

The political lives of deserts

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Abstract. Deserts, like any geographic setting, are not sites where geopolitical dramas simply unfold or “touch down”: rather, they actively constitute geopolitical orders. This article shows how taking deserts rather than states as an entry-point can provide a unique lens on geopolitics, state-making, and empire. Investigating the political lives of deserts requires asking how they are imagined, narrated, and connected across space and time, and with what effect. To do so, I consider one case of desert-to-desert connection: a long but little known history of exchange between individuals and institutions in Arizona and the Arabian Peninsula. Taking one example from this history, I show how the “desert” as an environmental imaginary figured in the University of Arizona Environmental Research Laboratory’s joint greenhouse/desalting plant, which was initiated in Abu Dhabi in the late 1960s. Primarily drawing from archival research in the UAE and Arizona, I also show how this project fit into shifting geopolitical relations in the Arabian Peninsula’s colonial relations, the rise of the UAE as an independent state, and the role of experts working in the service of broader political agendas of the state and the academy, as well as their own self-interest.

Keywords: desert; geopolitics; political geography; historical geography; Arabian Peninsula

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Introduction

Deserts lead curiously political lives. In practice and in popular culture, deserts around the world have served as the stage for imperial dramas of frontier masculinity and the modernist violence of subverting Nature to the will of Man (Ellis 2018; Isenberg et al. 2019; Worster 1985). Aspirations to make deserts “bloom” are one especially pervasive example of this imperial drama, as agricultural schemes in arid lands index diverse visions of technomodernity, human ingenuity, and political might across time and space (Biasillo and da Silva 2019; George 1979; Heslop 2014; Koch 2015; Ouis 2002). And while their diverse material resources – flora, fauna, sand, water, minerals, etc. – are commodified and travel around the world through a range of networks, deserts are frequently narrated as “empty” to justify their transformation into toxic zones of extraction (Kuletz 1998; Sanchez-Lopez 2019; Voyles 2015). Beyond the extracted materials, scientists and others have also extracted identities from deserts: building careers and entire academic institutions around expertise in drylands, arid lands, and all range of un/disciplined desert knowledges (Burtner 2012; Morrissey and Burtner 2019; Sayre 2017). In short, deserts are not just ecological zones, but highly charged technopolitical zones (Barry 2001; Davis and Burke 2011; Jasanoff 2015).

Like any geographic setting, deserts are not sites where geopolitical dramas simply unfold or “touch down.” Rather, environmental imaginaries about deserts are *geopolitical* imaginaries, actively constituting and constituted by relations, identities, and potentialities across time and space. To investigate these political uses of desert imaginaries – the political lives of deserts – I ask how they are imagined, narrated, and connected, and with what effect. Taking my cue from Verdery’s (1999) formulation in *The Political Lives of Dead Bodies*, I am likewise inspired to look

beyond the conventional entry-points for understanding politics, the state, and state-making. To do so, I focus on arid lands and their experts. Given the colonial logic of modernist states, a focus on science and scientists is particularly useful for explaining how state power and territorial authority came to be (and continue to be) manifested in and through deserts. Following scientists and research programs also allows us to trace some of the infinitely varied linkages between deserts beyond their immediate territorial extent, as individuals and institutions leverage their arid lands expertise in different parts of the world. These ties are often just as surprising as they are predictable, and one such case is the focus of this article: connections between the deserts of Arizona and the Arabian Peninsula spanning many decades. This case study vividly illustrates the role of the “desert” as an environmental imaginary in facilitating geopolitical relations between the U.S. and the Middle East. But as discussed below, I focus on the *political lives* of deserts because these imaginaries are often detached from the material realities of the deserts themselves.

Within the United States, Arizona holds a special place in the nationalist understandings of the desert, as well as the history of arid lands science. Today, Arizona institutions, researchers, consultants, and others routinely leverage their expertise in arid lands to promote their work in many deserts around the world (see e.g. McGinley 2018; Pigott 2018). In fact, Arizona scientists have made a special claim to expertise in desert agriculture and mobilized this in the Arabian Peninsula for decades: Saudi Arabia’s first experimental desert farm at Al Kharj, for example, was developed with the assistance of a group of Arizona farmers in the 1940s . Their work and the Al Kharj project more broadly was also supported by Karl S. Twitchell, an American engineer and geologist, who led the famous U.S. Agriculture Missions in Saudi Arabia in 1942 and 1944, and who had spent several early years in Arizona before his first trips to the Arabian Peninsula (Jones 2010; Woertz 2013).

