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On The Record

Our past creates our present: a brief overview of racism and colonialism in Western paleontology

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Abstract.—As practitioners of a historical science, paleontologists and geoscientists are well versed in the idea that the ability to understand and to anticipate the future relies upon our collective knowledge of the past. Despite this understanding, the fundamental role that the history of paleontology and the geosciences plays in shaping the structure and culture of our disciplines is seldom recognized and therefore not acted upon sufficiently. Here, we present a brief review of the history of paleontology and geology in Western countries, with a particular focus on North America since the 1800s. Western paleontology and geology are intertwined with systematic practices of exclusion, oppression, and erasure that arose from their direct participation in the extraction of geological and biological resources at the expense of Black, Indigenous, and People of Color (BIPOC). Our collective failure to acknowledge this history hinders our ability to address these issues meaningfully and systemically in present-day educational, academic, and professional settings. By discussing these issues and suggesting some ways forward, we intend to promote a deeper reflection upon our collective history and a broader conversation surrounding racism, colonialism, and exclusion within our scientific communities. Ultimately, it is necessary to listen to members of the communities most impacted by these issues to create actionable steps forward while holding ourselves accountable for the past.

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Introduction

The racial unrest in the summer of 2020 shone a spotlight on the racial inequality in Western society, including academia (Chen 2020). The culture and structure of academia, particularly in the disciplines of science, technology, engineering, and mathematics, have long reinforced these systems of discrimination (Table 1) and racial inequality, both actively and passively (Barber et al. 2020; *Nature* Editorial Board 2020; Wingfield 2020). Geology and paleontology (inclusive of paleobiology and evolutionary biology) are part of this system (Bernard and Cooperdock 2018; Montañez 2018). These disciplines are irrevocably tied to a complicated history of colonialism, extraction, and discrimination (Stafford 1988; Secord 2018; Yusoff 2018; Chakrabarti 2019; Table 1). The colonial roots of geology and paleontology have played a fundamental role in shaping their structures and cultures (e.g., Erickson 2020) and must be systemically addressed (Dutt 2020).

Being practitioners of a historical discipline, paleontologists and geologists cannot afford to ignore the history of the geosciences. Indeed, as stated by the Paleontological Society: “The sciences, including paleontology, have participated in the discrimination, oppression, and erasure of people of color throughout history. Failure to acknowledge this foundation of racism and oppression is one of the reasons we are not yet the professional society that we aspire to be” (Fraiser et al. 2020). Western paleontology did not develop independently from, or parallel with, racism and colonialism but has been intertwined with them throughout its history (Manias 2021). Here, we offer a brief review of the history of racism and colonialism in paleontology since the 1800s with specific focus on North America (but with examples from other Western countries; Table 1). We begin this review with the extraction of non-renewable energy resources, fossils, and biological specimens, followed by the roles of natural history museums, and finally how the power imbalances inherited through this history continue to shape the culture and structure of the discipline. We draw attention to examples that illustrate how Western paleontology

is complicit (Table 1) in the systems that perpetuate racist and colonialist ideologies. Acknowledging indirect examples of colonialism and racism in paleontology (e.g., participating in surveys and assessments of the economic value of stolen indigenous lands, failing to address instances of racism in academic settings) is critical to understanding the entanglement of Western paleontology with racist and colonialist structures. If paleontologists and geologists are to achieve the research goals within their disciplines (i.e., learning about the history of life on our planet across geologic time), then they must contend with the historical issues that continue to shape who participates in these disciplines.

Our goal is to promote reflection upon the collective history of the geosciences and to open the floor to a broader conversation surrounding issues of extraction, exclusion, oppression, and erasure (Table 1) within the paleontological disciplines. Thus, our review of the injustices that continue to shape our discipline is neither complete nor comprehensive, but rather it is meant to be a starting point for further discussion. As these dialogues continue, it is critical that individuals, institutions, and societies listen to members of these communities and use their experiences to create actionable steps to move the geosciences forward.

