Bones and Chromosomes: The Ancient DNA Revolution in Archaeology (Part 2)
Este libro ofrece una visión general de la arqueología de la región oaxaqueña, abordada desde sus orígenes, con los científicos del siglo XIX, hasta los estudios más recientes en la época moderna. Ubicada en el sur de México, esta región mesoamericana ha sido considerada como cuna de civilizaciones debido a su interrumpido desarrollo cultural, desde la prehistoria hasta nuestros días. El libro se presenta organizado en una manera cronológica, a fin de que el lector pueda comprender el desarrollo de las antiguas culturas que han convivido a lo largo de varios siglos en este agreste territorio. Ofrece una compilación de los conocimientos emananados de los varios proyectos arqueológicos que se han realizado permanentemente en Oaxaca, que han permitido ir construyendo la historia de los grupos humanos asentados desde la etapa lítica hasta la llegada de la conquista europea en las diversas sub-regiones. Muestra también los diversos enfoques de la arqueología mexicana y norteamericana que la han modelado, y que se han complementado de manera afortunada para hacer de Oaxaca una de las regiones más estudiadas de Mesoamérica.
# SAAarchaeological record

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Taino art centered on cult objects associated with the veneration of “zemis”—revered deities, ancestors, or landscape spirits. The term also refers to the idols and fetishes that were believed to be inhabited by powerful spirits. Large, cadaverous stone heads are thought to represent the deity Maquetaurie Guayaba, lord of the Land of the Dead. “Zemis” were kept in the home or in sanctuaries where they were honored with food and gifts.
suggested in my January column that the study of ancient DNA is having a significant impact on our discipline. Indeed, I think it is significant enough that it warrants a second set of articles. Thus, our March 2019 issue of *The SAA Archaeological Record* features Part 2 of the special section, “Bones and Chromosomes: The Ancient DNA Revolution in Archaeology,” guest edited by Matthew Piscitelli. Contributions continue discussions emphasizing ethical responsibilities, research challenges, and prospects for new insights. Matisoo-Smith provides a discussion of her experiences and insights from decades working with indigenous communities in the Pacific region. Tackney and Raff continue this discussion with a focus on ancient DNA, human subjects, and arctic communities. Nieves-Colón reviews multiple themes in ancient DNA research associated with Caribbean contexts. In doing so, she considers potential contributions, but also socio-political challenges, ultimately recommending engagement with multiple lines of evidence. Brunson makes the case for integrated ancient DNA and zooarchaeological studies. Fox warns against pitfalls associated with the “bone rush” and argues for careful management of collections with the expectation of critical future research needs. Finally, Vilar introduces the Genographic Project at the National Geographic Society and in doing so calls for discussions with diverse scholars and representatives of grant-making institutions to develop guidelines for ethical practice in the growing world of ancient DNA research.

This issues offers additional contributions, including articles by Lyons, Supernant, and Welch (“What Are the Prospects for an Archaeology of Heart?”) and Meyers and colleagues (“8 Things I Wish I Had Known as a Master’s Student”). Our Volunteer Profile is back with a new column by former SAA President, Diane Gifford-Gonzalez. Current SAA President Susan M. Chandler offers her final “From the President” column that includes results of our 2019 SAA elections. Congratulations to all! Finally, this issue closes with celebrations of the lives of two dear colleagues and overviews of the SAA fundraising process and progress.
FROM THE PRESIDENT

Susan M. Chandler, RPA

FAREWELL AND THANK YOU

When I ran for President of SAA, I had the following goals: to strengthen the Society and the profession of archaeology by fostering collaboration among professional archaeologists with varied research interests; to focus on ways to maximize gains in archaeological knowledge through innovative archaeological techniques and a dedication to involving the public and descendant communities in archaeological research; to emphasize a wider variety of professional development opportunities for SAA members; and to ensure that SAA play a critical role in advocating for funding of archaeological research and for the protection of archaeological sites, both in the United States and abroad. During the past two years, I have had the privilege of working with other SAA members—archaeologists employed by universities, museums, consulting firms, federal and state governmental agencies, tribes, or research institutions—to work toward accomplishing these goals:

• We have examined ways for SAA members to collaborate on research so that the vast quantities of raw data that have been, and are being, collected can be better synthesized and shared. We have also examined ways in which professional archaeologists can better convey the value of archaeology to the public that supports our profession.

• Thanks to staff efforts and the willingness of members to serve as instructors, we have been able to provide a wider variety of professional development opportunities for SAA members by increasing the number of courses taught through the Online Seminar Series and expanding the program in Spanish to our Latin American members (“Oportunidades Internacionales para Estudiantes de Arqueología de América Latina” by Amilcar Vargas, and “CRM in Latin America” by Sandra L. López Varela, are both available in Spanish).

• With the Board, Committees, and Task Forces, we have built upon the Society’s relationship with the European Association of Archaeologists and have looked for ways to make stronger connections between the SAA and other national and regional archaeological societies, including avocational archaeologists.

• SAA has also continued to participate in coalitions with groups that share our preservation values. I am proud that SAA is one of the founding partners of the Coalition for American Heritage. SAA has taken a proactive role in educating the US Congress about the importance of archaeology to our nation and has advocated for laws to prevent the looting or sale of antiquities. We have mobilized our members to take action when archaeological resources or the laws protecting them have come under attack, and we have taken a watchdog role when needed to ensure that archaeological resources are adequately protected. SAA has also continued our work with the World Bank in an attempt to strengthen environmental protections for cultural resources impacted by global developmental projects.

These great strides taken by the Society are not because of the president, but because of the hard work and dedication of our staff, our Board, the editors of our publications, and our members, particularly those who serve SAA on committees, task forces, and interest groups.

Results of 2019 SAA Elections

I wish to extend my sincere thanks to all of the candidates who were nominated and agreed to stand for election. My thanks also go to the 2019 Nominating Committee, who put together a strong slate of candidates for this year’s ballot.

Stephen Nash has been selected as the SAA Treasurer-Elect. Dr. Nash received his PhD in 1997 from the University of Arizona and is the Director of Anthropology and Curator of Archaeology at the Denver Museum of Nature & Science. He will serve on the SAA’s Executive Committee this coming year while learning the job from the current Treasurer, Ricky Lightfoot. Steve will become the SAA Treasurer at the annual meeting in 2020 and will serve for two years thereafter.

Two persons were elected to the SAA Board of Directors: Silvia Salgado (PhD 1996, University of Albany–SUNY) and Cynthia Herhahn, RPA (PhD 2004, University of California–Santa Barbara). Their terms begin at the 2019 Annual Meeting and extend until the 2022 Annual Meeting. Dr. Salgado is a full professor at the Universidad de Costa Rica. Dr. Herhahn is the State Archaeologist/Deputy Preservation Officer for the Bureau of Land Management, New Mexico State Office.

Patricia Crown, RPA, and T.J. Ferguson, RPA, were selected for one-year terms on the 2020 Nominating Committee. Dr. Crown received her PhD in 1981 from the University of Arizona and is the Leslie Spier Distinguished Professor of Anthropology at the University of...
FROM THE PRESIDENT

New Mexico. Dr. Ferguson received his PhD in 1993 from the University of New Mexico. He owns and operates Anthropological Research LLC, a research company in Tucson, Arizona, where he is also a Professor of Practice in the Department of Anthropology at the University of Arizona.

President-Elect Joe Watkins becomes SAA President following the Annual Business Meeting and Awards Ceremony at the 2019 Annual Meeting in Albuquerque, and Secretary-Elect Teresita Majewski will become Secretary. Both officers will serve until the 2021 Annual Meeting. Four SAA Board members will complete their terms of office at the 2019 Annual Meeting: Emily McClung de Tapia, Secretary; Patricia Garcia-Plotkin and Luis Jaime Castillo Butters, Directors; and myself. A full list of Board members can be found on the SAA website (under the Member Center Login).

2020 SAA Elections

I urge you to also consider serving SAA in a leadership role. Your participation will require a dedication of time and energy, but I assure you that the responsibility will also reap both professional and personal rewards.

The 2020 Nominating Committee will be chaired by former President Diane Gifford-Gonzalez. The committee will include the two members recently elected by the SAA membership (Crown and Ferguson) plus two members who will be appointed by the Board at the 2019 Annual Meeting. The 2020 Nominating Committee is charged with identifying two candidates for each of the following positions: President-Elect, Secretary-Elect, Board position 1, Board position 2, Nominating Committee position 1, and Nominating Committee position 2. Any SAA member in good standing can also suggest the names of candidates (including their own name) for any open position. The call for nominations will be published in the May issue of The SAA Archaeological Record.

This is my last column as SAA President. Thank you for allowing me the honor of leading our professional organization. My sincere thanks to all of those who assisted me during my SAA presidency. I will be leaving the office in the capable hands of Joe Watkins, who has worked closely with me during this past year and in whom I have every confidence.

New in Archaeology from The University of Alabama Press

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The Ritual Landscape for Late Precontact Eastern Oklahoma: Archaeology from the WPA Era until Today
By Amanda L. Regnier, Scott W. Hammerstedt, and Sheila Bobalik Savage

Archaeology Below the Cliff: Race, Class, and Redlegs in Barbadian Sugar Society
By Matthew C. Reilly
I joined SAA in 1972, while a graduate student in the “Old World Prehistory” program at the University of California Berkeley. My first meeting was in 1973 in San Francisco, a bus ride away from the East Bay. I was intending to research the emergence of food production in Europe or Africa—Africa won out. Some peers asked why, given my areal and temporal interests, I’d join the Society for American Archaeology. I replied that SAA is the professional society where I get new ideas, the stimulation to head in new directions with my own work, both through the Annual Meetings and in *American Antiquity*. Although I later joined many other professional organizations, SAA remained the intellectual pivot, and I seldom missed Annual Meetings over four decades.

As I continued to research early pastoralists in Africa, I kept coming back to themes and questions I first saw articulated in SAA publications and at the Annual Meetings, regarding other world regions. My interest in the intersection of social and ecological factors among pastoral peoples sprang from such experiences. When in the 1990s my role as a “sandwich generation” human—only surviving child of ailing parents and a single mother—prompted me to choose research in the Monterey Bay region, SAA’s leadership became even more central to my everyday and intellectual concerns as an archaeologist practicing in California.

Through my academic career, I began to view SAA not only as a source of intellectual inspiration but also as a professional organization that fostered ethical behavior and educational initiatives in which I could and should invest my time. I served on the SAA Board of Directors in 1992–1995, and only then did I realize how many areas in which SAA was engaged. I also clearly saw that archaeologists, even pretty renowned ones, tended to work toward forming consensus, often after what diplomats call “full and frank discussions.” As SAA moved more to collaborations with other, international archaeological organizations, its leadership in the wider, global context impressed me.

I am from a low-income family background and taught 40 years at a state university where Pell Grant recipients comprise nearly half of undergraduates, and about 65% of our undergraduate cohort is now from non-white families. I have seen the multiple challenges faced by students whose families live in poverty, lack educational opportunities, or face racial and ethnic discrimination in work and education. I was therefore glad to agree to be startup chair of SAA’s Minority Scholarships Committee (MSC) in 2011–2013. I am deeply grateful to my MSC colleagues for sharing their diverse experiences and perspectives as we worked to set up the Historically Underrepresented Groups Scholarships (HUGS) program. As we began, I wondered if we’d have to seek out applicants, but right from the start, there were more qualified HUGS applicants than there were funds to award. If I were to win the lottery, I’d definitely invest heavily in HUGS, which I’ve seen forward the careers of several recipients. If any readers have hit it lucky, this is a worthy cause.

I agreed to run for SAA President because I knew that archaeologists’ general inclination to work problems through to consensus would make that daunting job possible. The Board of Directors absolutely did not disappoint my expectations. My main regret on stepping down after two years as President was that I would no longer be working with that sterling set of colleagues and friends.

After 47 years, SAA remains my main archaeological organization. I urge any of you who care about archaeology, in this country or in others, to become an SAA volunteer.
What Are the Prospects for an Archaeology of Heart?

Natasha Lyons, Kisha Supernant, and John R. Welch

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here is a growing appetite in archaeological and other professional circles for alternative practices that embrace the whole person. We received an overwhelming response to both a session called “Archaeologies of the Heart” hosted (with Sonya Atalay and Jane Baxter) at the 2016 Society for American Archaeology (SAA) Annual Meeting in Vancouver and an SAA online seminar called “Building a Toolkit for the Heart-Centered Archaeologist” presented from Tucson in October 2018. In both cases, we were flooded with interest, inquiries, encouragement, good wishes, and requests for more information and resources. In this article, we summarize our emergent approach to heart-centered archaeological practice, present three short case studies, and provide a few tools for applying heart-centered practice to a range of work, field, and study contexts.

Heart-Centered Practice: What Is It & Why Do We Need It?

Archaeological practice is shifting in response to feminist, indigenous, activist, queer, and community-based critiques of how we do archaeology and how we use science to interpret the past lives of people (e.g., Atalay et al. 2014; Conkey 2005; Schaepe et al. 2017; Voss 2008). Inspired by these calls to action, we are developing the elements of a heart-centred archaeological practice to move away from the disconnected ethos that pervades (much of) archaeology as objective science and toward the unification of our intellectual and emotional selves to produce a more holistic and integrated approach to practice. An archaeology of heart invokes love, a subject that until recently has been taboo in the academic world, despite being a prime mover of human actions, personal and professional (Lyons et al. 2018; Supernant et al. 2019). Our project is inspired by Gene Anderson’s (1996) *Ecologies of the Heart* and its antecedents (e.g., Bateson 1972) and by work in the caring professions that speaks to those seeking more authentic, meaningful, and personal connections to their healthcare and its providers (Watson 2009). Such an approach is broadly applicable: if you have a heart—and we hope that is all of you—and you are an archaeologist, heart-centered archaeology may be for you.

Akin to the organ from which we draw inspiration, we define an archaeology of heart as flowing through four main chambers (Supernant and Lyons 2019):

- **Care** is the active practice of cultivating well-being in self and others, providing support and creating attachments rather than distance. Care is not inherent to the social practices of doing archaeology—competition for resources is a near-constant driving force in all sectors of the discipline—yet we can envision an archaeology where care is not a liability but a strength, and where careful listening is deeply valued (Kehoe and Schmidt 2017).
- **Emotion** represents the awareness of our feelings and how they are expressed and acted upon in decision-making and conduct. Heart-centered archaeology creates space for the emotions of practitioners, stakeholders, and ancient peoples (Perry 2018; Tarlow 2012).
- **Relationality** emphasizes practice grounded in healthy relationships between people and communities, with the archaeological record, and for some of our partners, with the sacred or other-than-human world (Wilson 2008). As archaeologists, it is important to make space for different ways of knowing without feeling that “our” disciplinary practices are being threatened.
- **Rigor** emphasizes integrity in our research processes, knowledge production, and relations with respective communities of practice and interest (Gero 2015; Wylie 2008). Heart-centered practice recognizes the different knowledge systems involved in understanding a given research question or situation and seeks to identify rigorous—yet also reflexive and appropriate—frameworks for vetting the knowledge and perspectives generated in our work.

Below, we present three case studies that explore how heart-centered practice has informed our experiences in teaching, navigating career paths, and finding our respective places in archaeology.