After WWII, American specialists were increasingly called upon by both U.S. and local governments to harness their expertise to bolster the Gulf rulers’ authority – and in so doing, they helped to build American empire (Jones 2010; Vitalis 2007). By the late 1960s, as America’s imperial presence began to grow in the Arabian Peninsula, the University of Arizona’s Environmental Research Lab was invited to develop Abu Dhabi’s first integrated desalination plant and experimental greenhouses – the project examined in this article. As one example of American influence beginning to spread internationally in the post-war period through its universities and research networks (Latham 2011), this case illustrates how Arizona’s arid lands experts strategically worked to construct the “desert” as a site of technoscientific intervention *and* as a geopolitical imaginary to facilitate and justify connections they sought to forge between the U.S. Southwest and the Arabian Peninsula. Such narrative uses of the “desert” are both strategic *and* unthinking, but they ultimately form the political lives of deserts. Like any life, they are diverse, eclectic, and full of potential, but never preordained.

This article highlights the analytical power of attending to the political lives of deserts. In so doing, I illustrate how US-Gulf relations have a deeper and broader history that goes well beyond oil and militarism, as is still so often assumed. Looking through the lens of arid lands exchanges, which have always been a key part of US-Gulf relations, we can see how American empire in the Middle East has worked through a more diverse set of political economies. Many scholars have analyzed internationally- and historically-shared visions about arid lands (such as mastering the environment through science, agriculture, etc.), but these connections are most

frequently analyzed as *parallels*.¹ Here, by contrast, I advance an approach to deserts that opens up new questions about their myriad – and often surprising – connections with other parts of the world. Methodologically, this effort is guided by the interdisciplinary body of work adopting transnational approaches to the history of science (see Hecht and Edwards 2010; Latour 1987). Like the powerful case studies in Finn’s (1998) *Tracing the veins: Of copper, culture, and community from Butte to Chuquicamata*, and Melillo’s (2015) *Strangers on familiar soil: Rediscovering the Chile-California connection*, my goal is to explain a long, if discontinuous, history of exchange between Arizona and the Arabian Peninsula.

This case study also links my own positionality as a political geographer, a Gulf and Arabian Peninsula studies scholar, and a native of Tucson, Arizona, to offer a situated snapshot of the long history of ties binding the two regions. In this part of a broader project on ties between Arizona and Arabia, I focus on the technopolitical networks of scientists and political actors who have bridged the two places through their own movements and material interventions, as well as their discursive productions of the “desert.” I have been conducting research in the Arabian Peninsula since 2012, though the dedicated research for this project 3 months of fieldwork in Arizona and 4 months in the Gulf, beginning in November 2018. In addition to informal interviews with relevant actors in the Gulf and Arizona, I draw on extensive archival research. For this article, I worked with holdings at the UAE National Archive, the US National Archives, the UK National Archives available via the Arabian Gulf Digital Archive, University of Arizona (UA) Special Collections, the UA History of Agriculture & Rural Life digital archive, the Arizona Memory Project, and Public Records Requests submitted to the University of Arizona. Finally, through systematic searches in my home institution’s news databases (primarily NewspaperArchive.com), I reviewed all articles related to the case study published in U.S. newspapers, periodicals, books, and academic journals from the 1960s-80s – amounting to approximately 100 individual articles.

Science and state-making in the desert

The contemporary geopolitical order is dominated by the state system – perplexingly so given the intensely networked modes of life and society today. Murphy (2013) thus called on readers of the *Annals* to give more attention to territory’s continuing “allure” and the surprising “stickiness” of the modern state system. The continued allure of the territorial state is difficult to address, though, because there is no global explanation: There are only local histories. In the face of such diversity, political geographers working to explain the persistence of the state have largely focused on state-making projects *themselves*. That is, while there are myriad actors who bring the “state” to life, nationalist storytelling (and methodologically nationalist social science) typically emphasizes those obviously “political” agents acting in the name of the of state or a nation. This article, by contrast, revisits Murphy’s question in light of recent advances in political geography research about the state system *without an explicit focus on the state itself*, by instead focusing on scientists and their research institutions. Further, I do so through the specific lens of deserts to emphasize the central place of environmental imaginaries in facilitating geopolitical relations. These imaginaries, I argue, are not just the product of *nationalist* imaginings of space, place, and the natural world, but are actually the result of *transnational* cooperation and conjunctures, as actors forge bonds across borders in pursuit of their geopolitical interests and agendas.