Geosciences Are Extractive

The purpose of the geological sciences is to foster an understanding of the Earth and its history. To generate such knowledge, the geosciences (including paleontology) rely heavily upon extraction—the removal and/or destruction of specimens, samples, or bodies of rock from their natural settings. Extraction in the geosciences is often viewed as necessary for acquiring Earth’s resources, including minerals, rocks, oil, coal, natural gas, and even fossils, although there are many worldviews and methodologies that are non-extractive (e.g., Popp 2018; Wilkinson et al. 2020). Each extraction event leaves a relatively small mark on the landscape, but when extraction occurs over hundreds of years and on industrial (inclusive of modern Western academia) scales, it becomes landscape-altering, at the expense of

TABLE 1. Glossary of anti-racism terms.

Term	Definition
Anti-discriminatory	Actions or steps to actively prevent discrimination of people (Thompson 2021).
Anti-racist	Beliefs, actions, or policies that promote the idea that people of different races and ethnicities are equal (Chaudhary and Berhe 2020).
Colonialism	“A practice of domination, which involves the subjugation of one sovereign people to another” (Kohn and Reddy 2017: para. 1).
Complicit	Benefiting from and/or contributing to systemic racism (Applebaum 2008).
Discrimination	“Acts, practices, or policies that impose a relative disadvantage on persons based on their membership in a salient social group” (Altman 2020: para.13).
Dispossession	The seizure of land and property from native peoples (Greer 2018).
Equity/equitable	“The effort to provide different levels of support based on an individual’s or group’s needs in order to achieve fairness in outcomes. Working to achieve equity acknowledges unequal starting places and the need to correct the imbalance” (CSSP 2019: p. 5).
Erasure	“The practice of collective indifference that renders certain people and groups invisible” (Seghal 2016: para. 3).
Exoticism	Eurocentric fascination with non-Western foreign cultures and peoples, who are viewed as “others” and used to reinforce sentiment of Western culture superiority (Staszak 2009).
Extraction	The exploitative and indifferent removal of natural resources (e.g., earth materials; biological specimens, including humans) for economic or scientific purposes (Yusoff 2018).
Gaslighting	“A type of psychological abuse aimed at making victims seem or feel ‘crazy,’ creating a ‘surreal’ interpersonal environment” (Sweet 2019: p. 851).
Inclusion	Intentional acts and practices of including and actively engaging with a diversity of people (DESA 2019).
Microaggressions	“Brief and commonplace daily verbal, behavioral, or environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory, or negative [...] slights” (Sue et al. 2007: p. 271).
Oppression	“The systematic subjugation of one social group by a more powerful social group for the social, economic, and political benefit of the more powerful social group” (Kenneth and Tema 2021: para. 5).
Power imbalance	A relationship structured such that one side has power and benefits from it (whether consciously or not), while the other side lacks power and is actively harmed by it (VeneKlasen and Miller 2006).
Racism	Prejudice against individuals because of their race in the context of a belief in the inherent superiority and inferiority of different racial groups, which is reinforced by institutional and historical structures (Chaudhary and Berhe 2020).
Repatriation	The restoration of removed cultural and scientific objects back to their country of origin (Simpson 2009).
Systemic/institutional (racism)	“Discriminatory policies and practices within organizations and institutions” (Morgan et al. 2018: p. 1) or a system of governance, which is subtle and not as identifiable as individual racism (Carmichael and Hamilton 1967).
Western	Nations and regions, including cultures and traditions, primarily from the United States, Canada, western Europe, Australia, and New Zealand (Kurth 2003).
White supremacy	“The idea (ideology) that white people and the ideas, thoughts, beliefs, and actions of white people are superior to People of Color and their ideas, thoughts, beliefs, and actions” (Kenneth and Tema 2021: para. 9).

the Earth and its inhabitants—a cost that is often disproportionately paid by the people least represented in the geosciences (Table 1).

Paleontology and the Extraction of Nonrenewable Resources.—The ever-expanding drive for the production of goods and luxuries, driven by industrialized (and predominantly Western) countries, has increased the prevalence of the destructive extraction of geological resources (McQuade 2019), and paleontology has played an important role in this destructive extraction (Lloyd 1975). Industrialized extraction prioritizes production over personhood, exploiting the health and well-being of workers and residents in the extraction process. Extraction often also takes place without regard of land-ownership, often displacing homes and bypassing payment or attribution to the original landowners. These extraction processes are supported by industries, governments, universities, museums, and research programs in North America, all of which are situated upon stolen land that was taken at great cost to Indigenous peoples (Nash 2019). Exploitation and extraction are ongoing processes—they are a structure, not a single event, that shapes our society and our perception of destructive practices (Wolfe 2006; Tuck and Yang 2012).