Heart-Centered Case Studies

Kisha: *Teaching Archaeology from the Heart.* All archaeologists, whether in cultural resource management, academia, tribal contexts, or other sectors of our discipline, are trained through classroom and/or field environments. Pedagogy and training are areas of archaeology where care has not always been centered, but where it is essential for creating a safe learning environment for students. The need for a care-centered practice is most acute in field environments, where
many students and trainees have reported a range of harassment and assault, as documented in the SAFE survey (Clancy et al. 2014). Creating a safe space for students to learn and engage in archaeological fieldwork requires an ethic of care approach, where we acknowledge the blurring of boundaries that can happen in field projects. Taking students into sometimes remote areas, into unfamiliar environments where team members not only work but live side by side, often creates intimacies not possible in the classroom. Therefore, it is essential to have clear policies and agreements in place that define and, when necessary, enforce those boundaries, with clear mechanisms for reporting and acting on incidents.

One way to accomplish this is to set out principles of community from the beginning of the fieldwork process and have participants engage in developing those principles. Principles of community move beyond codes of conduct to articulate aspirations for how we work together and to define our responsibilities to one another and to the archaeological record during the process. Rather than acting as a set of rules with consequences for violation, principles of community help set expectations collectively and establish a safe and supportive culture in environments where these expectations have often been unclear. Traditional Western modes of pedagogy give primacy to teaching the minds of our students, to imparting knowledge through lectures, assignments, and activities. However, we are more than our minds. Expecting that students will leave the other elements of their lives behind when they leave for the field or enter the classroom does a disservice to the complexity of our lived experience. I have been teaching archaeology for 12 years and have seen a transformation in my own pedagogy when I engage an ethic of care approach. Creating classroom and field environments that teach more to the whole person requires connecting with the students in more holistic ways. First, I invite the students to bring their whole selves to the classroom or field learning environment. I give them a sense of who I am beyond the teaching role in which they encounter me by telling them a bit of my own story. I emphasize that life exists outside the classroom for all of us and I invite students to share with me something about their lives outside of the classroom and to let me know when life outside the classroom impacts their ability to be present and learn. I also set care-full boundaries by noting that I may not always be able to help the students when issues arise, but I can connect them with resources to assist.

Teaching to the whole person requires an understanding that we are more than minds and that both the educator and the learner have relational responsibilities to one another. Articulating these responsibilities creates safer, more supportive, and more heart-centered learning environments. Teaching happens throughout all aspects of archaeological practice, and establishing heart-centered principles during the learning process has the potential to be transformative for our discipline.

Natasha: Finding the Sweet-Spot between CRM & Academia. Like all budding archaeologists, I made choices as I went through my studies and experienced different elements of archaeology, from my first field season (thrilling) to my first conference (boring!) to the first marking up of a graduate paper (horrifying!). I wanted to try a wide breadth of jobs related to archaeology and see what I liked—I worked for a local museum as a student programmer, taught at the college and university levels, worked as a Parks Canada archaeologist, and as a project paleoethnobotanist for a First Nations archaeology firm. For me, there has always been a current of both research and community-based practice in my work. Like most archaeologists, I have a strong independent and subservive streak. Yet, unlike most folks with a PhD in archaeology, I never really wanted to be tied to an academic institution as a professor. Fortunately for me, I’ve had some very strong mentors. John (Welch) was my postdoc supervisor, and Jane Kelley had a strong influence on me during my PhD. Both encouraged me to follow my heart and start a small company that would suit my interests. The company I started a decade ago with Ian Cameron, Ursus Heritage Consulting, is a CRM company, but the career I’ve developed within it focuses on work with Indigenous communities and academic projects to do community-oriented research. For me this is the sweet-spot between the independence of running a business and participating in the rigors of academic theorizing, reflection, and publishing, all processes that I love.

A few years ago, I was asked to be adjunct faculty at Simon Fraser University (SFU), near Vancouver, BC, where I did my master’s and postdoctoral studies. I work with many friends and colleagues at the universities in British Columbia and this fit made sense. In 2016, I became adjunct faculty in the Department of Archaeology at SFU. I see my relationship to the university as existing on equal footing with our company. In publications and presentations, the affiliations sit side by side to make the point that the relationship is a horizontal one rather than a vertical one; they are complementary. But the Ursus logo does have the edge and always goes first because our company gives me my living, and to be perfectly honest, it is nearer and dearer to my heart. Despite the general disciplinary notions about pecking order, academics are not superior to CRM practitioners (or others!) on the archaeological food chain. As a culture of professionals, it seems high time that we recognize what our colleagues in different sectors bring to the table and honor their knowledge and skills as those we may not have and could both learn and benefit from. Sitting in both camps, I know that real-world skills such as developing cost estimates, keeping to timelines, and managing budgets are not strengths of most professors; many CRM archaeologists are less comfortable teaching and presenting. Yet these lines are blurring, and what we archaeologists call practice is steadily shifting to encompass more ambiguity and breadth (Lyons and Blair 2018; Watkins 2008). I see this as a sign of things to come.

John: Personalizing Professional Preservation. This case study is a story of how heart-centered practice can arise, get a little carried away, and give way to clarity in professional roles and responsibilities.
My first gig as a professional archaeologist was as an excavation supervisor for the University of Arizona’s field school at Grasshopper in 1984. After two seasons I was fortunate to be turned loose to find, record, protect, and make management recommendations for the vast, rugged archaeological landscape that is the West End of the White Mountain Apache Tribe’s lands. At first the field school was 8 weeks. When we trimmed it to 6, I began finding excuses to hang back or to make weekend excursions up from Tucson. My 8-week field seasons extended to 10, then 12. By 1987, I had a bad case of geophilia. The romance caused some problems in other relationships. I slowed down my dissertation work for fear completion would force me away from Arizona. My mother worried.

The good news, then and now, is that Apaches love land, too: visiting it, naming it, and finding solace and wisdom in it. They recognized my infatuation and both encouraged and exploited it. They put me to work doing road and timber sale surveys and training the forestry presale crew to document and protect sites. I shared what I knew about federal heritage protection laws, culture histories, and documentation methods. Apaches taught me about their land, history, ecology, site locations, place names, and links among these—all fuels for my passion’s fire.

My field seasons got even longer when Raymond Palmer, one of the fire management bosses, got me qualified as a wildland firefighter. I figured out I could make more money over a long weekend of fire-fighting than in the 6-week stint on the Grasshopper staff. Keeping the bulldozers away from heritage sites was essential, but not more important than building common ground with Apaches over protecting lands, ecosystems, and places.

In 1992, my field season jumped to 52 weeks when I was the only applicant for the BIA job as the reservation archaeologist, my dream job. Most of those who have worked on interdisciplinary land management teams know the satisfaction that comes with focusing one’s mind and work within defined land boundaries. My job soon expanded to include the tribe’s historic preservation officer—THPO—affording added blessings through concerted deliberations with the tribe’s elected officials and cultural advisors, venerable elders like Ronnie Lupe, Eva Watt, Ramon Riley, and Levi Dehose.

As often happens in a flourishing romance, however, my passions led me astray. At a 1997 cultural advisory board meeting about whether to encourage a film about how some river rafters had dynamited a dangerous rock impediment out of the Salt River, I voiced eager support. Silence followed. Raymond Kane, a feisty elder I deeply respected, rebuked me, observing that I was—unlike the bedrock, and despite my best intentions and those of the dynamiters—a temporary landscape feature. I winced and a lump formed in my throat as the last vestiges of my little boy dreams of being an “Indian” vanished forever.

This experience, however painful, was transformative. I stopped using first-person pronouns (US, WE) in reference to the tribe. Professional and sociopolitical parameters soon complemented the geographical boundaries and clarified my status as an ally and employee of the tribe. I never again confused my own interests in the land and its proper treatment with those of the Apaches directly affected by short-sighted policies or profit-driven proposals.

I moved into academe in 2005 and am rounding out my career(s) in consulting, government, and academic archaeology working for the nonprofit Archaeology Southwest, but my relationship with the tribe and its lands, now steaming into its fourth decade, remains the foundation for my love for Apache lands, people, and places.

**Taking It to Heart: Applications for Professional Practice**

Below we present three takeaways of heart-centered archaeology for professional practice. These are tools as much as they are challenges for present-day practitioners of all ages, genders, contexts, and stages as they move forward through their careers.

1. **Connecting Self to Practice.** How do we implement all four chambers of a heart-centered practice? For instance, what would happen if you brought your best self to your work context every day? Imagine what it would look and feel like if everyone felt true and cared for themselves, recognized both our emotions and those of others in relation to each other and to the work we are doing, while maintaining a commitment to rigor in our professional obligations. If we all began to practice this way today, think how it would and could transform our discipline.

2. **Principles of Community** are statements which move beyond codes of conduct to inspire a group of people to work, study, or coexist cooperatively together (Clancy et al. 2014). Many universities are developing such principles and posting them on their main university web pages. In archaeological contexts, these agreements can be collaboratively produced at the outset of a project, class, field season, negotiation, or other context, in order to lay out the respective roles and responsibilities of the individuals involved, the hopes, aspirations, and goals of the work, and the agreed upon mechanisms for addressing conflict and transgressions, should they arise. Such principles create conditions in which respective partners, learners, or stakeholders are committed to and invested in the work at hand (Lyons 2011).

3. **Heart-Centered Leadership** is a commitment to modeling strong, caring, empathetic, and responsible conduct, no matter what your context of practicing archaeology. Heart-centered leaders recognize the diverse communities that are invested in caring for the
material record and demonstrate deep respect for the care, emotion, relationality, and rigor that these communities bring to their practice(s). A heart-centered leader is humble, listens deeply, and has respect for everyone involved. S/he creates situations where the field technician is as valued as the field director, where Indigenous and other local knowledges are standard parts of museum interpretation, and where the student has something to teach the professor. As heart-centered leaders, we create spaces and ways for these kinds of lateral sharing to happen.

Last Word
We all have hearts and we all care deeply about the work we do and the archaeological record we are privileged to study. It is time to bring our hearts into the center of our practices and recognize how care, emotion, relationality, and rigor make for an archaeology that teaches the whole person, creates career opportunities that are true to each individual, and helps us understand our roles in relation to the past, present, and respective communities of practice.

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References Cited

Anderson, E. N.

Atalay, Sonya, Lee Rains Clauss, Randall H. McGuire, and John R.Welch (editors)
2014 *Transforming Archaeology: Activist Practices and Prospects*. Left Coast Press, Walnut Creek, California.

Bateson, Gregory

Clancy, Kathryn B. H., Robin G. Nelson, Julienne N. Rutherford, and Katie Hinde

Conkey, Margaret W.

Gero, Joan W.

Kehoe, Alice B., and Peter R. Schmidt

Lyons, Natasha

Lyons, Natasha, and Susan Blair

Wylie, Alison

Voss, Barbara L.

Wilson, Shawn

Watkins, Joe

Watson, Jean

Kehoe, Alice B., and Peter R. Schmidt

Lyons, Natasha

Lyons, Natasha, and Susan Blair

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8 Things I Wish I Had Known as a Master’s Student

Julia Meyers, Aurora E. Camaño, Spencer Greening, Cara Kubiak, and Laura Termes

Entering graduate school for the first time can be a stressful experience. Armed with what seems like either too little or too much information on what to expect in your graduate program, knowing few or no people in your cohort, and potentially having just moved to a new location can be unsettling. We are a group of doctoral students who have had a myriad of experiences during our graduate careers. We have assembled here a few lessons learned during our master’s experience—things we wish we had known going in that we believe would have eased our transitions to graduate school. These guidelines were initially assembled for a presentation to Archaeology master’s students at Simon Fraser University; the list represents our common experience during our master’s degrees.

1. Down the academic rabbit hole: Finding your place in graduate school.

Being in grad school involves negotiating your place in relation to the institution, your department, your research team, and your supervisor. Understand the hierarchy and figure out how you and your research are valuable and valued at each level. Although the institution and your department can be intimidating, understand that they support you and want to help you find value in your research, as your success reflects well on them. If you are part of a research team, those relationships are more personal and provide the opportunity to collaborate with new and exciting people. These collaborations should be mutually beneficial and fulfilling. As a graduate student you are worthy of support and success; don’t be afraid to seek out either.

Whether at the beginning or further along in an academic career, every person feels at one point or another like an imposter. The reality is, if you got this far you have the ability to succeed in graduate school. Everyone around you has almost certainly grappled with similar feelings of self-doubt. Acknowledging those feelings of self-doubt allows you to shift your focus and start appreciating the skills and qualities you have. Furthermore, this allows you to improve and expand on things at which you are already skilled. Understanding both your fears and your strengths better places you in a position to succeed.

2. Navigating your relationship with your supervisor: Why won’t you talk to me?!

Your academic supervisor (sometimes referred to as an advisor) will be central to shaping your master’s research. While your supervisor is your superior, your relationship can end up being much more of a collaborative mentorship. Make your expectations of your supervisor known and understand their expectations of you. Have this discussion early on in your degree. This conversation will make your journey together easier to navigate.

While your supervisor plays a central role in your academic career, your success ultimately depends on you. Since your supervisor has a limited amount of time and energy available, you are the one in charge of your research. You are the person most invested in your research, and therefore in the best position to advocate for changes and improvements in your research trajectory. If you feel that you are being asked to take on too much, talk to your supervisor and practice saying “no,” as well as saying “yes.” Every student-supervisor relationship will be different. Some supervisors will be hands-off and others more intent on guiding your research. The time you spend with your supervisor can give you the tools and know-how for you and your research to succeed.

The supervisor-student relationship need not end with your thesis defense. Keep in touch. This is vital not only for the reference letters you will inevitably need but also for future research and professional opportunities. Finally, remind yourself that your supervisor is a human being, too. Yes, they may be famous, their credentials may be intimidating, but your supervisor still puts their pants on one leg at a time.

3. Picking up skills: Learn to do it all (or as much as humanly possible).

During your master’s degree, there will be a number of new opportunities to develop skills. Take advantage of these opportunities, but avoid burnout by being selective. While it is a good idea to augment your area of specialization, take advantage of the opportunity to diversify your skill set. This will give you an edge in the job market.
Get involved in your department. Take all the free seminars and workshops you can, volunteer on and off campus, and learn from the people around you. Ask other graduate students about their research and how you might gain similar skills. At the end of your master’s degree, you’ll be surprised by the growth of the skills section of your CV. On a related note, make a habit of updating your CV every month so you can keep up with all your new skills.


Networking is a hugely valuable part of being a master’s student. The connections you make now will help set you up for future studies and career opportunities. Since networking is typically not integrated into the program curriculum, the initiative is yours to make. In addition to the contacts you make through your supervisor, you should also forge your own professional relationships by introducing yourself and your research to the broader community.

There are several avenues available for showcasing yourself as a researcher and connecting to a broader community. Social media is a vital way to bolster your research profile. However, be aware of the drawbacks when publicly sharing preliminary research. Avoid posting complete unpublished works, and instead, post your title and abstract to Academia.edu, ResearchGate, or Humanities Commons. Interested individuals will find your attention-grabbing titles and then reach out to you directly to get access to the full work. Conversely, don’t be wary of reaching out to people in your field. Some of your best connections have been made by sending a rogue e-mail to senior academics about our shared interests, data needs, and advice. It might seem terrifying at first, but the worst that can happen is an e-mail gets ignored.

Another way to network is through attending conferences. Keep your eye out for conference postings (don’t rely solely on your supervisor for invitations) and attend different types of conferences (from big to small, from generalist to special theme). Graduate student conferences are great places to present and receive feedback on preliminary research and to network with your future colleagues, while large conferences are excellent platforms to show your work to the big names in your field. Review conference programs beforehand and e-mail people of interest to you to set up a meeting. Bring your business cards. Graduate school is the time where you find your future academic communities. Bring energy, thoughtfulness, and openness into the process of creating community.

