Uncertainty and Sensitivity Analysis in Archaeological Computational Modeling. MARIEKA BROUWER BURG, HANS PEETERS, and WILLIAM A. LOVIS, editors. 2016. Springer, Cham, Switzerland. xiv + 175 pp. $119.99 (hardcover), ISBN 978-3-319-27831-5. $119.99 (paperback), ISBN 978-3-319-80225-1. $89.00 (e-book), ISBN 978-3-319-27833-9.

Reviewed by Patrick C. Livingood, University of Oklahoma

Archaeologists are accustomed to thinking about uncertainty in their work, and this volume is an effort to come to terms with uncertainty in formal computational modeling—that is, the simulation of the past and of systems of interest to archaeologists. It is somewhat surprising that there was not any formal treatment of uncertainty in computational modeling in archaeology before the contributors to this book took it on, despite the fact that tools and processes to do so are commonly deployed in other fields. As discussed in the preface, the impetus for this volume came about when Marieka Brouwer Burg was preparing to defend her dissertation, and a geologist on the committee asked whether she had done a sensitivity analysis. This prompted the archaeologists involved to wonder what that would even look like, and products of this effort were an SAA symposium and this volume. Although all the chapters in this book engage somewhat with the general uncertainties involved in computational modeling (data, model choice, model precision, coding errors, etc.), the primary focus throughout is sensitivity analysis (SA), which examines the effect of input parameters on model output and performance.

The first two chapters are introductions to the volume. The first chapter—by Brouwer Burg, Hans Peeters, and William Lovis—does an excellent job of defining and situating uncertainty studies in archaeology. It also nicely surveys how other fields have done this and how these might be applied by archaeologists. Chapter 2, by Lovis, summarizes attitudes by archaeologists toward computational modeling, and Lovis champions a pragmatic role for SA as a way to better understand the models archaeologists do create and to maximize what they learn from them by engaging in controlled experiments.

The middle chapters are all case studies, and each has a very different approach to SA, demonstrating the diversity of forms this approach can take. Chapter 3, by Peeters and Jan-Willem Romeijn, analyzes a simulation of hunter-gather behavior and land use in the postglacial Netherlands. They analyzed the robustness of results to variations in parameters to identify thresholds of importance for further consideration. Chapter 4, by Brouwer Burg, deploys formally sophisticated forms of SA on a model of hunter-gatherer land use. In a corner-test SA, she changed the parameter expressing desirability of different game species to extreme values, and in a Design of Experiments analysis, she varied these independently to determine which values were most significant to the outcome. In Chapter 5, John Carroll analyzes a very abstract model of cultural transmission. The chapter demonstrates interesting nonlinear results when the parameter showing the percentage change that someone can be influenced in a cultural transmission event is modified. In Chapter 6, Joshua Watts revisits work that was done to analyze both how long (in simulation time) a simulation of Hohokam pottery exchange should be run and in how many different iterations of each model configuration should be generated. He argues that analysts should be thoughtful about such values, rather than just picking arbitrary ones, and he demonstrates the steps that were used in this example. Chapter 7, by Andrew White, analyzes a demographic model for hunters and gatherers. The model has a feedback value that increases or decreases overall mortality as total population deviates from a threshold. This chapter explores the implications of sweeping that variable across various levels on the results.

The final chapters reflect on archaeological simulation more broadly. Chapter 8, by Thomas Whitley, considers the fundamental purpose of digital archaeological models. He encourages analysts to ask why a model is being built in the first place in order to determine how to verify its performance. This chapter astutely notes that archaeologists in general seem more open to accepting "vague nonspecific generalized and qualitative models of human behavior than simulations based on concrete numerical assumptions and scale-dependent digital datasets . . . because there are very often too many arguments for alternative assumptions about the inputs for each model in the simulation" (p. 150), and there are no easy alternatives. Finally, the concluding chapter by Sander van der Leeuw effectively summarizes all of the chapters. He encourages archaeological modelers to treat uncertainty generated by fragmentary knowledge about the past differently from uncertainty related to ontological concerns or model choice. This is because the first can never be reduced by modelers, and their contributions should work to actively reduce uncertainty in the other domains.