Perhaps the most consequential extraction processes in the geosciences are those related to nonrenewable energy resources. The U.S. federal government has systematically stripped Indigenous peoples of their lands and autonomy for the purposes of extracting resources, particularly oil, gas, and coal (Redhouse 1985; Riley 2016). Examples of the continued exploitation of Indigenous peoples and their lands for the purposes of oil, gas, and coal include, but are not limited to:

1. the forced removal of Navajo and Hopi people from their lands in the Black Mesa in Arizona for access to coal deposits under the guise of a “land dispute” between the Navajo and Hopi (Redhouse 1985; Cheyfitz 2002; McBride 2017);
2. encroachment upon and threats to the well-being and safety of the Meskwaki, Standing Rock Sioux, and the Cheyenne River Sioux tribes posed by the Dakota Access Pipeline (Noicecat and Spice 2016), although a new

environmental review is being undertaken as of this writing (Frazin 2020); and

3. the decision by the federal government to allow the state of Oklahoma to control the environmental regulations over the recently restored autonomous tribal lands of the Five Tribes of Oklahoma (Cherokee, Chickasaw, Choctaw, Creek [Muscogee], and Seminole) to the benefit of the oil and agricultural industries (Chang 2020; Environmental Protection Agency 2020).

The extraction of nonrenewable resources disproportionately affects the lives of marginalized communities, especially Black, Indigenous, and People of Color (BIPOC) communities; this includes not only the direct impacts of extraction but also the negative effects of anthropogenically driven climate change (Wilson et al. 2010; Cuomo 2011; Sarfaty et al. 2014). While the extraction and consumption of nonrenewable resources have fueled the growth of industrialized societies worldwide, they continue to do so at the cost of BIPOC autonomy and sovereignty.

Paleontology has directly aided in the expansion of oil and gas production (Lloyd 1975). Reciprocally, oil and gas production (along with the human cost of their extraction) are linked to the expansion of paleontology. For the first half of the twentieth century, petroleum geology shaped the direction of paleontological research (Rainger 2001). An important way this influence reached researchers was through the *Journal of Paleontology*, which for decades served as the primary journal for the discipline of paleontology. In 1927, the newly created Society of Economic Paleontologists and Mineralogists (SEPM; now the Society for Sedimentary Geology), published the first issue of the *Journal of Paleontology* (Cushman 1927). The purpose of SEPM was to advance the utility of stratigraphic correlation using marine fossils for petroleum geology research, and the *Journal of Paleontology* was created to aid in these goals (“Society of Economic Paleontologists and Mineralogists” 1927; Rainger 2001). In 1935, SEPM voted to include the Paleontological Society, one of the preeminent societies devoted to paleontological research, as a publishing partner of this journal (“Society Records and Activities” 1935), a partnership

that would last until 1985, when SEPM sold its share to the Paleontological Society (“New Editorial Structure and Policies” 1986). By 1985, the focus of the *Journal of Paleontology*, along with that of paleontological research, had already shifted greatly to one centered on biological systematics, ecology, and evolution (Rainger 2001), and petroleum research shifted to a greater reliance on geophysical data and unconventional resource-extraction technologies. Although many universities and geology programs continue to receive endowment funding from energy companies (through both direct contributions and investments, with the 2020 average U.S. university endowment consisting of 7.7% investments in fossil fuels [Wirz 2020]), it is now easier to distance the general discipline of paleontology from the extraction of oil. Nevertheless, the history of paleontology, the Paleontological Society, and the *Journal of Paleontology* are inseparably entwined with the extraction of petroleum resources and are complicit in the resulting erasure and dispossession of BIPOC groups.