5. Publishing: The elephant in the room that no one stops talking about.

For many, graduate school is your first experience conducting research intended for publication. Publishing is becoming increasingly important for graduate students. The number of peer-reviewed publications a student produces influences entrance into future graduate programs, receiving scholarships, and career opportunities. While there is much talk about publishing, there is much less discussion about when, why, and how you should be publishing. Your master’s research is a good time to figure out the publication process and initiate the publication of your research. Few of us knew about the publishing process prior to starting our master’s degrees. Talk to your supervisor early. Find out what their expectations are in terms of publishing. Make it clear to them that you are interested in publishing any research you conduct during your master’s.

Expectations for number and types of publications will differ depending on whether your work fits into a natural science, or social science/humanities framework. Science-based, collaborative, and/or lab group research often entails large interconnected projects. Since this model can result in several multiple-authored papers, talk with your supervisor about author order and inclusion early on. If you are a social science/humanities scholar, it is likely that your research will be more independent and therefore it is acceptable that you publish as a single-author. Peer-reviewed publications are the main avenue for disseminating your work, but take advantage of other venues such as conferences, social media, blogs, and conventional media.

6. Time management: And…We’re out of time.

Thank you all. Goodbye.

The many dimensions of life as a graduate student can be tricky to organize. You may be unaccustomed to the balance of work required for your classes versus your thesis research. You may be working on several projects in addition to your own research, all while trying to maintain a high academic standing. It helps to treat your academic work like a 9–5 job, whether you work on-campus during your workweek as this provides structure and also connects you with your colleagues.

Work productively by blocking out times to focus on specific sets of tasks. If you can’t keep to a schedule, don’t beat yourself up. Start again tomorrow. Even if you have a good schedule, you can get delayed by the schedules of others. If you work in a large group or lab, then the progression of your work may rely on how quickly (or slowly) others complete their contributions. You need to be flexible and accommodating while also being clear with others about your needs.

It’s never too early to make a grand schedule that will take you from research crafting through to final thesis submission. Many students find themselves up against administrative deadlines at the end of their thesis. Plan for crucial deadlines like those associated with committee selection, departmental reviews, defense date, and final library submission. Your future self (and bank account) will thank you.
8 THINGS I WISH I HAD KNOWN AS A MASTER’S STUDENT

7. You’re probably not going to save the world with your research, and that’s okay!

Many of you will come to graduate studies eager to conduct research that will change the world. But, let’s face it, it’s hard to change the world—especially within the time limits of a master’s degree. In the spirit of optimism, think of your degree instead as the first step in the process of a lifetime of changing the world.

While a master’s degree may result in publications, an equally important outcome is that you’ve become an experienced researcher and a good learner. This process involves understanding your weaknesses and your strengths, as well as experiencing successes and (a few) failures. In addition, it is a part of research to feel like the final product could be improved. This awareness sets the stage for more research and more learning. Completing your master’s degree conveys to the world that you are ready to take on a life’s work of meaningful research.


You likely came to graduate school with high expectations of yourself. However, these expectations can be unrealistic, and even dangerous to your health. Being a successful student means knowing when to push yourself, but also knowing when to give yourself a break. Looking after your health, happiness, and self-esteem is essential not only to your success as a graduate student but also to your life outside of school. If you don’t take ongoing care of physical, mental, and emotional needs, these needs will compound, and burnout will eventually stop you in your tracks.

At different stages of your degree, isolation can also become an issue. It is easy to get cut off from the world and stuck in your own cozy hole with your data. But data are poor company in the long run. Make sure you keep connecting with the world in ways that work for you (e.g., making time for friends, family, other grad students).

Mental health is a huge issue in universities. Your university likely offers a range of resources to help you address your human needs, such as counseling services or physical recreation programs. It is helpful to seek out social experiences that are separate from your work life. We have found things like exercise and taking frequent breaks to be life savers. Take advantage of these resources; they are there for you.

Closing Thoughts and Take-Aways

There are a few final pieces of advice we would like to pass on from our experiences as master’s students:

- Get enough sleep. If you aren’t sleeping, you aren’t producing good work, and you will end up burning out.
- Back up your data—twice.
- Whenever there is free food and/or coffee, take it.
- Have fun. Keep your passion for your research going by finding joy in your work.
- Back up your data a third time.

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INTRODUCTION:
BONES AND CHROMOSOMES:
THE ANCIENT DNA REVOLUTION IN ARCHAEOLOGY (PART 2)

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Our special section is the second of a two-part series entitled “Bones and Chromosomes: The Ancient DNA Revolution in Archaeology,” Part 2 contains a series of insightful case studies that demonstrate the scope of ancient DNA research in archaeology today.

Elizabeth Matisoo-Smith reflects on her 30-year career working across the Pacific region and describes how she dealt with the ethical issues of anthropological genetic research. In their article focused on the Arctic region, Justin Tackney and Jennifer Raff address similar issues while evaluating the successes and failures of scientists to engage with Indigenous communities. Maria Nieves-Colón provides the final geographically focused contribution, a summary of ancient DNA research across the Caribbean.

Katherine Brunson offers a departure from the region-specific chapters to demonstrate how zooarchaeologists can benefit from archaeogenetics and vice versa. Keolu Fox shifts his perspective to the future, speculating about the unintended consequences of the modern “bone rush” and offering a positive outlook for the future of the field. Finally, Miguel Vilar closes our special section with a thoughtful look at the history of the Genographic Project, including current efforts by the National Geographic Society focused on ethically conscious, cutting-edge science.
t has been more than 30 years since the publication of Cann, Stoneking, and Wilson's paper on mitochondrial DNA and human evolution (Cann et al. 1987), which was arguably the start of the use of DNA to address questions about modern human migrations and expansion across the globe. Much has happened in those 30+ years, perhaps most notably the significant technological advances allowing for ancient DNA (aDNA) analyses and the development of second-generation sequencing technology. We are already seeing the value of large-scale aDNA studies for addressing questions about the human past. As a scientist, I see the possibilities of these new technologies for aDNA analyses and what genomic variation can tell us about human history. But before we rush to seize these opportunities for sequencing ancient genomes, it might be prudent to think about some key questions, the first of which might be, Have we not been here before?

Understanding human variation and reconstructing the history of human migrations was one of the main goals of the Human Genome Diversity Project (HGDP) proposed by Luca Cavalli-Sforza and Allan Wilson in the early 1990s. This project was, as is well known, the topic of serious debates regarding ethics and working with indigenous communities. As a result, the fieldwork component never got off the ground. In 2005 National Geographic's Genographic Project was announced, with many of the same goals as the HGDP. Though not without its own critics regarding engagement with indigenous communities (Reardon and TallBear 2012; TallBear 2007), there have been successes and examples of true engagement and community support for the research (Nagle et al. 2017; Sandoval et al. 2013; Schurr et al. 2011; Schurr et al. 2012). We are now at a point where some are proposing similar global-scale studies using aDNA—suggesting the creation of “an ancient DNA atlas of human diversity past and present, sampled densely through time and space” (Reich 2018). Given this history and these new “opportunities,” we might ask the following question: Are aDNA studies subject to the same ethical regulations as studies of modern populations? Some might think not, for how can we obtain consent from ancient remains? Who has the right to speak for the samples when recent aDNA studies have “shown” examples of near complete replacement of populations over time? How can we determine who the direct ancestors are without aDNA analyses?

I have been working through many of the ethical issues of anthropological genetic research during my 30-year career working in Aotearoa New Zealand and across the wider Pacific region, including as an investigator with the Genographic Project. I am contributing this paper in the hope that my experiences might help researchers understand some of the concerns of indigenous communities, but perhaps more importantly to demonstrate that true engagement with indigenous communities can actually be mutually beneficial and will impact the research in a range of positive ways.

A Pacific Perspective

Working in Aotearoa New Zealand means that legally and ethically researchers must work under the regulations outlined in the Treaty of Waitangi, the founding governing document of New Zealand, where the principles of partnership with Māori, the indigenous population, are explicit. As a result of decades of debate, discussion, and protest by Māori demanding that the government honour the Treaty, we have now reached a point where major government funding agencies, like the Health Research Council, have very clear guidelines regarding the importance of consultation, consent, partnership, and benefit sharing. Funding decisions are made based on the evidence of consultation and engagement. Māori have been engaged with genetic research and researchers for many years, and there are several excellent papers written by Māori col-
leagues providing information that is very useful for assisting those interested in undertaking genetic research in Aotearoa New Zealand (see, for example, Hudson et al. 2016). Many of the concerns expressed by Māori are shared by other indigenous groups, but working with indigenous communities also requires understanding the specifics of those cultures to appreciate why communities have such concerns and how that might impact the way that you do research.

Consultation

When I started my research career in the late 1980s, there was an increasing unease amongst Māori and other Pacific communities with biological research in general and a distinct mistrust of genetic research. So, while I was excited by the potential of the application of mtDNA research for reconstructing human migrations, it was clear to me that undertaking such research with Māori and Pacific peoples, at that time, was not going to be possible. Instead, I developed an alternative approach, using the mtDNA variation of the animals that the initial Pacific colonists transported in their canoes as a proxy for tracking voyages of colonisation. While this approach meant that I did not have to obtain Human Subjects Ethics approvals, I quickly learned that it did not mean that I did not have to consult. In fact, given the Treaty of Waitangi, and a Treaty Claim known as WA1262 lodged in 1991, I was required to consult with Māori as they had recognised ownership over native flora and fauna (Geismar 2013), including the Pacific rat (*Rattus exulans*), the animal I first intended to study (Figure 1). In undertaking this consultation, I learned much about differences in world view and also about the concerns Māori and many indigenous communities have about genetic research in general.

Respect for the communities with whom you want to work is perhaps the most obvious requirement for consultation and engagement, and that is probably first demonstrated by showing respect for the language and culture. This extends beyond translating information sheets and consent forms into the local languages. Different cultures have very different attitudes towards blood, hair, bone, or other tissues; about death, relationships with the dead, and the treatment of human remains; and different connections to land, place, and other living organisms. These different views have to be acknowledged and respected through the entire process of a project, from project design to sample processing to interpretation of data and publication and dissemination of results.

Consultation requires a significant period of time—people need time to consider the wider implications of research requests and may need time to reach a consensus. Consultation is not a one-off process, but a constant, ongoing discussion that occurs as the research develops and as results are obtained. Topics for discussion might include: Who would have access to samples and to data generated? Where will samples and data be stored and what exactly will be returned to the community, when? How might the community be involved in the interpretation of results and how will the results be reported both to the community and to the wider public? These types of discussions ideally need to take place face to face, which, again, is a sign of respect. Obviously, both face-to-face meetings and the answers to the various questions may have financial implications, which must be taken into consideration when establishing a research budget. So, starting consultation early, prior to writing a grant application, is highly recommended.

Engagement

Being engaged during the research planning means that a community is more likely to be engaged throughout the project, which can ultimately lead to better research design and interpretation of results. It was through my work on mtDNA variation in Pacific rats that I got to first establish relationships with numerous communities across the Pacific. While I was beginning to establish relationships with particular iwi, or tribal groups, in Aotearoa New Zealand, I also began trapping rats elsewhere in the Pacific, starting with French Polynesia. When I went to work there, I contacted government officials to get the right visas and permits. I contacted local mayors or other officials to make contacts with land owners. Land owners kindly let me have access to their gardens and pineapple fields to trap rats. When I finished my research, I sent copies of reports and published papers to the appropriate govern-
ment officials. I had done everything that I was required to do from an administrative perspective. But, sadly, I expect few of the people on whose land I sampled ever really understood what I was doing. I was just the rat lady (Figure 1), another foreign scientist doing some strange “research” on their land, and yet I was studying their history.

When I began to work in Papua New Guinea (PNG), I learned the value of community engagement and how much this actually added to the research. I first went to PNG with a close colleague, an archaeologist who has worked there for decades. Archaeologists in the Pacific have to have good relationships with communities. Generally, they are not going to be able to excavate unless there has been real community consultation. The amount of time necessary to undertake archaeological fieldwork is significant; you can’t just fly in and fly out. Locals are hired to work on the site with the archaeologists, and the research team lives within the community. There is a lot of time available to talk about what you are doing and how and why you are doing it. We would give community talks and lectures at local schools about the history of the Pacific and about science and the research we were doing. Unlike my previous work in French Polynesia, the community got involved with the rat trapping, bringing me fresh rats every morning. They started doing dissections and quickly learned to identify different species. They actually became engaged stakeholders in the research and thus became engaged with the results. It was through this research on Pacific animals that I slowly established relationships, and these eventually led to requests from communities to study their own DNA.

After working with a particular island community in PNG for several field seasons, doing both rat trapping and archaeological research, I was approached one day by some of the women who asked me: Why don’t you look at our DNA and see if it says the same thing that the rat DNA is telling you about Pacific migrations? They also wanted to know if their mtDNA would provide information that was consistent with their genealogical links to founding matrilineal clans. That was 2007, about the time that I was first approached to join the Genographic Project to engage with Pacific communities (Figures 2–3).

I must admit that at first, I was skeptical about the possibility of undertaking human genetic research with Pacific communities, but given the conversations that I had had in PNG I thought that it might just be the right time. So, in 2008, I joined Genographic and returned to the community I had been working with. I spent one field season collecting cheek swabs and genealogical data, including, at the request of the community, clan affiliations, and returned the following year with the results of our mtDNA and Y chromosome studies. I explained the results and talked them through with the community and with individuals (Figures 2 and 3). Having their feedback helped to explain some of the unusual results we obtained, linking some rare lineages to the migration of women from a distant island that had occurred several gen-
erations beyond the genealogical information I collected. I realised the value of such consultation and discussion for the science as well as for the community. They understood the results—what they meant, and perhaps more importantly, what they did not mean. I was able to explain, for example, why the results could not be used for land claims. This kind of information cannot be obtained from just reading a publication sent back to a community.

Throughout my work collecting modern DNA samples across the Pacific, I have found that collaborating with archaeologists in the field is also valuable, as it allows us to engage in discussions with the communities regarding the possible analysis of ancient DNA when and if any human or animal remains are discovered during excavation. Those decisions were always in the hands of the communities and we could never tell what they might decide. When I was working in Tokelau, the community on one of the atolls wanted ancient DNA analyses done on archaeological remains recovered during excavation and had some very specific questions that they wanted answered. On the neighbouring atoll, the community wanted any recovered human remains reburied immediately in the local cemetery.

Community-Specific Processes and Protocols

Every community I have worked with is unique and thus there are no blanket protocols or rules to follow for community consultation and engagement in genetic and genomic studies. Processes and protocols need to be determined in consultation with the community. However, it may be useful to discuss here some of the concepts and protocols we must consider when undertaking any genetic research with human tissues, modern or ancient, in Aotearoa New Zealand. As a non-Māori researcher, not fluent in te reo Māori, I do not profess to fully understand tikanga and kawa (Māori values and protocols), but I acknowledge and respect the concepts and the strong beliefs behind them. I try my best to adhere to the correct protocols as they have been described to me, and I am guided by Māori advisors and colleagues.

One of the most important concepts and values for Māori and many Pacific peoples is that of genealogical descent or, in the case of Māori, whakapapa. Whakapapa is often described as oral genealogy, but it has a much broader meaning as “a way of knowing, of locating a person or a thing in time and space” in which “there is no disjunction between the spiritual and material worlds” (Roberts et al. 2004). Whakapapa is not the same thing as genetic ancestry. Genetic ancestry may be part of whakapapa but is not a necessary part. Māori and Pacific knowledge of whakapapa is incredibly valuable when collecting genealogical information for genetic studies, but it also means that there is a direct connection to ancestors and to ancestral lands which may not necessarily reflect an identified genetic connection. Human remains or any human tissues, even if not identifiable to a particular person, are the physical manifestation of whakapapa.