Collectively, chapters in this volume tend to share similar philosophies about modeling. Most advocate for simple models with fewer parameters that work (as van der Leeuw argues in Chapter 9) to develop "tools for thought" (p. 160) rather than detailed models of reality. They also tend to be pessimistic (as is

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Lovis in Chapter 2) that archaeological simulations will usually be able to be as precise as some models in other fields because of inherent archaeological uncertainties and biased and missing data. And they all struggle with the fact (observed by Whitley in Chapter 8) that fully documenting and exploring a model can take a lot of time, and it is nearly impossible to ever present all of these explorations to readers.

This is a well-crafted volume that is essential reading for those who construct archaeological simulations, and it is an educational read for any other archaeologist to reflect on how to grapple explicitly with uncertainty in our field.

The Bioarchaeology of Socio-Sexual Lives: Queering Common Sense About Sex, Gender, and Sexuality. PAMELA L. GELLER. 2017. Springer, Cham, Switzerland. xxi + 232 pp. $109.99 (hardcover), ISBN 978-3-319-40993-1. $109.99 (paperback), ISBN 978-3-319-82236-5. $84.99 (e-book), ISBN 978-3-319-40995-5.

Reviewed by Molly K. Zuckerman, Mississippi State University

Over the past several decades, theory-building on sex, gender, and sexuality has flourished within anthropology, especially within archaeology and sociocultural anthropology. However, biological anthropology, including bioarchaeology, has greatly lagged. Within bioarchaeology, this lag is partially due to material concerns. It is true that biological sex has long been estimated from morphological characteristics of human skeletal material. But sex, gender, and sexuality are being increasingly recognized as plastic and highly culturally and historically contingent, with material traces that can therefore be complex to identify and reconstruct within skeletal material without substantial contextual information. The lag is also attributable to bioarchaeology's still limited engagement with contemporary, third- and fourth-wave gender and feminist theory from within the broader discipline of anthropology, the larger social sciences, and the humanities. Viewed from this perspective, Pamela Geller's *The Bioarchaeology of Socio-Sexual Lives: Queering Common Sense About Sex, Gender, and Sexuality* represents a major advance for building, using, and applying contemporary gender and feminist theory in bioarchaeology, and I highlight three major aspects of its contributions here.

First, Geller comprehensively reviews third- and fourth-wave theory at the beginning of the book, surveying the diversity of these concepts while keeping her explanations and examples grounded in bioarchaeology. (Third-wave theory mainly focuses on intersectionality, social constructivist approaches, gender performativity, queer theory, and new materialism, whereas fourth-wave theory is anchored in the digital world and intersectionality, particularly related to systems of power that reinforce the stratification of traditionally marginalized groups [e.g., women of color, LGBTQIA+ communities]). For example, Geller provides case studies in each chapter, tethering theoretical perspectives to examples from the bioarchaeological record. Importantly, this aspect of the book provides valuable guidance to bioarchaeologists who are less well versed in social theory about how these ideas—mostly developed to better understand current cultures and living bodies—might apply to the human past and human skeletal material.

Second, Geller convincingly rejects the utility of the traditional idea, rooted in second-wave theory, that sex and gender are rigidly binary systems, with exclusive meanings that are consistent across all temporal and cultural contexts. Instead, Geller advocates for integrating ideas from both concepts and exploring evidence of "socio-sexual" lives in the bioarchaeological record. This original concept encompasses the interrelated but distinct and intersecting social identities represented by sex, gender, and sexuality and their effects on human lived experiences. Analyses of socio-sexual lives within bioarchaeology, Geller argues, should be focused on relational aspects of identity and experience, and thoroughly contextualized culturally, historically, and/or ethnographically. Given bioarchaeology's time depth and emphasis on the material body, such analyses could create an unprecedently wide range of opportunities to uncover the diversity of sex, gender, sexuality—socio-sexual lives—in the past. Applying this approach in bioarchaeology would involve doing new research as well as rethinking old research. The opportunities are broad because much of the evidence so far uncovered on sex, gender, and sexuality in the past has been obfuscated by presentist approaches, which are overwhelmingly heteronormative. It is helpful that Geller accompanies these recommendations with numerous proposals for future research questions and topics, giving other bioarchaeologists a clear path forward rather than leaving them confused about how to apply the concept of socio-sexual lives to the past.

Finally, Geller's text represents a major advance because it constructively demonstrates that bioarchaeological work on sex, gender, and sexuality that is anchored in contemporary gender and feminist theory can change not only how we understand social identities and the lived realities people in the past but

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