Extraction of Fossils and Biological Specimens.—The link between paleontology and extractive processes is clearly defined with respect to biological specimens and the lands from which they are extracted. Here, we define biological specimens as both extinct (including fossilized) and extant organisms that were collected for the express purpose of furthering scientific exploration and scholarship. Throughout modern history, Western science has directly benefited from the extraction of biological specimens born out of colonialist expansion (Sheets-Pyenson 1986; Roy 2018; Chakrabarti 2019; Christison et al. 2020; see also Fagan 2007). These specimens formed the foundations of new theories and subdisciplines of scientific thought (Stix 2009), including scientific racism (Curtin 1960). Thus, as an active participant in colonialism, Western science accumulated skills, respect, and perceived value, with “world-class” universities and natural history collections that continue to be exalted and visited to this day (Sheets-Pyenson 1986; Heidenreich and Plaza 2015). However, for the Indigenous groups of colonized territories, the cost of the extraction of biological specimens included the misrepresentation and erasure of

their cultural heritage, exploitation of their physical and mental labor, and the loss of their sovereignty, as well as genocide, disease, and poverty (Wolfe 2006; Kantor 2007; Turnbull 2007; Crosby 2013; Das and Lowe 2018). In this section, we illustrate just a few of the many examples of how the extraction of biological specimens is intimately linked to colonialism and Western expansion. These extractive and colonial practices, including the extraction of biological specimens, the dominance of Western countries in scientific disciplines, and a lack of acknowledgment for BIPOC sources of knowledge are not consigned to history—they continue to define modern science (Dahdouh-Guebas et al. 2003; Marks 2012; David-Chavez and Gavin 2018).

The extraction of biological specimens in conjunction with colonial endeavors formed the foundation of evolutionary biology and paleobiology. For example, Charles Darwin extracted thousands of specimens during his voyage on the HMS *Beagle* (Fagan 2007), a collection that served as the basis for the theory of evolution by natural selection; however, the purpose of the voyage of the HMS *Beagle* was to map the coasts of South America to aid in the expansion of the British Empire (Thompson 2019). Conspicuously, none of Darwin’s specimens are now located in their countries of origin (Steinheimer 2004). In a similar manner, the American Bone Wars (a period of competitive fossil hunting in the United States during the nineteenth century), while spurring a revolution in American paleontology, took place against a backdrop of westward expansion and the genocide and displacement of Native Americans (Bradley 2014). Beyond the Bone Wars, there have been countless instances of paleontologists disregarding treaties, stealing fossils, and desecrating Native American lands (Dussias 1996; Mayor 2007; Bradley 2014). While these practices have declined in frequency, they still continue among modern paleontologists (Bradley 2014; Jones 2019).

Grave-robbing by Western scientists, including by such notable figures in paleontology as Othniel C. Marsh (O’Brien 2013), Edward D. Cope (Bradley 2014), and Annie M. Alexander (O’Brien 2020), is another form of biological extraction. Extracted Indigenous remains from various regions around the world, along with

remains of Black slaves, were used in attempts to objectively demonstrate human “evolutionary progression,” placing racialized groups closer to nonhuman primates and lauding those of western European descent as the pinnacle of human evolution (Morton 1839, 1844, 1849; Nott and Gliddon 1854, 1868; Gould 1978). Whereas studies that attempted to demonstrate Caucasian superiority based on cranial size have been discredited (Gould 1978; Mitchell 2018), they were influential in affirming scientific racism (Bates 1999). Moreover, these craniometry studies validated Social Darwinian sentiment during the late nineteenth to early twentieth century (Hecht 2000). Many of these stolen remains continue to be used in studies of human intelligence and are the subject of substantial controversy (e.g., Rushton and Rushton 2003; Rushton and Ankney 2009). Furthermore, many repositories still retain the human remains of various Indigenous peoples in their collections with no repatriation (Table 1) efforts in progress (Gallagher 2010), and those with repatriation efforts are being driven primarily by public pressure (Crimmins 2021).

Antiquated practices and views continue to shape the discipline of paleontology. The Myanmar amber trade provides another recent example. Myanmar gained independence from the United Kingdom in 1948 and continues to suffer from a decades-long civil conflict, which has been funded in part by the amber trade (Sokol 2019; Joel 2020). Western paleontologists continue to benefit from the amber trade at the cost of lives in Myanmar (Sokol 2019; Joel 2020). Progress has been made in limiting the purchase of and publication on Myanmar amber (Rayfield et al. 2020), with a strict moratorium put in place on the publication of material collected after the most recent military coup in February 2021 (Theodor et al. 2021). However, current proposals to limit the scientific acquisition and study of Myanmar amber have their detractors, and the Society of Vertebrate Paleontology is allowing the publication of materials collected before 2017 (Theodor et al. 2021), which leaves the issue largely unresolved (Haug et al. 2020). Such examples illustrate how the paleontological community continues to perpetuate and benefit from extractive colonial practices and their legacies.