In Aotearoa New Zealand, whenever human remains are discovered, as a result of an excavation or by natural processes, we are required to contact the police and local iwi, or tribal representatives. If it is determined that the remains are pre-European Māori, all decisions as to what happens to those remains is in the hands of the local iwi and hapā (tribe and sub-tribe), and this includes whether any research may be conducted. My colleagues and I are finding that we are getting an increasing number of requests from iwi for biological analyses including, in some cases, destructive analyses such as DNA or isotope studies. This increased interest, I believe, is due to the awareness on both sides of the potential value of collaborative research between researchers and iwi. This change has come about slowly as relationships and trust have been developed and as power relationships between researchers and communities have shifted.

Practical Considerations for Working with Human Tissue

If decisions for further analyses are made by iwi, there are important concepts and protocols that need to be considered in the transport, storage, processing, and disposal of samples and derived sub-samples, including DNA data. The same goes for circumstances when you are working with fresh tissues or DNA samples.

Two key concepts to understand when working with any tissue, modern or ancient, in Aotearoa New Zealand and much of the Pacific are those of tapu and noa, sometimes defined as sacred and profane. Any human tissue or any locations where human tissues are present are considered tapu. This includes burial sites, the places where human bones are stored in a university or a museum, and the labs that are working on ancient tissues. At the University of Otago, we have a recognised wāhi tapu, or a sacred space, within the Anatomy Department that has been blessed and is recognised as an appropriate storage space for human remains. When our ancient DNA lab was constructed, before it was open for use, we also had the space blessed by local iwi representatives as well as those whose tupuna (ancestors) were being studied. This was done to make sure that the space was safe, both for their tupuna and, because of the whakapapa links, for the descendant communities. They were also, however, making it safe for those of us who would be studying the remains.
Iwi representatives are always welcome to visit our labs and facilities to see where the samples are stored and where they will be studied—this provides reassurance that proper protocols are being followed.

Handling human tissue brings with it a state of tapu. Tapu can be removed or reduced through water—washing of the hands and sprinkling water over the head and body. In doing so, the person returns to the state of noa, or a normal, safe state. Ideally, these protocols are followed and water is available in any area where human remains may be kept.

We make every attempt to adhere to Māori protocols when working with human tissues and remains, from the time that they are collected in the field to the point of return or destruction of the sample. This often includes the promise to provide a karakia or prayer prior to the final destruction or disposal of any human tissues or DNA samples.

Tissue, be it bones or DNA samples, is a taonga, or a treasure, something precious and significant. When provided for research, it is on loan to the researchers but does not belong to them. So, requests from collaborators to send samples overseas present some significant problems. Some communities that I work with are not comfortable with the concept of posting samples overseas and we have agreed that, when possible, all sample processing should be done here. It is not impossible for ancient or modern DNA samples collected from Māori to be sent overseas, but it does require informed consent and may require special arrangements such as someone from the iwi accompanying samples.

**New Opportunities and Future Research**

While most of my work has focused on reconstructing past migration pathways, I have found that many communities are more interested in the future and how any genetic evidence we might find from our work will help to address health or economic issues that their families and communities face. In the past, we focused almost exclusively on mtDNA for both ancient and modern DNA studies, so there was little that we could contribute to understanding or addressing the health issues facing Pacific peoples. There was also less of a concern about what people might be able to do with the mtDNA data. With the recent developments allowing for whole genome data to be obtained from both modern and ancient samples, there are new opportunities for our research to address health issues, but these opportunities also generate new concerns that require new and different discussions between researchers and communities. In some cases, this may mean that researchers have to obtain new consents to use previously collected samples, but if relationships have been established and maintained, these discussions are always possible.

**Conclusion**

Many of the exciting developments in ancient DNA research to date have focused on population history in Europe. There has not been a significant issue regarding ethical approval or community engagement in working with most European skeletal material. As long as the appropriate permissions have been given by national museums or other government research agencies, research has been able to take place. Researchers and research projects in Europe may not be subject to the same regulations and requirements for community consultation and engagement that are necessary for those based in Aotearoa New Zealand. It has been pointed out to me more than once that there are plenty of opportunities for overseas researchers to access Māori and Pacific remains from overseas museums or collections. Other Pacific or developing countries may not have as many indigenous researchers involved in debates about the ethics of genetic and genomic research and indigenous rights and thus may not have established protocols for access to human remains for genetic studies. They may have more pressing issues to focus on. Ancient DNA researchers may see these as opportunities for access to samples, but I would argue that this is a short-term view and will result in long-term negative impacts for all researchers interested in understanding human history and diversity.

We have come so far in the last 30 years in terms of engagement, with both scientific and indigenous communities learning from each other. I believe this has resulted in more meaningful and relevant research and interpretations. While the recent technological advances are now opening up previously unimaginable opportunities for aDNA research to better understand human history and migration, who knows what questions we might be able to address in the future? Before we rush in, I suggest we pause and reflect on what we have learned about community engagement and consultation. I urge a cautious and conscientious approach where researchers work with indigenous communities in genetic research rather than working on samples, so that the benefits are shared and long term.

**References Cited**

BONES AND CHROMOSOMES: THE ANCIENT DNA REVOLUTION IN ARCHAEOLOGY (PART 2)

Geismar, Haidy


Anthropological research of Native Americans has a long history marked by many missteps. It is mainly for this reason that these First Peoples are historically under-represented in genomic studies (see Bolnick et al. 2016). Nevertheless, over the past decade we have participated in productive and fruitful human genetic research in the North American Arctic, in collaboration with Inuit, Iñupiat, and Aleut communities. The relative success of these projects can in part be traced back to investigator priorities, which emphasized that ethical and principled academic collaboration with human subjects needs to be sensitive to the concerns and perspectives of all parties. In this short discussion we wish to highlight what has led to these comparatively positive interactions, where we have seen ourselves and others fall short, how we currently see our role in the network of research collaboration, and which issues and concerns should be considered in future research.

Genetic Research in the Arctic

There is substantial genetic and archaeological evidence that present day Eskimo-Aleut speakers have components of their ancestry that are not shared with other Indigenous groups in North and South America, but are instead linked to Holocene-aged population expansions out of Beringia (Dryomov et al. 2015; Raghavan et al. 2014; Tackney et al. 2016). Our group has specialized in this region of prehistory.

With the support of the Ukpeagvik Iñupiat Corporation, their Senior Scientist Dr. Anne Jensen, the Barrow Senior Advisory Council, and the Native Village of Barrow, we genetically characterized Neo-Inuit Thule individuals buried at Nuvuk, Pt. Barrow, Alaska (Figure 1; Coltrain et al. 2016; Tackney 2016). Simultaneously, the Genetics of the Alaskan North Slope (GeANS) project was initiated in collaboration with each of the recognized communities of the North Slope—Atqasuk, Anaktuvuk Pass, Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright—for genetic ancestry identification (Raff et al. 2015). Further to the south, we identified potential source populations for the Aleut Archipelago by sampling ancient DNA (aDNA) from Alaskan remains near Port Moller, Brooks River, and Mink Island. This required outreach and consent from the Council of Katmai Descendants and the Native Village of Nelson Lagoon, as well as from federal entities—the National Park Service and the US Fish and Wildlife Service (Raff et al. 2010). Many of these projects were initiated by Dr. Dennis O’Rourke and Dr. M. Geoffrey Hayes, building upon earlier work on Neo-Inuit migrations into the Canadian Arctic (Hayes et al. 2003; Hayes et al. 2005), ancient Aleut population history (Smith et al. 2009), and contemporary Aleut genetic variation (Crawford et al. 2010). We maintain relationships with these communities, and continue to build upon these projects in our current research.

Figure 1. Dr. Justin Tackney collecting aDNA samples at Nuvuk, Pt. Barrow, Alaska.
Avenues of Success

We attribute our longstanding relationships with Indigenous communities in the Arctic to the research philosophy of our mentors, who taught and demonstrated ethical and principled practices in person, in the field, and in the laboratory. These principles are in line with those recently advocated by the SING (Summer Internship for Indigenous Peoples in Genomics) consortium as best practices for working with Indigenous communities. These include a set of guiding questions researchers could ask themselves before initiating a project (Bardill et al. 2018) and a research framework that includes understanding existing local regulations and sovereignties (in addition to those recognized at the federal or state level), building cultural competency, improving study transparency, and disseminating findings in a community-accessible format (Claw et al. 2018). We acknowledge the long-standing literature and discussion of community/participatory/public archaeology (Colwell 2016), and we offer here a unique perspective from our own genetic and paleogenomic studies with Indigenous communities.

There are five principles that steer each of our research projects involving ancestral remains or living peoples. The first is to arrive at an understanding of the questions Indigenous communities wish to pursue with genetic research, both in reference to themselves and in reference to any human remains under their purview. These questions might be quite different from those we ourselves had when we first conceived and planned the project. After discussion, if the research aims are mutually compatible, and if everyone understands the potential repercussions of the answers, then and only then do we initiate genetic study. For example, in the discussions with community leaders about questions we might address in one project, we were explicitly told to avoid any health-related genetic research. Given the vast amount of genetic data provided by newer technical methods, this directive had long-term effects for any future use of the collected sequence/genotype data, and dictated the way in which we designed our projects.

The second principle is intimately related to the first: we never sample or initiate an extraction of modern or aDNA without prior consultation and a memorandum of agreement that specifies how samples will be collected and manipulated, what kinds of analyses will be done, how data are to be stored, details on return of unused molecular samples, and how the community wishes to be informed of (or involved in) the project’s progress. If we want to use previously obtained genetic samples for a new study, we go back and begin consultation again if there is no provision for additional research in the agreement or if the agreement was formalized many years ago. Such consultation would be best practice, but sometimes it is not legally required. In situations where third parties provided human remains, we do our due diligence to make sure all relevant parties are contacted and consulted on our proposed research. And in situations where we ourselves are doing the sampling, the project is never submitted for funding until all consultations are completed. This process takes time and patience, but helps us avoid inadvertently harming our community partners. For example, in one situation, we knew that the genetic results we would obtain could potentially be used by museums in assessing repatriation claims of additional human remains by descendant communities. We needed to make sure prior to the initiation of research that everyone understood that the results and their interpretation might be used against the community’s self-interest. The community decided that the research was worth the risk involved, and the project was approved.

We spend the time and money long before a project is initiated to interact with the local communities and develop ideas in partnership with them. At bare minimum, this requires in-person visits to the communities and a significant amount of correspondence and phone calls. During the course of a project, we aspire to include local participants when possible. In our opinion, a phenomenal example of this is Dr. Anne Jensen’s community-driven Nuvuk Archaeology Project, initiated in 2005 (Jensen 2012). We were fortunate to be invited into an active archaeological site that had the approval of community Elders and the participation of high school students in the excavation and study of their own ancestors. Active research participation, such as in the Nuvuk project, is just one example of the diverse ways in which stakeholders contribute. In some projects we have been involved in, community members were interested in simply being briefed about the results of the project at regular intervals, or at the end of the research. In others, they wished to help with interpretation of results, offering important Indigenous knowledge to strengthen the final publication. Finding out how a community wishes to participate, rather than making assumptions or dictating it based on what is convenient for the researcher, is critical to developing a true partnership.

We also aim to break down the dichotomy between Indigenous subjects and outsider scientists so common to scientific research. This is a very long-term endeavor, and we are not always successful, but we support the efforts of programs like SING (of which Jennifer A. Raff is a faculty alumna) to build capacity among Indigenous communities for genetic research. Efforts like these are critical in encouraging Indigenous students wishing to become genetic researchers, supporting communities’ efforts to develop their technical knowledge, and empowering communities to make more informed decisions about study participation.

Lastly, we attempt to present all our findings in a culturally informed way, respectful of how they might be interpreted.
Here we rely strongly on our local community member connections and on the archaeologists or cultural anthropologists with whom we collaborate. We try to visit communities following each project’s completion (but prior to publication) to present results and seek feedback.

**How Interactions Can and Do Go Wrong**

We have observed several recent situations either firsthand, in the literature, or in the press, where interactions with Indigenous communities of the Americas went poorly. Modern and aDNA research that is not anthropologically informed can be scientifically careless, and if it is not done with sensitivity to stakeholders’ concerns, it can be harmful to communities. Harm understandably erodes trust, and this erosion can impact the work of colleagues and the long-term health of the discipline. For example, the case of Kennewick Man (also known as The Ancient One) pitted scientists against Indigenous communities in a years-long legal battle about who had the right to determine whether or not his remains were scientifically studied. The resulting legal decision that permitted scientists to study the remains resulted in invaluable insights into his life and that of peoples living 9,000 years ago, but the research came at the expense of harm to the descendant communities and to relationships between Indigenous and scientific communities (Bardill et al. 2018; Bolnick et al. 2016; Claw et al. 2018). In our geographic region of interest, the 1979 Barrow Alcohol Study was a seminal example of insensitive anthropological research resulting in harms done to Iñupiat communities. While initiated to accumulate data on alcohol abuse in the North Slope Borough, in the hopes of creating effective programs to reduce mortality, it has negatively influenced perceptions of scientific research ever since. In addition to numerous methodological concerns (unacknowledged at the beginning of the study, and highlighted in formal academic responses afterwards), the resulting insensitive press (released before local community input) distressed the communities, and the data gathered lent no tangible benefit to alcohol prevention or intervention programs in Barrow (Balestrery 2010).

An area in which we ourselves have recently needed to grow is an understanding of the use of communities’ preferred terminology for themselves. We all too often have relied on archaeological designations to name genetic groups (a recent analysis of this practice can be found in Eisenmann et al. 2018), but we have done a poor job of recognizing some of the potentially political or cultural implications of our naming conventions. The use of “Eskimo” as a blanket term to describe all Indigenous communities in the Arctic, both past and present, continues to this day. We note that this example in particular is extremely widespread (likely due to unawareness on the part of scientists) and is considered extremely problematic by many Arctic communities. Archaeological traditions in the Arctic continue to be widely referred to in the literature as “Neo-Eskimo” and “Paleo-Eskimo,” despite calls for the use of the more culturally appropriate terms “Inuit” (or “Neo-Inuit”) and “Paleo-Inuit” (Friesen 2015). Similarly, the widely used terms “Native Americans” and “First Americans” should not be used without an awareness of their political implications (Bolnick et al. 2016). Indigenous colleagues have suggested the substitution of “First Peoples,” as this does not impose a colonizing nation-state retroactively onto past populations, and we intend to adopt this in our communications.

Finally, we observe that disregard for (or ignorance of) existing Indigenous scientific knowledge is distressingly common in paleogenomics research. It has been our experience that consulting with Indigenous communities, both during study design and in the interpretation of results, has strengthened our research. For example, our 2015 paper on North Slope Iñupiat communities benefited from discussions with community members, who suggested explanations for patterns of lineage-sharing between villages and contributed linguistic knowledge to help interpret observed FST results (Raff et al. 2015). One way to encourage this practice would be to develop a formal method for citing Indigenous knowledge, nonacademic research partners, and informal insights in publications (Milligan-Myhre 2018, Twitter).
The Role of the Anthropological Geneticist

Research with human participants is inherently complex, and genetic study in the Americas has had a checkered past. In our specific field of paleogenomics, for example, ethical best practices haven’t kept up with the pace of research (Bardill et al. 2018). Samples from “unaffiliated” human remains are occasionally still collected and analyzed with museum approval, but without any Indigenous consultation or acknowledgment. While situations like these might be following the letter of the law, they are not following the spirit of collaborative research. Even when legal custody lies with the museum, and even if the museum is not obligated to engage in consultation, the researcher should be. If not, these approaches can grow into bigger controversies, resulting in harm to communities and making future genetic research harder for everyone involved. Involving a more diverse pool of people earlier in the process would help.