¹ A handful of exceptions are found in comparative studies of deserts, some of which trace direct connections between two places, e.g. Akhter and Omerod 2015; Biasillo and da Silva 2019; Francaviglia 2011; Isenberg 2019; Isenberg et al. 2019; Morrissey and Burtner 2019.

Many scholars, within geography and beyond, have illustrated how scientists and other technical “experts” have long labored in the service of building a state and territorializing it *without* claiming a public profile (see e.g. Akhter 2015; Ashutosh 2017; Barnes and Farish 2006; Doel 1997; Elshakry 2015; Farish 2010; Pinkerton et al. 2011; Sneddon 2012, 2015). Much of this research draws from and speaks to a rich literature in Science and Technology studies (STS), which vividly illustrates how science and state-making are intimately interconnected enterprises, consisting of multiple transnational circuits of knowledge, power, and spatial imaginaries. Indeed, geography itself is intimately connected with the history of the state, as its diverse tools for perceiving and portraying the earth – *geo-graphing* – were enlisted not just for navigating the world, but also for *territorializing* political power, which is a crucial aspect of the modern state (Agnew 2003; Sack 1986; Winichakul 1994). Although generally assuming a lower profile than public officials, scientists and other experts are essential to the practice of producing the state – transforming it from a *hollow* notion into a *hallowed* one, endowed with both meaning and substance. As the STS literature shows, these scientists have routinely crossed borders to do in the service of states *other than their own*. This is especially apparent in the Arabian Peninsula along its postcolonial transition.

Gulf geopolitics has not received much attention in geography, but the rise of the territorial state in the Arabian Peninsula has been considered by a number of critical historians. These scholars have shed light on the stunning array of actors, infrastructures, imaginaries, and economies that are called upon and called into being through imperial forces in diverse corners of the Arabian Peninsula (e.g. Fuccaro 2009; Khalili 2018; Legrenzi 2015; Low 2015, 2020; Onley 2007, 2009; Vitalis 2007). The region’s environmental history has also been the subject of a small but growing number of studies, which have examined the relationship between imperial modernization agendas, state-making, and the natural environment in the Gulf (e.g. Joseph 2018; Joseph and Howarth 2015; Koch 2019; Hightower 2015; MacLean 2017; Woertz 2013). Much of this research has been inspired by Toby C. Jones’ (2010) seminal book, *Desert kingdom: How oil and water forged modern Saudi Arabia*, but it also arises out of a wider literature on colonial constructions of “nature” and the environmental history of the Middle East and Northern Africa (e.g. Ahram 2015; Alatout 2006, 2008, 2014; Barnes 2009, 2012; Davis 2004, 2007, 2016, 2019; Davis and Burke 2011; Derr 2019; Farmer and Barnes 2018; Hodge 2007; Mikhail 2012; Pritchard 2012; Tesdell 2015, 2017; Verhoeven 2018).

This article diverges from this impressive body of scholarship, however, by adopting an explicit focus on geopolitics from the ground up. Discussions of empire and the environment often orbit around narrow questions of extraction, whereby complex and layered relationships are collapsed into a simple binary of colonizer/colonized or metropole/periphery. Yet as Pritchard (2012, 593) forcefully argued in her work on French colonial water management in Africa, “the tidy dichotomy of metropole-periphery fails to capture historical complexities and the fact that ‘hydropower’ is not simply about management of a material resource but also the very production and control of knowledge regimes.” She emphasized the plurality of actors, conflicting allegiances, and flows in many directions, as bureaucrats and experts returned to France, stayed in Africa, or transferred their skills to other parts of the globe.

Scholarship on geopolitics and state-making in political geography has likewise emphasized this multiplicity, but has accorded relatively less attention to environmental themes until recently (Moisio et al. forthcoming; O’Lear 2020). Some scholars working at the intersection of political geography and political ecology have focused on the *materiality* of the natural world, however, to highlight the role of the nonhuman in geopolitical systems (e.g. Squire 2015; Sundberg

2011). While I do not contest the validity of this work, my focus here is different. Rather than concentrate on the material features of the two desert contexts I consider – Arizona and the Arabian Peninsula – I am interested in how the desert is narratively produced as a technopolitical zone. As I show, it is precisely erasing or ignoring the materiality of these places that makes the “desert” a convenient environment imaginary around which specific actors forge geopolitical ties. My goal is thus to show how political leaders and scientific experts work together to craft a specific narrative of the natural world and, in so doing, their environmental interventions do not just *reflect* a geopolitical order, but bring it to life through territorializing particular political geographies. Initiated in 1968, the UA ERL project in what was then the non-sovereign Emirate of Abu Dhabi is an exemplary case.