Museums and Acknowledging the Past.—At their conception, modern natural history museums in the West dealt in exoticism (Table 1). These museums displayed specimens and cultural objects forcefully extracted during colonial conquests of far-off lands, which were used to establish the need to “civilize” Indigenous peoples (Seth 2009; Roy 2018; Vawda 2019). While natural history museums have developed into multifunctional institutions that now serve a diverse array of disciplines, peoples, and purposes, they are grounded in these colonial origins and continue to benefit from the degradation of Indigenous cultures and centuries of unethical extraction (Turnbull 2007; Williams 2013; Abungu 2019).

Contemporary natural history museums are focused on the preservation of collections, research, outreach, and education. However, the ability of museums to achieve these goals has been hindered both by their origins in Western colonialism and the need for a proper redress of their history (Das and Lowe 2018; Vawda 2019; Kohlstedt 2020). Increased recognition of this historical context has led to an ongoing discussion of whether museums possess critical flaws and if they can, or should, be saved (e.g., Ahn et al. 2020). We assert that many of the concerns raised about museums are valid and require meaningful rectification. These concerns include, but are not limited to, the following:

1. failure to acknowledge and educate others about the origins of museums and their ties to colonialism;
2. lack of credit for/erasure of Indigenous contributions and naming rights;
3. reluctance or refusal to return specimens (including biological, anthropological, and geological specimens) or to assist local institutions that wish for their repatriation;
4. limited public and financial access to museums and their collections;
5. inequalities among museums, with some museums having greater resources than others;
6. reliance on unpaid and low-wage labor in research and outreach that precludes the participation of BIPOC individuals and people of lower socioeconomic status (Clay 2019); and

7. lack of diversity, particularly ethnic and racial diversity, among senior personnel (e.g., administrators, curators, and collection and lab managers) who shape the culture, structure, and practices of museums (Das and Lowe 2018; Vawda 2019; Kohlstedt 2020).

Such concerns erode public trust in museums and hinder their ability to fully serve the communities with which they seek to engage.

Addressing the various cultural and structural concerns regarding museums and natural history collections requires both introspection and a willingness to change (Das and Lowe 2018; Abungu 2019; Vawda 2019). This type of transformation necessitates a strong emphasis on the importance of repatriation efforts and investing in the development of Indigenous scholars and local scientific institutions (Abungu 2019). These actions will create a vital discourse between local communities and Western scientific institutions (Abungu 2019). The incorporation of Indigenous perspectives into museums, which may include views that are antithetical to the narratives previously professed by these institutions, would be a substantial step forward in addressing the colonial history of natural history museums (Vawda 2019). Furthermore, museums can and should be held accountable for cataloging their histories of colonialism and extraction to spur reflection on that history and grow beyond it (Das and Lowe 2018). As part of this effort, the flaws of founders, scientists, and other historic figures involved in the narratives of museums must be publicly recognized for museums to maintain their credibility (Roy 2018). Museums must also root out the elements that perpetuate racism and colonialism, such as the lack of rightful attribution and the cultural context in which specimens were collected. Such actions will help to further the role of natural history museums as centers of learning and repositories of the past in service to society.

Manifestations of Racism and Colonialism in Academia

Western geosciences were founded on systematic practices of exclusion, oppression, and

erasure. These practices have been ingrained in the structure and culture of these disciplines (Yusoff 2018) and continue to permeate modern academic settings. Identifying and addressing the manifestation of these practices in academia (e.g., discrimination, tolerance of abusive behavior, entrenched stereotypes) could be facilitated by a reflection upon the history of the geosciences within a broader social context (Núñez et al. 2020). However, meaningful redress of these issues is effectively prevented by the same power dynamics that facilitated the growth of the geosciences described here. Indeed, the structure of Western academia, including the geosciences, is built upon imbalances of power (Clauset et al. 2015; Moss 2018; Marín-Spiotta et al. 2020). These kinds of power imbalances are ubiquitous, yet seldom addressed, in professional or academic settings (Marín-Spiotta et al. 2020). Here, we illustrate how perception of the history of paleontology reflects these imbalances of power, before discussing how these dynamics reinforce racist structures and norms within academia.