Because of their multidisciplinary training, anthropological geneticists are well positioned to serve as the point of connection between population geneticists, Indigenous communities, museums, and archaeologists (Figure 2). A background in anthropology can provide the necessary appreciation of cultural diversity and archaeological knowledge that might be lacking in the more typical biological or human genetics programs. In much the same way as genetic counselors are playing an integral role in merging genetic test results with physician diagnoses and patient comprehension, anthropological geneticists can connect different specialists to address complex problems of human population history. Indeed, the history of the discipline in the United States and the national framework of academic funding has led to many aDNA or nonmedical human population genetics projects taking place in anthropology departments.

We do not, however, wish to imply that anthropological geneticists need to be gatekeepers of all nonmedical human genetic research. We have entered projects at all stages, and therefore have experienced collaboration in multiple ways. Most often we have relied on archaeologist-driven projects. One of our recent collaborations was with Dr. Ben Potter at the significant and Indigenous community input.

Tanana Chiefs Conference and the local community, his assurance of the community’s support for the research, and the documentation of this support.

As another example, we are currently in the initial stages of developing an aDNA project at the request of the leadership of an Indigenous group. A representative of the community approached us and already had conceived of potential research questions of interest. We are currently engaged in dialogue between community representatives, archaeologists from multiple institutions, and potential funding agencies, to shape the outlines of the project: which questions will be researched, how we would conduct sampling of the remains, and how the community wishes to be involved in the process. In this case, we are leading project development, but relying heavily on archaeological and Indigenous community input.

Paths Forward

There is an uneasy balance in conducting both large-scale and ethical paleogenomics research in today’s competitive, fast-paced research environment. As discussed above, there are examples of exploitative practices in the history of this research that have resulted in an understandable distrust of researchers by many Indigenous communities. We draw upon our experiences working in the Arctic to offer some suggestions for future approaches.

We have found thinking smaller, rather than thinking bigger, to be a productive path forward. This is not meant to imply that one should suppress the research connections, or the broader impacts of the results, or the influence on important hypotheses in the field. Instead, it is meant to promote a focus on the humans being studied (ancient or contemporary), their own unique significance, and how the results speak to their own histories. What specifically happened in this village, at this time point, with these deceased individuals, and how these individuals relate to the people that came before and after, is a better way of presenting research, than “these are sample IDs #102–145 in a greater project concerning human migrations.” Over-promising the benefits of a study or undermining the sovereignty of Indigenous communities with an imposed narrative is usually not as well received as a desire to understand what happened within the community’s own backyard.

Another path to successful, ethical paleogenomics research is through collaborations between multiple smaller groups, each with their own specialty and connections to the community. We emphasize “small” because in our experience smaller research groups more frequently have long-term, more collaborative relationships with communities and can advocate for their concerns and interests when they aren’t active partici-
pants. One reason is that these groups by necessity maintain a smaller number of active projects at one time, while larger groups run the risk of turning into assembly-line production houses. The best results in recent paleogenomics research have emerged from a process where interdisciplinary team members are carefully chosen to reflect a wide diversity of expertise and perspectives, all authors are involved early in the research process rather than “tacked on” to a paper at the end, and weight is given to all contributions. It is becoming untenable for one group of similarly trained scientists to successfully and ethically cover all bases of a genomic-scale study that involves human populations.

As highlighted earlier with regard to consent and involving the communities from which genetic samples originate, we encourage all people wishing to conduct genetic research with Indigenous communities to read a pair of papers (Bardill et al. 2018; Claw et al. 2018) authored by the SING Consortium. These outline Indigenous-recommended frameworks for consultation, collaboration, and capacity building. We additionally all need to be reminded that long-term relationships don’t end with data collection, or even publication. We need to make more effort in information dissemination and engagement, in a community-appropriate or requested manner, after project completion.

Finally, we encourage researchers to avoid fixating on any single genome as the key to unlocking the secrets of the past. The history of genetics research in the Americas has shown us that there is more to be gained from the careful accumulation of data through anthropologically informed, long-term studies than from the blind pursuit of the oldest genomes for their own sake. Researchers should not look for reasons to avoid asking for permission simply because it may result in a negative response. Be prepared and comfortable with walking away unless you are certain all parties involved have given consent to all aspects of the research. At the heart of collaborative research is the commitment to open dialogue with stakeholders and the willingness to risk hearing—and respecting—“no.” Awareness of and respect for the complex perspectives and issues surrounding research on deceased people, and with their living cultural or biological descendants, will ensure the long-term success of our discipline.

References Cited


BONES AND CHROMOSOMES: THE ANCIENT DNA REVOLUTION IN ARCHAEOLOGY (PART 2)

Milligan-Myhre, Kat (@Napaaqtuk) 2018 "I would love to see a standard citation along the lines of "Name, tribe, year discussed" if the person is willing to be referenced, or at least "tribe, year" if the tribe is OK being referenced. Best to ask at both the personal and tribal levels." Twitter, August 16, 2018. https://twitter.com/Napaaqtuk/status/103017897872508928


Tackney, Justin 2016 Arctic Prehistory through Ancient DNA. PhD dissertation, Anthropology, University of Utah, Salt Lake City.


Asian Perspectives: The Journal of Archaeology for Asia and the Pacific
Editors: Mike T. Carson, University of Guam and Rowan Flad, Harvard University
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ANCIENT DNA AND CARIBBEAN ARCHAEOLOGY

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The Caribbean islands form an arc-shaped archipelago that extends across the Caribbean Sea. They are divided into three major groups: the Greater Antilles, the Lesser Antilles, and the Bahamas (Figure 1). Although this is a small region geographically, it has a rich history of human dispersal beginning with its initial settlement during the early Holocene and continuing through the Columbian encounter, European colonization, and the Transatlantic Slave Trade. Despite a long tradition of archaeological research, there is still much we do not know about the peoples who have called it home.

At present, the consensus view is that humans first reached the islands approximately 7,000 years ago, but the origins of these first migrants and the exact routes they took on their voyage(s) are still debated. We also know that over time island communities developed local artistic and technological industries and set up expansive interaction networks. But we are still investigating how these people dealt with the challenges of island life, how they adapted to the surrounding ecology, how mobile they were, and what diseases afflicted them, among other questions (Fitzpatrick 2015). In addition, the fate of Indigenous communities after contact and colonization,

Figure 1. Map of the Caribbean highlighting islands where aDNA has been recovered from archaeological human skeletal remains. Green = Published report, Orange = In progress, unpublished. 1) Cuba, 2) Eleuthera Island, Bahamas, 3) Hispaniola, 4) Puerto Rico, 5) St. Martin, 6) Guadeloupe.
the nature of their interactions with postcontact migrants, and their contribution to the ancestry of contemporary islanders remain active areas of research (Benn-Torres 2014). When interpreted within the context of other lines of evidence, ancient DNA (aDNA) can inform some of these questions, test existing hypotheses, and pose new directions for future inquiry.

Ancient DNA and Caribbean Population History
In Caribbean archaeology there is a strong focus on answering big picture questions about human migration and population history, many of which can be enriched by the integration of genetic data. For instance, questions remain unanswered regarding how, when, and from where came the first people who settled the Antilles, as well as the scale of subsequent movements both between islands and from the continental circum-Caribbean. The archaeological record indicates that humans first arrived in the Antilles approximately 7,000–5,500 years before present (YBP). It is unclear whether these populations (varyingly called Archaic, Pre-Arawak, or Pre-Ceramic, despite having some pottery and small-scale agriculture) originated in Central America, the Isthmo-Colombian region, South America, or even all three; and whether they entered the Caribbean in one or multiple waves. By approximately 2,500 YBP, the appearance of elaborate pottery and intensified agriculture indicate that a new group of peoples entered the Antilles. These populations likely originated among the Arawak-speaking cultures of the Orinoco River basin, in present-day Venezuela and northeast Colombia. Their arrival marks the beginning of the Caribbean Ceramic Age. Although it was initially thought that these migrants displaced preexisting populations, more recent archaeological evidence suggests both groups may have contributed to the ancestry of Late Ceramic Age (LCA) populations who expanded and diversified throughout the archipelago after 1,500 YBP. Material and isotopic evidence suggest that inter-island interaction, trade, and mobility expanded during the LCA, but the role of genetic exchange in establishing and maintaining these networks is currently unknown. By the time of European contact in the fifteenth century, the Caribbean had become a pluralistic region where multiple ethnic groups, including the Taino, coexisted (Figure 2; Fitzpatrick 2015; Wilson 2007).

Ancient DNA has the potential to address many gaps in our knowledge of Caribbean precontact history. But the warm and humid tropical climate hinders skeletal and DNA preservation. DNA degrades quickly after death, exponentially decaying into small, degraded fragments and becoming very susceptible to external contamination. This process is accelerated in environments with large temperature fluctuations and high precipitation, such as the tropics. For this reason, most aDNA studies have historically focused on small but informative fragments of mitochondrial DNA (mtDNA). MtDNA is the maternally inherited genome found in the mitochondria of eukaryotic cells. Since mitochondria are present in many copies per cell, mtDNA is more likely to be preserved in ancient, degraded tissues than autosomal DNA, which is present in just one copy in the cell nucleus. However, recent improvements in aDNA extraction and processing methods, and the use of next-generation sequencing technologies, now allow for recovery of complete mitochondrial genomes and at least partial autosomal genome data from extremely degraded samples (Hofreiter et al. 2015).

Nevertheless, suitable samples for aDNA research are scarce in Caribbean archaeological contexts. The warm climate and acidic soils of most precontact sites results in extensive taphonomic damage and poor macroscopic preservation. This limits sampling strategies to whatever bony elements are available and precludes careful selection of elements known to contain the most genetic material (such as the petrous portion of the temporal bone). Geographic and temporal...
coverage is also spotty. Very few remains dating to the early occupation periods have survived or are available for destructive analysis. Thus, most bioarchaeological and aDNA research necessarily focuses on the LCA, which has a more extensive skeletal record.

Because of the poor preservation and the paucity of available remains, more research has been conducted examining precontact population history by characterizing the genomes of contemporary islanders than those of ancient peoples (Martínez-Cruzado et al. 2005; Moreno-Estrada et al. 2013). Overall, these studies have found that modern Caribbean populations retain varying proportions of Native American, African, European, and sometimes Asian ancestry. These patterns differ across islands, are highly sex-biased, and reflect recent postcontact demographic dynamics. But, by examining the Native American segments present in these modern genomes, researchers have partially reconstructed the genetic diversity of ancient Caribbean groups, traced precontact migration routes, and identified instances of ancient gene flow (Moreno-Estrada et al. 2013).

Unfortunately, using modern genomes to reconstruct ancient population processes is problematic because contemporary populations may not retain all the genomic diversity of ancient groups. Evolutionary forces such as genetic drift and natural selection affect lineage survival, and population replacements can mask ancient genetic signals. The latter problem is especially relevant in the Caribbean where a recent history of colonialism, slavery, and migration led to extensive genetic admixture between populations from several continents (Moreno-Estrada et al. 2013). Thus, aDNA, even if it is harder to obtain, is the most direct way to characterize precontact genetic variation.

Ancient DNA has been recovered from human skeletal remains excavated at several precontact Caribbean sites. The earliest studies, which were conducted before the advent of next-generation sequencing, recovered partial mtDNA fragments from individuals attributed to the Ciboney/Guanahtabey and Taino cultures of Cuba and Hispaniola, respectively (Lalueza-Fox et al. 2001; Lalueza-Fox et al. 2003). However, due to the scarcity of available remains and insufficient DNA preservation these studies obtained data from a very small number of individuals that were separated by over 1,000 years. More recently, partial mtDNA data was also obtained from a few individuals excavated at several LCA sites in Guadeloupe (Mendisco et al. 2015). With the advent of next-generation sequencing, higher resolution, genomic-scale data have been obtained from other precontact Caribbean contexts. In 2018, one full autosomal genome was recovered from the remains of a woman buried at a Lucayan Taino cave site in the Bahamas (Schroeder et al. 2018); and additional research is currently ongoing with complete mtDNA genome data obtained from human skeletons excavated at three LCA sites in Puerto Rico (Nieves-Colón et al. 2016).

Taken together, these studies suggest that precontact Caribbean populations are genetically most closely related to modern South American Indigenous groups. This is consistent with archaeological evidence that supports multiple dispersals from South America into the Antilles during the precontact era. Interestingly, the closest affinities reported so far are not with coastal South American populations, but with more inland groups, which suggests that ancient migrants may have traveled along riverine systems such as the Orinoco to enter the Caribbean (Mendisco et al. 2015). Although archaeological and modern genetic evidence also suggest a possible ancient connection with Mesoamerica or the Isthmo-Colombian region, the aDNA data recovered so far can neither support nor exclude this possibility.

Caribbean aDNA studies have also yielded evidence for genetic continuity between precontact populations and present-day islanders. For instance, Schroeder and colleagues (2018) found a close relationship between the Native American component of present-day Puerto Rican genomes and the ancient Lucayan Taino. In addition, most precontact communities sampled to date carry patterns of mtDNA diversity that are similar to those seen among present-day islanders with Native American mtDNA ancestry. However, not all lineages seen in the ancient populations are still present in modern groups. The Lucayan Taino individual, for instance, belonged to an mtDNA lineage that is rare in the Caribbean today and has not been found in other ancient individuals. Ongoing research in Puerto Rico has also identified multiple mtDNA lineages in the precontact population that are no longer present among modern Puerto Ricans. These differences likely reflect the drastic changes that occurred in Caribbean genetic diversity after European contact.

In addition to examining precontact population history, aDNA has also been used to enrich historical research into the postcontact Caribbean experience. For instance, little documentation exists describing the specific ethnic or geographic origins of the many Africans who were transported to the Caribbean during the Transatlantic Slave Trade. Thus, to complement historical and archaeological studies, partial autosomal genome data was obtained from the remains of three enslaved Africans buried on the island of Saint Martin (Schroeder et al. 2015). The individuals’ origins were traced to specific subcontinental regions within sub-Saharan Africa, such as the present-day nations of Ghana, Nigeria, and northern Cameroon. This finding has expanded our understanding of the Caribbe-
an slave trade and may guide future work characterizing the ancestry of afro-descendant peoples in the Antilles.

**Animal Ancient DNA**

Ancient DNA can also be used to refine faunal identifications, characterize the diversity of wild and domesticated species, and investigate potential domestication targets. In contrast to the relative rarity of human remains, faunal remains are often much more ubiquitous. Thus, animal aDNA studies can sample from a large number of individuals and, if preservation allows, recover DNA at a population scale. However, interpretation of ancient faunal DNA may be complicated by limited availability of reference data, especially if the organism is rare or extinct.

In the Caribbean, two aDNA studies have been conducted examining the genetic diversity of species that went extinct soon after human arrival. The first used aDNA to track the radiation of endemic oryzomyine rice rat species in the Lesser Antilles (Brace et al. 2015). The second characterized the mtDNA diversity of the Bahamian giant tortoise (*Chelonoidis albanyrorn*). The tortoise study was notable for being the first to successfully isolate aDNA from partially fossilized (also known as subfossil) remains found in a marine cavern (Kehlmaier et al. 2017). Both of these studies demonstrated that aDNA from wild species can contribute to the study of island biogeography and characterize human paleoecology and anthropogenic environmental impacts.