Prior to achieving statehood in 1971, the UAE’s constituent emirates became active sites for the reconfiguration of British and American imperial relations. Given local and colonial anxieties about the region’s desert environment, water and agriculture projects were especially important sites for cooperation and development. Such projects in the UAE have received little attention among Gulf studies scholars to date, as they were fewer and later than the better known Gulf projects in Saudi Arabia and Kuwait.² The UAE is nonetheless instructive, since it shows how local actors function alongside arid lands experts from Arizona in their state-making efforts on the cusp of independence. Following the ERL project into the period of Emirati statehood, we see how these individuals worked together, not only building from the traditions of their predecessors during the era of empire, but also serving as a bridge in that remarkable transition between imperial configurations to today’s state-based political geographies.

By following specific U.S. actors in the post-WWII period, we can see the negotiation of shifting relations between the state, science, and colonialism, which set American empire apart from its French or British counterparts in the Middle East. Rather than claiming to be agents of the state as such, the U.S. agents of empire consistently articulated their work in the name of science – a dynamic that Latham (2011) brilliantly elucidated in *The right kind of revolution*. Across the Arabian Peninsula, American imperial expansion was tied to technical projects related to agriculture, water, desalination, and other infrastructural interests extending well beyond the oilfields that have made the region so famous. Given the Arabian Peninsula’s physical geography, U.S. actors (governmental and nongovernmental alike) continually emphasized their special ability to develop such projects by emphasizing their expertise in arid lands sciences. Arizona-based experts lacked the expertise in oil extraction, which individuals from Texas or Oklahoma could readily deploy in justifying their bids for major U.S. projects in the Gulf region. They instead relied more on their specialized knowledge of desert farming, water, and other arid lands infrastructural challenges.

The history of Arizona’s association with desert agriculture and other forms of arid lands expertise dates to the territory’s early colonization by Anglo-Americans in the mid-1800s (which cannot be detailed here, but see Blackhawk 2006, Meeks 2007; VanderMeer 2010). In his account of how the “Sonoran Desert” was codified, commodified, and ultimately constructed as an *American* icon, Burtner (2012) highlighted the intertwining colonial logics binding the conquest of the Arizona desert and deserts elsewhere in the world. He showed how scientists “studying Arizona assisted US domination and provided the tools necessary to look out at global arid lands.

² Decades before the primacy of hydrocarbons in writing about resources in the Arabian Peninsula, however, agriculture was an important topic in social science research on the region, e.g. Bowen-Jones and Dutton 1983; Crary 1951; Cressey 1957; El Mallakh 1970, 1981; Melamid 1957; Sanger 1954; van der Meulen 1957; Twitchell 1944, 1958.

The expertise gained by U.S. scientists in the Sonoran Desert became the basis for a comparative model useful in generalizing about the world's deserts in the first half of the twentieth century" (Burtner 2012, 277) – and, as we shall see, well beyond. One of the more enduring threads in this history has been the narrative of the “desert” that has so often served as the basis for exchanges between the U.S. and the Middle East.

The political lives of deserts in Arizona and Arabia

The Gulf Arab countries today are often set apart from research on the Middle East, primarily because of the region's special political economy and demography (Vora and Koch 2015), but also because of its unique relationship with agriculture, water, and resource extraction. Yet the Gulf's historical connections with Arizona are important in that they show how scientists and politicians have worked with particular environmental imaginaries to *include* or *normalize* the region on the basis of its desert constraints. Deserts around the world have a long history of being framed as “deficient” (Davis 20106; Isenberg et al. 2019), but this is not the primary narrative used by actors in Arizona and the Arabian Peninsula working together to realize common political, corporate, and personal agendas. They have instead narrated the desert as a site of *opportunity* – a scientific laboratory or frontier, and an ideal place to build geopolitical connections through dryland agriculture and arid lands science. This section illustrates this kind of “desert geopolitics” in action through a case study of the UA ERL greenhouse project in Abu Dhabi, initiated in 1968.

The ERL project was the first serious effort to develop commercial greenhouses in the Trucial States – what would later become the United Arab Emirates. It was not the first high-profile agricultural experimentation site, however. This was the British Agricultural Trials Station at Digdagga, opened in 1955 in the emirate of Ras al-Khaimah. The Digdagga project was aimed at testing the viability of certain fruits and vegetables for local markets and educating local farmers in “scientific” cultivation methods through a school eventually opened there (MacLean 2017; Zacharias 2017), and the program built on a broader British pattern of promoting agriculture in its colonies to promote development – and its image of benevolence (Hodge 2007). The Digdagga Trials Station focused on traditional agriculture and its produce did not circulate widely because of limited production, means of transport, and colonial authorities' disagreements about whether goods should be marketed and sold at all. By the 1960s, commercially-oriented agriculture still had not yet reached other emirates, and fresh produce remained available only by import.

