackademics: Hacks Toward Success in Academia." *American Journal of Human Biology* 34 (2022): e23653.

Panofsky, A., K. Dasgupta, and N. Iturriaga. "How White Nationalists Mobilize Genetics: From Genetic Ancestry and Human Biodiversity to Counterscience and Metapolitics." *American Journal of Physical Anthropology* 175, no. 2 (2021): 387–398.

Poor, M., and J. M. Matthews, eds. *Interrogating Human Origins: Decolonisation and the Deep Human Past*, 500 pp. Abingdon, Oxon, and New York, NY: Routledge, 2020. ISBN 9780203731659.

Raff, J. A., and C. J. Mulligan. "Race Reconciled II: Interpreting and Communicating Biological Variation and Race in 2021." *American Journal of Physical Anthropology* 175, no. 2 (2021): 313–315.

TallBear, K. "Standing with and Speaking as Faith: A Feminist-Indigenous Approach to Inquiry." *Journal of Research Practice* 10, no. 2 (2014): N17.

Tsosie, K. S., A. Bader, K. Fox, et al. "Ancient DNA Researchers Write Their Own Rules." *Nature* 600, no. 2, December (2021): 37.