Animal aDNA has also been used to examine human mobility and interaction in the Antilles through the study of translocated fauna. This approach, known as the “commensal model,” relies on using organisms that cannot reach island systems without intervention as proxies for human movement. For instance, Kimura and colleagues (2016) used aDNA to trace the origin of guinea pig remains found in LCA trash middens in several Caribbean islands. The genetic data suggests the animals were initially introduced from Colombia into Puerto Rico and subsequently transported to the rest of the Antilles. This finding supports additional isotopic and archaeological evidence, which demonstrates that precontact Caribbean peoples established trading routes and interaction networks that spanned most of the archipelago and circum-Caribbean region.

**Ancient Health and Disease**

To better understand overall patterns of health and disease, the growing field of microbial archaeology uses aDNA to characterize the microorganisms that lived within ancient human bodies. For instance, studies that focus on identifying commensal microbes can track the evolution of the human microbiome by characterizing microbial diversity and function and identifying healthy patterns of microbe-host interaction. As with other aDNA studies, the largest obstacles to conducting research with ancient microbes are poor preservation and contamination, especially from the exogenous microorganisms that abound in the soil and other deposition contexts. For this reason, rigorous authentication measures are required to ensure that recovered microbial profiles correspond to the actual sample and do not stem from modern environmental sources.

Ancient microbiome research in the Caribbean has focused on sampling dental calculus and coprolites to characterize the oral and gut microbial diversity of precontact human groups (Cano et al. 2014; Santiago-Rodriguez et al. 2013; Santiago-Rodriguez et al. 2017). Two of these studies investigated whether differences in fecal microbial profiles could be used to distinguish between Ceramic Age groups with distinctive material cultures in eastern Puerto Rico. Through the use of microscopy, Cano and colleagues (2014) also detected the presence of enteric parasites, such as hookworms, whipworms, and pinworms in the coprolites. However, these studies were largely exploratory and limited to small sample sizes due to the rarity of well-preserved coprolites. More in-depth analyses of ancient Caribbean microbiomes will require larger sampling and implementation of strict authentication measures to rule out potential contamination from exogenous microbes.

Microbial archaeology approaches can also be used to detect and characterize ancient pathogens. Such research often focuses on identifying the etiological agents behind past epidemics, tracing the evolution of pathogenic species and exploring host-pathogen interactions. Unfortunately, detecting and isolating ancient pathogens can be very difficult. This is because pathogen DNA is usually very fragile and present in smaller proportions than the surrounding host DNA.

Due to these limitations, no successful attempts at recovering ancient pathogen genomes have yet been reported from the Caribbean. But integrating this approach into comprehensive bioarchaeological studies offers great potential for reconstructing ancient disease patterns and refining paleopathological diagnoses. For example, paleopathological evidence for treponemal disease has been reported for several precontact Caribbean sites (Santos et al. 2013). Confident diagnosis is challenging, though, because different treponemal subspecies can cause similar skeletal presentations. Nevertheless, the recent development of more sensitive screening and enrichment methods has facilitated pathogen detection and enabled recovery of even minute quantities of
Ancient DNA can inform a variety of debates within Caribbean archaeology, including outstanding questions about initial human settlement, paleo-mobility, paleoecology, migration, and ancient health and disease. As seen in this overview, most research to date has focused on characterizing the population history of precontact Caribbean communities. But some work has also examined more recent, postcontact histories. Despite the limitations imposed by the adverse preservation conditions of the tropics, methodological advances now make it feasible to obtain genomic-scale data from tropical Caribbean remains. However, the scarcity of well-preserved samples limits the temporal and geographic contexts wherein aDNA approaches can successfully be applied. In the future, Caribbean aDNA research may be able to address an even wider breadth of theory-driven questions at individual, site, or population scales. For example, at the individual level, molecular approaches could be used to identify the etiology of ancient pathological cases. At the site level, aDNA could be used to identify relatives among commingled burials. At the population level, diachronic sampling of large subfossil assemblages could be used to investigate the effects of anthropogenic climate change on populations of island fauna. However, these and other insights gleaned from ancient Caribbean genomes will be most useful if they are generated from well-dated and documented archaeological contexts. Proper interpretation and contextualization of such results will be essential to accurately contextualize and interpret ancient genetic results.

References Cited

Benn-Torres, Jada

Brace, Selina, Samuel T. Turvey, Marcelo Weksler, Menno L.P. Hoogland, and Ian Barnes


Fitzpatrick, Scott M.


Haslip-Viera, Gabriel


Lalueza-Fox, Carles, M. Tomas P. Gilbert, Antonio J. Martinez-Fuentes, Francesc Calafell, and Jaume Bertranpetit


Lalueza-Fox, Carles, Fernando Luna-Calderón, Francesc Calafell, Bernal Morera, and Jaume Bertranpetit


Martínez-Cruzado, Juan C., Gladys Toro-Labrador, Jorge Viera-Vera, Michelle Y. Rivera-Vega, Jennifer Startek, Magda Latorre-Esteves, Alicia Román-Colón, et al.


Nieves-Colón, Maria A., William J. Pestle, Jada Benn-Torres, and Anne C. Stone


Santiago-Rodríguez, Tasha M., Yronne Narganes-Storde, Luis Chanlatte-Baik, Gary A. Toranzos, and Raul J. Cano


Santiago-Rodríguez, Tasha M., Yronne M. Narganes-Storde, Luis Chanlatte, Edwin Crespo Torres, Gary A. Toranzos, Rafael Jimenez-Flores, Alice Hamrick, and Raul J. Cano

2013 Microbial Communities in Pre-Columbian Coprolites *PLoS ONE* 8(6): e65191. https://doi.org/10.1371/journal.pone.0065191

Santos, Ana Luísa, Michael T. Gardner, and Philip Allsworth-Jones


Schroeder, Hannes, Maria C. Ávila-Arcos, Anna-Sapfo Malaspinas, G. David Poznik, Marcela Sandoval-Velasco, Meredith L. Carpenter, José Victor Moreno-Mayar, et al.


Schroeder, Hannes, Martin Sikora, Shyam Gopalakrishnan, Lara M. Cassidy, Pierpaulo Maisano Delser, Marcela Sandoval-Velasco, Joshua G. Schraiber, et al.


Wilson, Samuel L.

BONES AND CHROMOSOMES: THE ANCIENT DNA REVOLUTION IN ARCHAEOLOGY (PART 2)

DATA IN THE BONES
WHY ZOOARCHAEOLOGISTS AND ARCHAEOGENETICISTS NEED EACH OTHER

Katherine Brunson

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Zooarchaeologists and archaeogeneticists both depend on bones. Zooarchaeologists study individual animal bones in order to identify butchery marks, describe pathologies, and compare size measurements. They also examine bone assemblages in aggregate to infer taxonomic diversity, herd mortality patterns, and site taphonomy. In addition, bones and teeth can preserve biomolecules, which allow for radiocarbon dating, analysis of dietary stable isotopes, and collagen fingerprinting. Similarly, archaeogeneticists use bones as a primary source of data by analyzing their ancient DNA (aDNA). The shared reliance on bones has pushed the disciplines of zooarchaeology and archaeogenetics more closely together in recent years, resulting in exciting new discoveries about evolutionary biology, human impacts on ancient ecosystems, and animal domestication. Given the growing number of methodological advances in aDNA, it is important to examine opportunities for further collaboration that would benefit practitioners in both fields.

Why Zooarchaeology Needs Archaeogenetics

Before the development of aDNA methods, zooarchaeologists were generally constrained by what they could learn about a deceased animal based on its skeletal morphology. Advances in aDNA methods have 1) improved faunal identification methods; 2) added complexity to studies of human impacts on past animal ecosystems; and 3) clarified our understanding of animal domestication.

Faunal Identification

Fragmentary bones that lack distinguishing morphological traits can now be identified genetically to the species level. For example, aDNA has proven very effective for identifying ancient whale bones that were otherwise challenging to identify based only on morphology (Speller et al. 2016). Ancient DNA also has been used to test the reliability of morphological traits commonly used by zooarchaeologists for species identification (Yang et al. 2005) and to develop new morphological criteria for distinguishing between similar species (Brunson et al. 2016). However, aDNA remains prohibitively expensive for use for faunal identification on a large scale. Collagen fingerprinting, also called Zooarchaeology by Mass Spectrometry (ZooMS), currently provides a more cost-effective biomolecular method for identifying faunal specimens to the genus and sometimes species level (Buckley 2018). As aDNA laboratory methods continue to become more efficient and affordable it is likely that genetic faunal identification will become a more common application of aDNA in zooarchaeology. There are also many ways that aDNA could improve other aspects of faunal analysis, such as the identification of demographic patterns in faunal assemblages. Traditional zooarchaeological analyses of herd demographics and mortality patterns benefit from including information about sex ratios (Marom and Bar-Oz 2009). While the sex of an animal or the sex distribution of an assemblage can be determined only by morphological analysis of specific bones (e.g., the pelvis in some mammals) or metric comparisons of multiple specimens (e.g., Zeder 2001), aDNA can reveal the sex of almost any bone specimen containing well-preserved genetic material. This could greatly increase the ability of zooarchaeologists to study past herd management strategies.

Human Impacts on Past Animal Ecosystems

A second way that aDNA contributes to zooarchaeology is through conservation archaeogenomics (see Hofman et al. 2015 for a useful review). Zooarchaeology is the only source of long-term data on how humans have impacted past animal ecosystems. Therefore, zooarchaeological collections are valuable sources of paleogenetic data for addressing questions about past environments, past animal ecologies, and paleodiseases. For example, aDNA can be used to determine when animal population sizes declined in order to assess whether human hunting contributed to megafaunal extinctions at the end of the Pleistocene (Lorenzen et al. 2011). Studying the factors that af-
The many contributions of aDNA to research on animal domestication have been reviewed elsewhere (Larson and Fuller 2014; MacHugh et al. 2017). Ancient DNA has revolutionized our understanding of animal domestication by clarifying the geographic origins of many domestic taxa, specifying the relationships between domestic taxa and their wild progenitors, and identifying genes that may have been subject to selection during domestication. A key finding from this research is that modern distributions of domestic animals are the result of migration events and directed breeding over the last few hundred years, making modern DNA wholly inadequate for drawing conclusions about domestic origins or domestication genes without further confirmation with aDNA (Flink et al. 2014; Ottoni et al. 2013). Ancient DNA studies also reveal that some taxa, including dogs, pigs, and horses, may have been domesticated multiple times and in multiple regions from diverse source populations (Frantz et al. 2016; Gaunitz et al. 2018; Larson et al. 2005). Interbreeding between domestic and wild stocks was also common (Marshall et al. 2014). In short, domestication processes appear to have been more fluid than we used to think before aDNA, and it is now clear that zooarchaeologists need to pay close attention to how domestication processes varied from species to species and from archaeological context to archaeological context.

Ancient DNA continues to make significant contributions to zooarchaeology in the three areas outlined above, but there are more opportunities for incorporating archaeogenetics into future zooarchaeological research. One of the most promising areas is the identification of phenotypic traits, which can then be used to address a variety of economic or social questions. Can we find evidence that people selected for certain traits in their domestic herds, such as raising sheep that produce more wool or pigs that produce more fatty meat? Did people select animals with a certain coat color or animals of a certain sex for use in special sacrificial contexts? Incorporating aDNA research into these types of questions—especially in smaller geographic regions or at archaeological site-specific scales of analysis—will help to address the broadest possible dimensions of human-animal interactions.

Why Archaeogenetics Needs Zooarchaeology

Many recent advancements in archaeogenetics have focused on the human species, leading to fantastic new discoveries about human evolution and global population migrations. Luca Cavalli-Sforza (2001:31–32), one of the founding figures in studies of human population history, once observed that because human evolution cannot be repeated, geneticists still need data from other fields to fully understand human activities in deep time. Within archaeogenetics, zooarchaeological data has been relatively untapped despite the insight it can provide into practices that were critical to the history and development of humans. Archaeogeneticists should turn their attention to zooarchaeological collections because 1) animal bones are more plentiful than human bones and represent all time periods and regions, allowing archaeogeneticists to refine their methods and test their assumptions about evolutionary genetics; 2) animal bones provide powerful alternative sources of DNA data that avoid some of the ethical problems associated with aDNA studies of human remains; 3) animals can serve as proxies for human activities such as migration; and 4) zooarchaeology provides additional lines of evidence for interpretation and contextualization of genetic results.

Animal Bones Are Everywhere

Animal bones are found at archaeological sites around the globe, making them a ready source of comprehensive data for looking at long-term evolutionary processes and for making cross-cultural comparisons (Figure 1). Because zooarchaeological sources of aDNA data are relatively plentiful, they have much to offer aDNA research. Destructive sampling of a few bones to extract aDNA does not limit further research on the larger faunal assemblage. Laboratory methods under development by archaeogeneticists can be tested and refined using common zooarchaeological materials before applying the same methods to rarer samples such as Paleolithic human remains. The temporal coverage of zooarchaeological specimens also allows archaeogeneticists to test the assumptions of population genetics and evolutionary theory. In population genetics, most analytical models are designed based on modern genetic data. Incorporating ancient genomes into these models has led to the development of new analytical frameworks and statistical methods that are changing our understanding of evolutionary processes (see Leonardi et al. 2017 for a useful review). Ancient animal remains offer an
important canvas on which to test and refine these models and methods.

**Ethical Concerns and the Value of Animal Proxies**

Many descendant communities object to destructive sampling of the remains of their ancestors. This is especially true in North America and Oceania, and limits the number of samples available for studying human migration and population dynamics in these regions. Animals can serve as proxies for human migration when human remains are unavailable. For example, aDNA from commensal animals such as Polynesian rats has been used to inform on the migratory routes used by humans in Oceania (Matisoo-Smith 2018), and aDNA from bison has been used to predict when the ice-free corridor first opened for animal and human migration into North America by land (Heintzman et al. 2016). Although aDNA studies of animal bones can help avoid some of the ethical problems involved in destructive sampling of human remains, it is important to remember that zooarchaeological materials are also finite resources. Developing best practices for sampling anthropological collections in museums and other repositories will be critical for the future of ancient DNA research (Austin et al. 2019).

**Contextualizing Ancient DNA Results**

Just as aDNA results sometimes force zooarchaeologists to reconsider assumptions about the faunal record, zooarchaeological data can bring decades of prior research to debates about how to best interpret genetic findings. Paleogenetic studies of animals frequently focus on genetic data in isolation from all of the other lines of evidence that zooarchaeological specimens can provide. A single animal bone or tooth not only provides aDNA, but it can also reveal information about age at death, pathologies, isotopic markers for diet, and much more. This zooarchaeological data can help with the interpretation and contextualization of aDNA results, as has been done recently...
in studies that combine aDNA with other methodologies (e.g., Ames et al. 2015; Ottoni et al. 2013).

The Future of aDNA Research on Animals

Animal bones are a data-rich material that provide opportunities for interdisciplinary collaboration among zooarchaeologists and archaeogeneticists. Zooarchaeology needs archaeogenetics because it provides state-of-the-art methods for the analysis of aDNA and spurs novel techniques that can be used to address zooarchaeological research questions. Archaeogenetics needs zooarchaeology because it provides alternatives to DNA research on humans as well as critical contextual information for interpreting genetic results. Nonetheless, there are challenges that this integrative research will continue to face.

First, as is the case for all archaeological materials, there are biases in the faunal record that impact its use in aDNA studies. These biases can be due to a variety of natural and cultural factors as well as the excavation process itself (Figure 2). For example, it is well known among archaeologists that the size of the mesh used to screen soil will influence the sizes and types of bones found, leading to an underrepresentation of small animals, juvenile animals, and non-mammals. In some parts of the world, screening still is not used or may not be used consistently. This will of course also bias the types of bones that are available for aDNA research. Zooarchaeological context is thus critical for understanding sample biases that may influence aDNA results.