This situation frustrated Sheikh Zayed bin Sultan Al Nahyan, the aspiring leader in nearby Abu Dhabi, who eagerly promoted agricultural development and all range of “greening” projects. After Zayed deposed his elder brother, Sheikh Shakhbut, in 1966, he assumed control of the Abu Dhabi emirate. Zayed's primary concern and the alleged reason for the dramatic action was that Shakhbut refused to use revenue from oil, discovered in 1958, for the territory's development. Therefore, when Zayed came to power, he quickly set about adopting policies and allocating funds to promote the development of Abu Dhabi and realize his vision for the emirate's “modernization.” Modernizing its food supply and bringing green vegetation to the desert landscape was a fundamental part of this vision, which was bound up with “the political system of with a system of paternalism that has come to be termed Zayedism” (Ouis 2002, 338). And here, in this confluence of imaging and opportunity, walked another man and his shared vision of greening the desert through high-tech agriculture: Carl N. Hodges.

The University of Arizona in Abu Dhabi

Born in 1937, Hodges began graduate studies at the UA, after having received a UA undergraduate degree in Mathematics in 1959. In 1961, he was hired as a research assistant for the university's new Solar Energy Research Laboratory, which was established in 1955 by A. Richard ("Dick") Kassander. Within a few years, Kassander, a trained physicist and a budding UA administrator, appointed Hodges to be the Laboratory Supervisor. It is unclear why Kassander placed so much confidence in Hodges, who was only 24 years old when he assumed the position in 1963 and had not completed his advanced degree (and never would).³ Yet Kassander clearly saw Hodges as a kind of protégé and this paternalistic relationship is vividly captured in a series of PR photographs for the Solar Lab's first major project in Mexico – two of which are seen in **Figure 1** – as well as in a short *Spectrum* television documentary featuring the two men together (NET 1965). Indeed, this project was the beginning of a close bond that lasted until Kassander's death in 2017 (Jensen 2017).



Figure 1. Richard Kassander (left) and Carl N. Hodges (right) at the UA Solar Energy Research Laboratory in Puerto Peñasco, Mexico, 1964. Source: *UA Special Collections (UA Bio, Hodges, Carl N. 1937-, Photographs)*.

In the early 1960s, the U.S. Department of the Interior's Office of Saline Water (OSW) awarded the UA Solar Lab a grant to work with the University of Sonora in Puerto Peñasco to build a solar-powered desalting plant (on the OSW, see Low 2020). Drawing on his connections at the Rockefeller Foundation, Kassander secured additional support for the project's expansion to pair the desalting plant with plastic-covered greenhouses (Negri 1987). Kassander, who would later become UA's first Vice President of Research, had an entrepreneurial spirit and was keenly aware of the importance of advertising the university's high-tech initiative through popular media outlets and science journals alike. For his part, Hodges loved the limelight and especially being characterized as a "boy-wonder" – credentialed or not. Together, the two men ensured that the

³ UA Special Collections, UA Bio, Hodges, Carl N. 1937-, Printed Materials. Hodges' CV updates filed with the university are inconsistent regarding his field of graduate study, which is sometimes named as meteorology, atmospheric physics, or water resources administration.

lab's Mexico project received ample press coverage, and it was ultimately profiled in a 1967 issue of *Time* magazine, which heralded Hodges as a visionary:

Although the oceans lap at their shores, more than 18,000 miles of the world's coastlines are virtually uninhabited because of the lack of available fresh water. Visionaries have long dreamed of using sea water to make these deserts bloom, but University of Arizona Scientist Carl Hodges is actually doing something about it. And not by means of futuristic and costly nuclear-powered desalination plants, but by efficient use of simple diesel-electric engines like those that now provide power to remote communities all over the world. A pilot project on Mexico's Gulf of California is already accomplishing in miniature what Hodges hopes to achieve on a global scale. ("Science - Technology: Diesels in the Desert" 1967)

Indeed, as this article notes, the Puerto Peñasco project never actually ran its desalting process on solar power, and it is probably for this reason that the Solar Energy Research Laboratory was renamed the "Environmental Research Laboratory" (ERL) in 1967, with Hodges installed as its Director.