A reflection upon how the history of paleontology is presented in the classroom provides an introduction to the concept of power imbalances in modern academia. In many Western paleontology courses, syllabi ignore how the establishment of paleontology (and geology) in the Americas relied on the removal and erasure of BIPOC groups. In addition to the material presented in the previous sections, examples include Native American beliefs surrounding the biological origins of fossils (Dussias 1996); the first fossils known to Western science in the Americas were identified by enslaved Africans (Mayor 2005); evolutionary theory was grounded in societal and political views regarding race and culture, wherein evolution and extinction were viewed as mechanisms of removing “unfit” species, and was used to justify Western colonialism (Sepkoski 2020). Discussing these facts in a science classroom at all ages and education levels may seem inconvenient and unsettling. Students are often taught that science is apolitical, unbiased, and egalitarian, when in reality it is not. Because of this, reality is often supplanted by a racist, colonialist, and inherently misleading narrative (Sabbagh 2017). Most Western paleontology

and geoscience courses are taught by white faculty who control course curricula (Dutt 2020; Marín-Spiotta et al. 2020). Without uncomfortable examination of current teaching methods and textbooks, most paleontology courses will continue to emphasize the contributions of white (often male) Western scientists to paleontology, while simultaneously failing to address the racist beliefs of Western scientists, the knowledge of BIPOC scholars, and the historical and modern exploitation of BIPOC communities to benefit Western institutions. This amounts to white supremacy (Truss 2019; Table 1). Failure to recognize and address unequal power dynamics and their effects on academia only serves to entrench these behaviors.

Power imbalances manifest as cultural and structural issues in our disciplines. These include legacies of exclusion, discrimination in hiring practices, entrenched power dynamics (especially between senior white faculty and BIPOC scholars), and tolerance for racially motivated abusive behaviors, all of which are examples of institutionally enforced racism (Marín-Spiotta et al. 2020). Failing to recognize racist and discriminatory norms and structures as problematic produces a disconnect between the perception of one's own values (anti-racist, anti-discriminatory, inclusive, etc.) and the actions one takes to address the cultural manifestations of power imbalances (racially motivated harassment, discrimination, microaggressions, etc.) that contribute to hostile climates (Sue et al. 2009; Sensoy and Diangelo 2017; Wilkins-Yel et al. 2019). Collective failure to respond to instances of cultural and structural racism places an undue burden directly upon those who identify as BIPOC (Sue et al. 2009; Harrison and Tanner 2018; Wilkins-Yel et al. 2019; Pickrell 2020). In short, the lack of representation of BIPOC scientists in academia is not part of a passive "leaky pipeline" problem (Bernard and Cooperdock 2018; Dutt 2020). This metaphor is misleading and inadequate and frames underrepresented scientists as an extractable resource (Marín-Spiotta et al. 2020). Rather, the attrition of such scientists is an active process that is driven by cultural and structural barriers that individuals fail to identify as problematic, tacitly accept as the norm, and fail to take measurable action against

(Puritty et al. 2017; King et al. 2018; Dutt 2020; Marín-Spiotta et al. 2020).

Tackling the issues created by power imbalances is not simple. Many of these issues are not unique to paleontology; however, addressing power imbalances is critical for having a meaningful discussion about racism and colonialism within our departments, communities, and disciplines (Ali et al. 2021). Identifying problematic cultural and structural barriers, while acting as a participant in the institutions that perpetuate them, is a challenging task (e.g., Bonilla-Silva 2012). It requires us, collectively as academics, to reconsider what we accept as normal behavior or acceptable practices and actively listen to the experiences of others, even when their experiences may sharply contrast with our own (Sue et al. 2009; Puritty et al. 2017; Harrison and Tanner 2018; King et al. 2018; Wilkins-Yel et al. 2019; Núñez et al. 2020; Pickrell 2020; Viglione 2020). For the geosciences to advance, we must scrutinize institutional policies, respond to racist behaviors, and identify and call out past and present instances of racism (Harrison and Tanner 2018; Barber et al. 2020; Dutt 2020; Ali et al. 2021).