Second, the storage of faunal collections poses a challenge for aDNA research. Most archaeological materials around the world are not stored in environmentally controlled settings. Ancient DNA may immediately start to break down in bones housed in museums and institutional storerooms—especially in hot and humid conditions that speed up aDNA degradation. A key challenge for the future of cultural heritage management will be to establish and implement best practices strategies for storing archaeological materials in ways that preserve biomolecules.

Third, aDNA research in some regions is more challenging than in others. Many countries have restrictions on exporting archaeological materials, and there are significant inequalities in terms of researchers’ access to the specialized lab facilities needed for top-tier aDNA analyses. This will improve as more archaeologists do aDNA research and as more aDNA labs are built around the world. Still, considerable effort will be needed to ensure that scholars in developing nations have access to these facilities and training in aDNA methods.

Clearly, the future of both zooarchaeology and archaeogenetics rests in finding new sources of animal aDNA and incorporating aDNA research into broader zooarchaeological narratives. Exciting work is currently underway, and aDNA has been extracted from dental calculus, coprolites, soils, and even residues on stone tools (Green and Speller 2017). These alternatives hold great promise for identifying taxa at sites with poor bone preservation and for determining the exact uses of animals and animal products in the past. While current research trends are focused on what aDNA can reveal about ancient animal ecologies and domestication, the future lies in new areas like testing the reliability of morphological criteria in faunal identification, examining phenotypic traits in animals that were subject to cultural selection, and using animals as proxies for human migration. Ancient DNA also shows great promise for use in social zooarchaeology, studies of ancient foodways, and studies of worked bone artifacts. Moving forward, zooarchaeologists and archaeogeneticists will need each other as they create new insights into past relationships among humans and animals.

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References Cited

Ames, Kenneth M., Michael P. Richards, Camilla F. Speller, Dongya Y. Yang, R. Lee Lyman, and Virginia L. Butler

Austin, Rita M., Sabrina B. Sholts, LaShanda Williams, Logan Kistler, and Courtney Hofman

Brunson, Katherine R., Xin Zhao, Nu He, Xiangming Dai, Antonia Rodrigues, and Dongya Yang

Buckley, Michael

Cavalli-Sforza, Luca


Frantz, Laurent A.F., Victoria E. Mullin, Maud Pionnier-Capitan, Ophelie Lebrasseur, Morgane Ollivier, Angela Perri, Anna Linderholm, et al.

Gaunitz, Charleen, Antoine Fages, Kristian Hanghøj, Anders Albrechtsen, Naveed Khan, Umberto Albarella, Meiying Fang, Elizabeth Matsisoo-Smith, Judith Robins, Steward Lowden, et al.

Lander, Greger, and Dorian Q. Fuller


Lorenzen, Eline D., David Nogués-Bravo, Ludovic Orlando, Jaco Weinstock, Jonas Binladen, Katherine A Marske, Andrew Ugan, et al.

MacHugh, David E., Greger Larson, and Ludovic Orlando

Marom, Nimrod, and Guy Bar-Oz

Marshall, Fiona B., Keith Dobney, Tim Denham, and José M. Capriles

Matsisoo-Smith, Elizabeth


Yang, Dongya Y., Joshua R. Woiderski, and Jonathan C. Driver

Zeder, Melinda A.
THE FUTURE OF PALEOGENOMICS
WHAT’S LEFT WHEN THE BONE DUST SETTLES?

Keolu Fox

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As an undergraduate at the University of Maryland I would often travel to Washington, DC, for an osteology course held in the Smithsonian National Museum of Natural History’s (NMNH) renowned “bone lab.” One afternoon I walked into the laboratory and observed a display with multiple human skulls—a few of which had gaping holes from bullet wounds—and I immediately wondered, Who were these people and what stories could these bones tell?

Elsewhere in the famed museum thousands of visitors traipsed through the towering rotunda marveling at the 12-ton elephant statue. Nevertheless, I doubt that few, if any, stopped to think about what remained hidden behind the scenes. I’m even more convinced that most of those visitors did not know that the NMNH is home to ~20,000 sets of human remains—one of the largest collections in the world and a treasure trove of genetic material potentially available for study.

In the decade that has elapsed since my college days, paleogenomics—the study of the past through the examination of preserved genetic material from ancient remains—has evolved into a thriving field with global reach. Furthermore, the industrial scale at which ancient specimens are being ground into bone dust is yielding unprecedented insights into human (pre)history (Callaway 2018). Dr. John Hawks (2018) has aptly dubbed this current moment in paleogenomics the “bone-rush era.” Nevertheless, this unprecedented growth comes with unanticipated consequences, and paleogenomic research has ignited a range of debates and ethical issues (Bardill et al. 2018). Although there are thousands of specimens, human remains like those in the NMNH are a finite resource, and extracting the best-quality DNA requires their (partial) destruction. But is that destruction justified by the possibility for discovery? And when the bone dust settles, will future scientists with new methods lament the destruction characteristic of today’s bone rush?

Nearly 30 years after the passing of the Native American Graves Protection and Repatriation Act (NAGPRA), it still seems as though we do not know the answer to questions such as how many human remains exist in museum collections and how best to manage issues of group affiliation. In response to then recent looting incidents, NAGPRA mandated that museums that receive federal funding inventory the human remains in their collections (Fine-Dare 2002). As of October 2015, the National Park Service estimated that ~51,000 individuals had been repatriated or returned to Native American tribes from museum collections around the US (Goff et al. 2015). Despite these efforts, a survey by Redman (2016) revealed that over 116,000 sets of human remains and nearly one million burial objects were still considered culturally unaffiliated and thus ineligible for return. Their unaffiliated status made them accessible for unrestricted research.

Like those estimates for domestic museums, the estimates for museum collections outside the US are conservative and difficult to track. A proportion of these human remains have come to museums not from archaeological excavations but as donations from private donors or acquired through auction. In addition, policies designed to protect ancient ancestral remains (e.g., NAGPRA) in other countries have not been able to keep pace with research agendas and emerging technologies, resulting in the exploitation of policy loopholes and a lapse in ethical values within the paleogenomics community (Bardill et al. 2018). The availability of the technology without the constraints of policy or ethical guidelines has sent both the archaeology and molecular biology communities into a “bone-rush” frenzy, with researchers hunting for specimens in museums around the world in hopes of unlocking the next big discovery. But how did we get here?

Between 2005 and 2008, 12 different ancient DNA (aDNA) laboratories were established in the US and Europe (Figure 1). Quickly, however, technological advancements and proprietary knowledge created a power struggle among those laboratories. Today, there are about 70 aDNA laboratories across the globe (80% are in the US or Europe), but just 3
produce the majority of data currently available (Green et al. 2010). These data are often specifically tailored to methods and software originating in one of those three labs and are thus not compatible, or available, to other researchers. And without taking the time necessary to combine these genetic data with local histories, archaeological, and linguistic data, findings are sometimes rushed to publication (Lewis-Kraus 2019; Lipson et al. 2018). Furthermore, the accelerated pace of paleogenomics is producing papers highlighting “new discoveries” that were previously confirmed by archaeologists and Indigenous peoples, which indicates a lack of communication among stakeholders that would have otherwise yielded more comprehensive interpretations (Crowe 2018; Finney 1977).

Fortunately, the growing number of aDNA laboratories around the world and a steady increase in innovative multidisciplinary collaborations suggests that the democratization of paleogenomics is currently happening. Given the scarcity of aDNA samples and the high probability of DNA damage in ancient genomes, two key areas of research will require capacity building in the future: sample reanalysis and functional investigation of ancient hominin variation.

Sample reanalysis will be essential for future computational efforts to aggregate and harmonize newly discovered ancient hominin sequence datasets, as well as to confirm signatures of selection as the number of publicly available ancient genome assemblies grows (Atkinson et al. 2018; Enard et al. 2009). However, in order for computational scientists to reanalyze ancient hominin data, raw datasets must be available via open source access. Once these raw data are publicly available, future generations of scientists can begin to address one of the ultimate questions in evolutionary biology—what makes us human? In order to comprehensively approach this question the field of paleogenomics will require a reverse genetics approach (Starita et al. 2017). This reverse engineering approach will provide an avenue for growth and innovation in the field of paleogenomics by functionally investigating both introgressed (i.e., gene mutations originating in Neanderthals or Denisovans that exist in contemporary human populations) and ancient hominin-specific variation (i.e., gene mutations.
that are exclusively found in Neandertals or Denisovans and do not exist in contemporary human populations).

It is important to understand that we are all accountable for managing the consequences of the bone rush. This includes not only opportunistic archaeologists, molecular biologists, and computer scientists but also the many gatekeepers along the way, including auction houses, private collectors, museum curators, scientific journal editors, grant-making organizations, science journalists, and Indigenous community members. In an era where the time lag between data production and publication is longer than the time it takes to double the data generated in the field, I believe it is important for us to recognize that once these ancient remains are ground into dust, we may never realize their full potential for understanding our past and uncovering its hidden stories. In the same way that the field of archaeology has largely shifted from broad, intensive excavation to less invasive methodologies, it is important to ensure that a handful of Argonauts hunting for “golden fleeces” do not “fleece” humanity for what rightfully belongs to all humankind—the right to repatriate our collective past, strengthen our identity today, and unite us as a global community in the future (Waxman 2010).

References Cited


Hawks, John (@johnhawks) 2018 “It seems that a “bone rush” atmosphere has taken hold. Labs compete intensely for samples. I’ve seen and talked with many in this field who behave like colonizing powers. 5/x” Twitter, March 21, 2018. https://twitter.com/johnhawks/status/97616550131506080


In April of 2020, the Genographic Project will turn 15 years old (Shreeve 2006). Over the years, the landmark project greatly advanced the field of biological anthropology, launched a market for consumer genetics, and propelled the careers of dozens of researchers. However, the years were filled with twists and turns, some of which are still playing out today.

In the fall of 2015, I took on the role of directing Genographic. It was my turn. A year soon passed and I was struggling to make in-roads and keep Genographic scientifically relevant. Yet at that time, it became clear that my journalist colleagues across the National Geographic courtyard were also at a turning point. National Geographic had entered into a joint-venture with 21st Century Fox (Hudson 2015) in which the famed magazine became part of a new for-profit company called National Geographic Partners. This turn invited questions about the magazine's image and journalistic integrity. However, by the spring of 2017 the magazine had made positive waves with its single-topic issue on gender (Gender Revolution, National Geographic Magazine January 2017), and there were growing whispers in the office of possible awards for outstanding exploratory journalism. The organization had successfully navigated a timely and controversial topic, and there was a palatable feeling of pride and optimism among colleagues. A question still remained, though: Where to go next?

In my inbox that same spring was an e-mail from one of the magazine editors asking to discuss how we could use Genographic to tell a story that would weave DNA and the topic of race. In my eyes, this was an opportunity to highlight the Project, lead an impactful discussion, and contribute to one of the best teams in science journalism. I loved the idea and National Geographic was uniquely positioned to do it better than any other organization. From that spring meeting a magazine feature was born (Black and White, National Geographic Magazine April 2018).

Likewise, Genographic took a number of turns throughout its history. The 14-year-old initiative, fueled by the ever-changing genetic technology, was born from a simple scientific idea: To analyze DNA samples from thousands of people across the world, albeit with the donor’s expressed permission, and tell the human story to show how we are all connected. From the analyses of the DNA donated, we told dozens of migration stories. However, the stories were often written by non-indigenous scientists and journalists, with limited input from the DNA donors. We soon acknowledged that we were missing valuable opportunities; efforts shifted to include global perspectives in our writings, and we began to focus the Project on grant-making and science education.

During that early turn in the history of the Project, the field of genetic anthropology also began shifting. Scientists in Europe had successfully sequenced the first Neandertal genome (Green et al. 2010), and shortly after that the first ancient human genome (Rasmussen et al. 2010). The field of ancient DNA (aDNA) was taking form.

In the last nine years, the field of aDNA has grown exponentially. Multiple labs in the US and Europe have developed the capability to extract genomic DNA material from
ancient human remains. These amazing advances in technology have enabled us to grow in our understanding of human diversity and migration through time and space. We can tell a more detailed story of the human journey and not just infer stories from the DNA of living people, representative of lineages that may have survived for arbitrary reasons. We can now base our story on DNA from people who were alive thousands of years ago. We have the power to answer questions that Genographic never could, and the shift in the field could present an opportunity for us to write a new chapter for the Project.

However, just because we can do it, doesn’t mean we should. As the field continues to grow, there is significant concern among researchers and descendant communities over the lack of ethical standards and guidelines for the collection and study of DNA from human remains (Bardill et al. 2018). This is troublesome not only because aDNA retrieval is a destructive process but also because it has the side effect of informing on human biological ancestry with possible medical, cultural, and political repercussions. Further, skeletons do not have the ability to consent to be part of research, something that is always required of human research subjects, and there is limited consultation of descendant communities other than in some exceptional Native American and Australian Aboriginal cases. In fact, this is so new that Internal Review Boards from our best universities do not have guidelines in place to address human aDNA work.

As a grant-maker and a voice for science, we have the opportunity to be a leader in the development of ethical standards for aDNA research. To do so, I have joined a growing group of archaeologists, geneticists, ethicists, indigenous scholars, and grant-making institutions to help create a set of guidelines for best ethical practices in the field of aDNA. This new turn for Genographic will enable us to continue as a leader in cutting-edge science, while helping ensure it is done correctly.

References Cited
Black and White 2018 National Geographic Magazine Special Issue: April 2018.
Gender Revolution 2017 National Geographic Magazine Special Issue: January 2017.
SAUL L. HEDQUIST
1980–2018

Saul Luther Hedquist, a Southwest Archaeologist, passed away peacefully at his home in Tempe, Arizona, on Sunday, November 4, 2018. He was only 38. Saul was a rising leader in the field of archaeology and garnered great respect for his superb scholarship, and for his enthusiasm for working collaboratively and across disciplines. His success stemmed in part from his genuine love for interacting with people. Saul had a natural ability to be fully present during even the most casual of conversations with both colleagues and friends.

Saul was born September 16, 1980, to Nona Meyer and Paul Hedquist and grew up in Des Moines, Iowa. He graduated from Hoover High School in 1999 and from the University of Northern Iowa in 2003. Saul was always enamored of history, culture, and the outdoors. In college he channeled these interests into an anthropology major. His dedication to anthropology brought him to Flagstaff in 2004, where he received a master’s degree in anthropology from Northern Arizona University (NAU) in 2007. His thesis focused on the relationship between exotic material culture and social complexity within the Sinagua who lived in the region in the eighth through fourteenth centuries. His MA research led to his long-term interest in turquoise.

Soon after arriving at NAU, Saul was introduced to the rich, enduring Indigenous communities that literally surround Flagstaff, sparking his future desire to include their perspectives in his research. Immediately following his MA, Saul launched his career in the CRM community that continued to the end of his life. Throughout his CRM career, Saul directed crews who respected his attention to detail and respectful treatment of people working with him. He encouraged multiple perspectives on how to interpret the archaeological record.

While working part-time in CRM, Saul began his doctoral studies in anthropology at the University of Arizona in Tucson, where his research focused on the cultural significance, exchange, and multiple uses of turquoise in ancient and contemporary Puebloan communities in the American Southwest, particularly the Hopi and Zuni. In May 2017, he received his PhD in anthropology. His dissertation was unique and innovative in looking at turquoise circulation through multiple lenses: by where it was deposited within large Pueblo communities in the fourteenth century; by sourcing it through lead/strontium isotopic analysis; and by interviewing dozens of Hopi and Zuni descendants of these early Pueblo communities to include their perspectives on the value and meaning of turquoise. As a result of this research, Saul learned that turquoise referred not only to the mineral form but also to a much broader cultural category that included objects painted blue or green with copper oxides. Saul presented his findings to cultural advisors at Hopi and Zuni and was working on converting his dissertation into a book, strongly encouraged by the University of Arizona Press.