The *Time* article was also described as a turning point for the UA lab because it found its way to the ruling emir of Abu Dhabi, Sheikh Zayed, who asked to have one built in Abu Dhabi (Hodges 1975; Negri 1987).⁴ The reporting on Zayed's request was sensational and orientalist, as several introductions to the project's genesis suggest:

Tucson Daily Citizen: Take one tiny Saudi Arabian sheikdom of sand, sea and sun, mix in some scientific expertise from the University of Arizona and what do you have? Vegetables sprouting from the desert — tomatoes, cucumbers, squash, lettuce, eggplant, peppers, broccoli and cabbage. The sheikdom is called Abu Dhabi. And when an article appeared in a 1967 edition of *Time* magazine about a UA facility at Puerto Penasco, Abu Dhabi was interested in one of its own. (Finkelstein 1972, 14)

Science: When the sheik heard about the successful experiment in Puerto Penasco he dashed off a check for \$3.16 million to build a similar project in his desert kingdom large enough to keep his 50,000 subjects in fresh vegetables year round. The check went to the University of Arizona Environmental Research Laboratory here—inventors of the combined system that provides cheap power, water and food on coastal desert lands. (Hillinger 1969, 6)

The news reports are uniform in painting an image of Zayed's spectacular wealth, routinely highlighting his ability to allocate large sums of money on a whim, and framing him as an "Arabian sultan" (Hillinger 1969, 6) and the ruler of a fantastically wealthy "postage-stamp Shaikhdom [...] now is the richest state in the world" (Crone 1969, 25).

⁴ Elsewhere, the connection with Sheikh Zayed is described not as resulting from the magazine article, but the result of a meeting with one of Zayed's advisors that Hodges had in Kuwait, while on a 17-country tour to further broadcast the greenhouse/desalting plant in Mexico (e.g. *Business Week* 1970).

The sense of awe and surprise permeates the articles, as they dwell on the financing and the titillating possibilities of collaborating with a leader who can so easily write a check for what might be otherwise deemed a whimsical or risky investment: “Kassander said the small, oil-rich nation, whose 50,000 Arab residents are mostly illiterate, sent, the university enough money to finance the building of the desalting plant with the balance deposited in Abu Dhabi banks to be spent there for on-site construction” (Thomas 1969, 51). Today’s audiences may find it uncomfortable to see news of a US university administrator boasting that he was taking millions of dollars from an Arab royal whose residents are described as “mostly illiterate.”⁵ This attribution was so frequent in the reporting, however, that it was obviously a point of pride – evidence of Zayed’s unique desire to modernize his backward territory through partnering with the high-tech visionaries of the University of Arizona. Ever the enthusiast for splashy media coverage, Hodges clearly reveled in the fame and prestige that accompanied his association with an “Arabian sultan” (on the evolution of these discourses about Arabian Peninsula wealth in the U.S. media, see Smith 2015).

Consistent with the findings of other STS scholars, Hodges’ pursuit of this media attention shows how scientists are seldom driven by some “pure” intellectual motive, but arises from overlapping financial, political, and personal motivations (see Jasanoff 2004; Robinson 2018). Further, as this scholarship shows, individual researchers are operating within networks, which do have broader political implications, but not necessarily because of any directed or intentional agendas. Rather, “the network ‘acts’ because of the multiplicity of motives at play” (Robinson 2018, 9). What is more, Robinson (2018, 9) noted, some scientists may be in a better position than others to benefit from the interconnections between science and policy fields. Hodges is a clear case of one such individual, given his position as a young white male with substantial administrative backing navigating an increasingly entrepreneurial US academy of the 1960s and 70s (Geiger 1993, 273-283). Crucially, he was an active ally in