Beyond our perception of ourselves and our disciplines, power imbalances themselves pose additional hurdles to taking meaningful action against them. Entrenched power imbalances can make pushback against racist norms feel futile, create fears of retaliation for speaking out, and expose individuals to ridicule through the denial of their personal experience (Truss 2019). Furthermore, a lack of action by those in positions of relative power can be just as harmful as direct attacks (gaslighting, harassment, etc.), as silence conveys tacit approval (Wilkins-Yel et al. 2019; Marín-Spiotta et al. 2020). The complexity of our disciplines, comprising a network of museums, professional societies, and universities that all hold power and operate under their own set of rules and cultural norms, also complicates such action. However, structural change is possible with a unified, community-driven, and active effort to push back against racism, discrimination, and harassment and the structures that uphold them (e.g., Dobbin and Kaelav 2016; Sensoy

and Diangelo 2017; Estrada et al. 2018; Golom 2018; Ash et al. 2020; Visaggi 2020; Ali et al. 2021; Bell et al. 2021; Pico et al. 2021; Watt et al. 2021).

Conclusions and Future Prospects

Introspection and reflection are daunting to many, but they are the first steps needed to enact meaningful change within the geoscience disciplines (Ali et al. 2021). We can better ourselves and our science, and we can begin this process by asking critical questions that allow us to reckon with ideas that we inherently take for granted. To facilitate and promote introspection and discussion going forward, we ask readers to reflect on their own research agenda and how it intersects with racist and colonialist issues presented here:

1. Am I collecting specimens from Indigenous lands?
2. Who truly owns the specimens/data I am using for my research?
3. Who might be affected by my research, and what role do they play in this research?

We also ask readers to consider the demographics of their collaborators and students and who is being left out of their discipline and why. As we begin to reflect upon our past and present and consider our future, we may feel uncomfortable with what we find. We as academics must listen to and affirm the experiences of our friends, colleagues, and students, even when they differ notably from our own. We must identify and address where racism and colonialism manifest in our own institutions, professional societies, and disciplines. Science, technology, engineering, and mathematics have complex and often violent histories that are intertwined with colonialism, racism, and discrimination. To ignore this past or to dismiss its effects in the present serves to perpetuate the colonial and racist structures on which our disciplines were founded. We must work together as a community to reflect upon and address the ongoing racism within our disciplines.

While difficult work lies ahead, many individuals and institutions are providing examples of how we can work to create a more equitable,

inclusive, and diverse environment. Greater attention is being paid to the complicated history of paleontology (Sepkoski 2020; Manias 2021), including in the U.S. national media (Daniels 2021; Elbein 2021). The Paleontological Society formed the Diversity and Inclusion Committee, which was the driving force behind the implementation of a stronger policy on anti-harassment and code of conduct within the society (<https://www.paleosoc.org/non-discrimination-and-code-of-conduct>), among other initiatives to make the society more inclusive and equitable. Other academic societies, such as the Society of Vertebrate Paleontology (<https://vertpaleo.org/code-of-conduct>), have begun a critical review of their codes of conduct and reporting systems for instances of harassment and discrimination too. The Society for Vertebrate Paleontology also recently joined a concerted effort to have the U.S. federal government reinstate the original boundaries of Bears Ears and Grand Staircase-Escalante National Monuments to restrengthen protection of rich fossil deposits and ancestral cultural sites of the Navajo Nation, Hopi Tribe, Ute Mountain Ute Tribe, Pueblo of Zuni, and Ute Indian Tribe (Kreier 2021; Reese 2021). Museums have also started addressing their origins and history through a combination of collaborative and reparative efforts. For example, the Museum für Naturkunde in Berlin, Germany, has worked with Tanzanian officials to provide support in Tanzania for local museum development, the training of local paleontologists, and the excavation of new fossils as reparation for German excavations of the early 1900s, including those that recovered the world's tallest mounted skeleton, *Giraffatitan brancai* (Vogel 2019). These examples of progress provide a template for others to follow and are a first step toward addressing the inequitable past and present of our disciplines.

This brief review is meant to encourage further discussion about colonialism and racism in geology and paleontology but represents only a first step in addressing a broader suite of structural and cultural issues and their histories (sexism, including the “macho” tropes reputation of paleontology; ableism; gender discrimination; etc.). As we begin to grapple with these issues, we must listen to the

marginalized groups they impact and work together to create actionable steps forward founded on their lived experiences. Dismantling our own institutionalized worldviews and reluctance toward change is crucial for *both* the social and scientific advancement of the geosciences. To create a better and more equitable future for our students, colleagues, and communities, we, individually and institutionally, must choose to both acknowledge the founding of our discipline in racist and colonial ideologies and address the cultural and structural impacts of these origins that continue today.

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