During his short career, Saul was tremendously productive and, above all else, collaborative in his research and publications. With rare exceptions, he co-authored chapters, articles, and technical reports with colleagues, including Indigenous scholars. This collaborative spirit was a natural outgrowth of who Saul was as a human being, always showing respect toward alternative viewpoints and including them in his research.

It is not surprising that most of all, Saul loved being with his family and friends. He was an avid outdoorsman and spent many happy days hiking, camping, fishing, running, listening to music, and playing disc golf with friends and family. Saul wanted nothing more than to make other people happy and do good in the world. On both fronts, he was tremendously successful, and he is missed by all who were fortunate to love, know, or work with him.

Saul is survived by his wife, Leigh Anne Ellison; daughters Chelsea and Leila Hedquist; his mother, Nona Meyer; father and step-mother, Paul and Meg Altmix-Hedquist; brothers Seth Hedquist and Zach and Jake Simmons; and his mother-and father-in-law, Sandy and Jeff Ellison.

Saul Hedquist’s list of publications can be found at the SAA website: https://www.saa.org/publications/the-saa-archaeological-record

—Leigh Anne Ellison, E. Charles Adams, T.J. Ferguson, and David J. Killick
IN MEMORIAM

RUTHANN KNUDSON
1941–2018

It was the middle 1980s. SAA’s Board of Directors concluded its meeting at the annual conference. The door of the meeting room was thrown open, the five men on the Board pushing through, arms around each others’ shoulders, laughing, “On to beer!” Behind them, the Board’s four women stood, ignored. Ruthann Knudson squared her shoulders to announce, “There goes the Old Boys’ Network. OK, here’s the Old Broads’ Network! Let’s go to dinner!” So began a feminist standpoint in SAA, with Ruthann, Dena Dincauze, Leslie Wildesen, and Annette Cheek, plus Alice Kehoe tagging along with the Board women.

Ruthann Knudson was born in Wisconsin where some of her forebears had settled in the nineteenth century, members of the Seventh-Day Baptist sect that had been outcast as heretics by Roger Williams from his seventeenth-century colony. When Wisconsin was opened to settlers, the sect built a village on the Midwest frontier. Ruthann’s parents lived in Milwaukee, then moved to Duluth, MN, where teenage Ruthann worked as a cook. She attended Hamline University in St. Paul, MN, 1959–1961, followed by the University of Minnesota for her BA, 1963, and MA, 1966, degrees. Her master’s thesis, directed by Elden Johnson, was on Cambria in southern Minnesota; that thesis remains significant for the archaeology of the region. She pursued doctoral work in archaeology (PhD 1973) at Washington State University (WSU), where a small cohort of women was called Daugherty’s Daughters, their abilities and drive recognized by WSU professor Richard Daugherty. Summers, she had worked as a salad cook and seasonal ranger in Yellowstone Park, Mesa Verde, and Bandelier National Monument, which in 1963 sparked her interest in America’s precontact past and its First Nations. Their lithic artifacts became her field of science, and recognizing First Nations people as colleagues led to her Legacy work with the National Park Service (1991–1996), her years on the Montana Burial Board (2001–until her death), her Great Falls College course popular with Indian students, and the culmination, an invitation to join in the reburial of the Anzick Clovis child in 2014 (Knudson 2015).

Eileen Johnson met Ruthann in 1967, participating in a Snake River project of Washington State University. Eileen recalls, “She was having a rough time as a woman in the field. Ruthann broke through barriers but was also deeply affected by the inequities and the cost of breaking those barriers” (email, 12/2/2018). Ruthann taught at Washington State, the University of Northern Colorado (1966–1968), Wright State University (1974), and University of Idaho (1974–1981). In the 1980s, she worked as Vice President/Senior Project Scientist for Woodward-Clyde Consultants (1981–1988). She then became a BLM archaeologist in Montana (1989–1990) before moving on to Washington, DC, to work for the National Park Service Archeological Assistance Division where she was responsible for the Department of Defense Legacy Resource Management Program and the Native American Sacred Sites task area. Finally, from 1990 to 2005, she was Superintendent of Agate Fossil Beds National Monument on the Nebraska-Wyoming border. Agate Fossil Beds includes a museum and collections of American First Nations artifacts. When she retired from government service in 2005, Ruthann settled in Great Falls, Montana, creating Knudson Associates for continuing professional work, teaching courses on American Indians for Great Falls College of Montana State University (2008–until her death), assisting avocational archaeologists and Montana Archaeological Society, and working to create active communities in Friends of the Museum of the Plains Indian, Browning, MT, and in the Methodist church she chose to join. The list of oversight and public education boards and projects she participated in is lengthy.

One phrase sums up Ruthann’s passions: range of variation. In her student days, River Basin Surveys employed the greatest number of crew archaeologists, paying top wages of $40 per week. Only men were hired. Women with several years of field experience could obtain, at best, in the very few field positions offered, $18 per week. So in the range of young persons seriously preparing for careers in archaeology, the type specimen was a man, and women were excluded from the range of variation. Bad sampling! Women were similarly not hired for tenure-track academic positions, and most were offered only adjunct or one-year positions; at the University of Idaho, Dr. Knudson managed the Laboratory of Anthropology in addition to teaching, and did receive tenure in 1979. Scroll on to her analyses of lithics: she insisted on laying out the range of...
IN MEMORIAM

variation around accepted types, an approach that a cocksure younger male archaeologist recently denounced: “You don’t know Plainview!” Ahem, young sir, you don’t understand contemporary scientific method. Ruthann’s friends saw that passion for seeing range of variation in her kitchen, with ranges of pickles and jams and jellies and sauces beyond imagining.

A startling example of Ruthann’s deep-science ability to see range instead of stereotype is her paper on working in River Basin Surveys (RBS). Ditching the standard story of only men being hired, Ruthann estimated that 75% of RBS workers were women: consulting experts, laboratory managers and technicians, editors, office staff, occasional field crew, “and unsalaried working wives” (Knudson 2014:180). Not until 1968 did the Smithsonian inquire whether RBS directors were complying with the Equal Employment Opportunity rule (Knudson 2014:181). Long before, in 1948, Ruthann’s mentor H. Marie Wormington had surveyed a Colorado reservoir for RBS. Who knew?—other than Ruthann whose expertise in Paleoamerican lithics was fostered by Wormington. Twenty years later, Ruthann worked on Wormington’s Frazier excavation and the next summer, 1968, with Wormington and Joe Ben Wheat at Jurgens. Not a few of the women Ruthann lists in her breakthrough paper worked professionally and, at the same time, as camp cooks, on men’s projects—women such as Mildred Wedel and Hester Davis!

Ruthann was married to C. Thomas Shay, a fellow Minnesotan student, from 1964 to 1967, and for one year, from 1970 to 1971, to W. Raymond Wood. 1971 brought her to Don Crabtree’s knapping workshop, where her vision of good science inspired her to found, with Guy Muto, the Newsletter—now Journal—of Lithic Technology. Then, in 1972, she carried her expertise to Peru, working that summer for Richard S. MacNeish’s Ayacucho Archaeological-Botanical Project. She came into her own in 1974, with an NSF grant to write up the Red Smoke site in southwest Nebraska, followed by tenure-track employment at the University of Idaho. In 1978, Ruthann agreed to serve the Society for American Archaeology as its Legislative Coordinator, testifying before Congress and maintaining a national network of SAA members willing to be involved in political action. Through this office, Ruthann participated in drafting and speaking for the National Historic Preservation Act Amendments of 1980. For this work, she was awarded the American Anthropological Association’s prestigious Margaret Mead Award, 1983, along with awards from the American Society for Conservation Archaeology and the National Conference of State Historic Preservation Officers. SAA recognized her talent for leadership when she was elected to its Executive Board, 1981–1985; she was also elected to the Board of Directors for the Plains Anthropological Society, 2003–2005.

Two setbacks in the late 1980s turned Ruthann toward employment with the National Park Service. In 1985, a truck struck her as she was helping a freeway accident victim. Seriously injured, she put her energy into healing, returning to work at Woodward-Clyde only to be laid off in 1988, when its Hanford Basalt Waste Isolation Project was canceled by Congress. Her positions with the National Park Service, beginning in 1990, did not formally include NAGPRA, but did put her in charge of the interagency Public Awareness Working Group. The year before, she and Bennie Keel had convened a session at the University of Maine Conference on the People of the Americas, published in 1995 as The Public Trust and the First Americans. Part of Ruthann’s commitment to what the Smithsonian’s founder called “democratic science” was her readiness to work with avocationalists and with Indian people. Retired to Great Falls, she was active in the Montana Archaeological Society and its Archaeological Education Committee. Informally within the Society, she was one of the Sisters of the Travelling Trowel, urging acknowledgment of 23 outstanding women in Plains archaeology whom she listed. The Montana Archaeological Society has established two scholarships in the name of its “friend, mentor, and teacher” Ruthann Knudson.

Michael Wilson points out “how important a role she played in building and maintaining these relationships. She played similar roles on advisory committees for the SAA and other organizations, building linkages yet not seeking to stand in the limelight. And she spent a great deal of time contributing to the proper, lasting documentation of archaeological finds, new and old, especially those relating to the Cody Complex... much of Ruthann’s work was done ‘behind the scenes’, yet the results, and her influence, are all around us and will remain strongly with us” (Wilson, email, 12/31/18). He remarks on the 1970 photo that he sent, of the Henley Ranch site crew, “The triumphant photo of our truck, embedded to its hubcaps, was the result of a statement along the line of, ‘No sweat—if we take a run at it, I’m sure we can get across easily.’” Note Ruthann stands in front, instinctively the leader for a sticky job.

We must return to Ruthann’s engagement with Paleoamerican lithics. She was superb at drawing them, and like many lithic artifact specialists, knew an artifact only through drawing it. Thousands of specimens passed under her eye and hand. Her dissertation, completed in 1973, was on artifacts from the MacHaffie site, in Montana, and the Plainview site in Texas. When she finally summarized her knowledge in
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the co-edited volume *Plainview*, Plainview as a species of artifact was definitively defined for today’s scholars (Knudson 2017). Her colleagues said of her, “no one else has ever seen, carefully examined, described, and drawn so many of the key Great Plains and related Paleoindian artifact assemblages” (Holliday et al. 2017:xvii). With Plainview now scientifically and accessibly described, Ruthann turned to its Northern Plains congener, Goshen. Once more she sought out specimens, in museum and private collections, inquiring of professionals and avocationals, scouring the literature. Goshen and maybe-Goshen lithics lay on her work counter over pages of meticulous drawings. In between field-walking with associates over the Sun River flats at Great Falls, driving to Helena to figure out, with an avocational group there, why there was confusion over the MacHaffie site location, cooking and serving needy families with her church ladies, Ruthann relished the challenge of What, Where, When Was Goshen? The stroke that cut her down so suddenly ended that quest.

Acknowledgments

Thanks to colleagues who shared remembrances of Ruthann: Vance Haynes, Dale Henning, Ann Johnson, Eileen Johnson, Marcel Kornfeld, Leo Pettipas, Becky Timmons, Michael Waters, Michael Wilson. Marcel Kornfeld partnered me in casting nets to fish out documents and photos of a dear, very busy and productive colleague, and engaged with drafts of this obituary.

—Written by Alice B. Kehoe, facilitated by Marcel Kornfeld

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References


Knudson, Ruthann 2011 Ruthann Knudson. Summary of her life to February 2011, written as a draft by herself, distributed at her funeral. Copies in author’s possession; if you wish a copy, email akehoe@uwm.edu.


As the incoming Chair of our Fundraising Committee, let me thank all of my fellow donors listed in this issue of the SAA Archaeological Record. Your generous contributions not only help to maintain a healthy society, but also allow the SAA to accomplish many goals in addition to publishing journals and hosting our Annual Meeting.

During my time working with the Fundraising Committee, the most common question I have gotten from friends and colleagues is, Why does the society need my donation; aren’t my dues enough? The short answer is that the contributions from our donors allow the Society to pursue a variety of initiatives to promote our shared values as archaeologists. As I thought about what to include in this letter I realized that I wasn’t actually aware of all of the ways in which our donor funds support the mission of the Society. I reached out to our staff who have helped to fill me in on the diversity of our efforts, and I want to highlight some of these.

Our scholarship programs are some of the more visible uses of our donor funds. In 2018 we were able to provide scholarships for 15 students to advance their studies. One of our oldest, the Native American Scholarship Endowment, made four awards, including one funded by the National Science Foundation. In 2012 the Society initiated the HUGS Scholarship Fund for historically underrepresented groups to promote diversity in archaeology. Although not yet endowed, we were able to award three scholarships in 2018. The Cheryl L. Wase Endowment was created through a generous donation in 2013. We have awarded scholarships to eight young women using this endowment this year.

Donor funds are also used for the many awards presented at our Annual Meeting. These include the Paul Goldberg Award; the Douglas C. Kellogg Fellowship; the Fred Plog Memorial Fellowship; the Dienje Kenyon Fellowship; the Crabtree Award; the Institute for Field Research Annual Meeting Travel Award for Undergraduates; the Gene Stuart Award; and the Stanish Travel Award. These meaningful awards not only promote quality research; they also serve as a bond within our archaeological community.

There are a number of much less visible uses for the donor funds, but they are just as important. The funds for the general endowment provide for the long-term financial stability of the Society. Not very exciting, but invaluable. The funds also allow the Society, under the supervision of the Board of Directors, the flexibility to promote our shared goals. A good example is the work of our Manager of Education and Outreach, Elizabeth Pruitt. During the past year, Beth has used our funds for two significant projects: the Ipsos American Perceptions of Archaeology Poll and Girls Inc. STEM and Leadership Academy.

The poll was an update to the Harris Poll from 2000. Our funds were used to pay for the polling data, report, infographic, and printing. This poll gives us a snapshot of the public’s perception of archaeology—93% of Americans say that the work archaeologists do is important. By continuing to conduct this type of polling, we will gain longitudinal data on the impacts of our public education efforts, as well as the overall trends in how the public perceives our profession. In addition, archaeologists can use that data to educate politicians and recruit them to join us in protecting our archaeological resources.

The Girls Inc. DC STEM and Leadership Academy is an annual summer program that partners with Howard University. The SAA hosted one week of this six-week program for girls in grades 6–10. They worked with 50 girls, introducing the students to archaeology as a STEM career. Using a variety of hands-on activities and a visit to an active archaeological excavation, they wrapped up the week with five local professionals in a Q&A panel on careers in archaeology.

I hope this brief look at some of the ways your donations benefit the SAA in fulfilling our stated mission will encourage you to consider helping out. The Society can use your treasures as well as your time and talents in pursuing our common goals as archaeologists. Check out saa.org, volunteer on a committee, get involved.
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The Society for American Archaeology is a 501(c)(3) not-for-profit organization that serves the archaeology community throughout the Americas. Charitable contributions help the SAA achieve its mission, sustain archaeology, promote public education programs, and provide scholarships for Native American and other minority students to receive education and training to advance their careers in archaeology. On behalf of the Board of Directors, staff, and members, SAA thanks each and every donor for their generous support.

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Life Benefactors have made cumulative lifetime gifts of $10,000 or more to the SAA. Unfortunately, we only have access to donor records back to 1990 when the records began to be kept electronically. Any omissions from this list are unintentional. If you believe that your name should be on the Life Benefactor list, please contact Amy Rutledge (amy_rutledge@saa.org), manager, Communications and Fundraising, to let her know, so that we can investigate and correct the error.

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