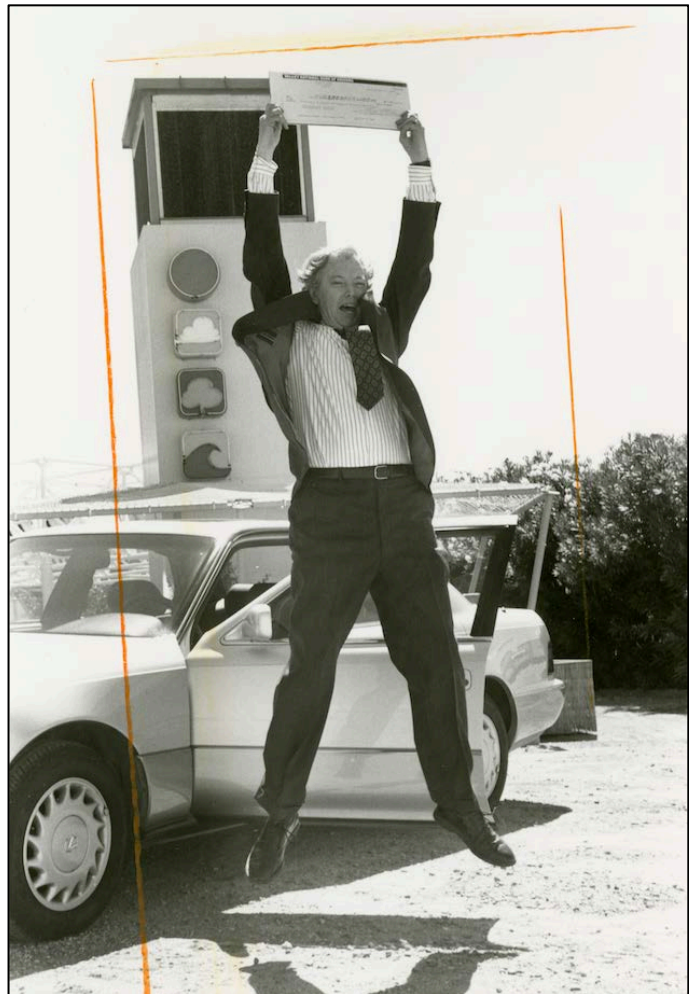


Figure 2. Carl N. Hodges with an oversized check. *Source: UA Special Collections (UA Bio, Hodges, Carl N. 1937-, Photographs).*

⁵ See by contrast recent reports critiquing US universities for accepting funding from sources in the Arabian Peninsula, e.g. Sokolove 2019.

Kassander’s push to bring in large external grants for the university, taking great pride in his ability to sell his desert “science” visions to foundations and “Arabian sultans” alike – and reap the financial rewards (see **Figure 2**). So while he may not have had a graduate degree, the primary ticket to being taken seriously in academia, he had a laboratory directorship to his name and keen interest in selling himself as a “visionary” and “Wunderkind” – both for personal, financial, and political rewards. This awareness did not translate into success, however, given a number of individual and structural challenges he and the ERL project faced in the shifting geopolitical environment of the Arabian Peninsula in the early 1970s.

Desert geopolitics: Opportunities and constraints

The ERL desalination and greenhouse project was ultimately developed and fresh produce, primarily tomatoes and cucumbers, started to grow in the Abu Dhabi desert. But for all the flashiness of the Hodges’ association with Sheikh Zayed, and the easy millions that were imagined to be flowing from the Arabian sands, the financial and political relationship between the Emirati and American partners was fraught. Shortly after the project got off the ground, on 23 July 1970, Sheikh Zayed toured the ERL’s greenhouse facilities (see **Figure 3**; for additional images, see Dennehy 2019; Fortini 2018). During this



Figure 3. ERL greenhouse project on Saadiyat Island. Top left: Sheikh Zayed (second from right) visits with other Emirati leaders. Top right: ERL staff with Arid Lands Research Center sign, reading “Established for the people of Abu Dhabi through a grant from H H Shaikh Zayid bin Sultan al Niyan to the University of Arizona.” Bottom: ERL’s plastic-covered greenhouses from outside (left) and inside (right). *Source: Merle Jensen, 1970s.*

visit, Hodges apparently invited Zayed and/or his son to visit the United States for a “scientific tour,” which would cover facilities in Arizona, the University of Arizona facility at Puerto Peñasco, Hawaii, and on Zayed’s request, NASA’s “next moon shot.”⁶ Hodges also thought a visit to New York City and Washington, DC, would be in order. Several weeks later, he met with representatives from the U.S. Department of State to discuss the logistics of arranging such a visit. Since the UAE was not yet independent, Zayed was still only the Emir of Abu Dhabi – and thus not a leader of a sovereign state. Accordingly, Hodges went about inquiring about “USG protocol considerations for receiving either Saykh Zayid or his son,” pointing out to the State Department officials “that Shaykh Zayid had already made ‘state visits’ to Beirut, Amman and Rawalpindi.”⁷

Meeting resistance or simply being ignored by U.S. government officials, Hodges persisted in trying to get Zayed an invitation by contacting the Arizona State Senator Paul J. Fannin. In a remarkable letter from 28 September 1970, Hodges makes his case for inviting Zayed to the United States, explaining, that “it would be extremely desirable (as a matter of fact critical to the success of our long-range objectives, I believe) for His Highness to visit the United States and take a scientific tour of various projects here. In that way, he can better understand the benefits of his commitments to research, development and training.”⁸ Although Hodges notes that the visit would probably need to be private, he requests the Senator’s help with getting an invitation to Zayed from then-president Nixon and, perhaps some kind of audience in Washington, D.C.:

Because of the political situation in the Arab world, it is probably desirable that His Highness’s visit be a (pg. 1) private one, with the University of Arizona as host; that would eliminate the possible political criticism of his visit. I know, however, that he is extremely impressed with the international activities of the United States in all areas and would be particularly pleased to receive some comments from President Nixon regarding his visit—and, of course, honored if he might have an invitation to at least visit, briefly and informally, with the President. I have, therefore, prepared the enclosed suggested draft letter that President Nixon might consider sending to Shaikh Zayed. Could I ask your assistance in presenting this suggested letter to the President and requesting his cooperation?

I know, from my meetings with Shaikh Zayed, that he is an outstanding individual. He honestly has the welfare of the people of Abu Dhabi as his main concern. Unfortunately, he is under tremendous pressures to budget a greater and greater portion of his wealth for military purchases and other such activities. He must justify any commitment he makes to research, development and training in terms of well-defined future benefits. I believe Shaikh Zayed will become the Ruler of the Federation of Trucial States when it is finally formed, and, as such, will be a most powerful figure in the Persian Gulf. With this consideration, it is not only of great importance to the University of Arizona that he come to the United States under favorable conditions, but of significance, I believe, to the whole United States.

Figure 4 is a copy of the draft letter that Hodges wrote, mentioned here, and included with his letter to Senator Fannin. Hodges’ draft is remarkable for many reasons, including the sheer

⁶ UAE NARA 2631, Department of State Memorandum of Conversation: Power/Water/Food Project in Abu Dhabi, 19 August 1970

⁷ Ibid.

⁸ UAE NARA 2631, Letter from Carl Hodges to Senator Paul J. Fannin, 28 September 1970.

audacity of writing in the name of the U.S. president. If the Arizona researcher was not already positioning himself as a supporter of Sheikh Zayed's state-making agenda through realizing the ERL project in Abu Dhabi, he clearly does so in all his efforts to fulfill Zayed's wish to visit the United States as a kind of dignitary. Not only is he confident that "Zayed will become the Ruler of the Federation of Trucial States" (or the United Arab Emirates, as it is eventually named upon independence), Hodges is actively helping Zayed in solidifying this position as the "natural" leader of the soon-to-be independent country. For both, the ERL project is framed as evidence of Zayed's benevolence and his ability to entice prestigious international cooperation. Zayed also clearly hoped that it could be leveraged to secure a "state visit" to further bolster his credentials ahead of the British withdrawal from the Trucial states in 1971.

Draft of suggested letter for
President Nixon to His Highness
Shaikh Zayed Bin Sultan Al Nihayan

His Highness
Shaikh Zayed Bin Sultan Al Nihayan
The Palace
Abu Dhabi, Arabian Gulf

Your Highness:

Senator Fannin of the State of Arizona has told me of the outstanding work of the Government of Abu Dhabi in establishing its Arid Lands Research Center and the cooperative program with the University of Arizona. I would like to compliment you on your foresight in establishing this research, development and training facility so early in your country's development.

I have also been told that the University of Arizona has invited you for a scientific tour of the United States. I am most pleased to hear of this as I am certain that there will be great value in our two countries cooperating on research and development programs to improve the quality of life in man's last great land reserve, the deserts of the world.

I was raised in the southwestern United States which contains many areas that are very similar in climate and geography to Abu Dhabi. As a result, I have long had an interest in high-quality programs of the type the University of Arizona is carrying on to develop these areas for the maximum benefit to mankind.

I have also been informed of your conversation with Mr. Hodges and Dr. Riley regarding your interest in the United States space program, and I have asked Senator Fannin to make arrangements for you to visit the Manned Spacecraft Center in Houston as part of your scientific tour.

I realize your trip to the United States is a private visit and will be concerned primarily with scientific projects. I would hope, however, that you will find time to visit Washington and, if our schedules permit, that we can meet informally.

The President

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Figure 4. Draft letter that Hodges wrote in the name of US President Nixon, appended to his letter to Senator Fannin, September 1970. Source: UAE National Archive (NARA 2621).

Especially noteworthy for our purposes here are Hodges' references to the desert environments in his draft Nixon letter. As he praises Zayed's commitment to cooperating through R&D in "man's last great reserve, the deserts of the world," arid lands become a geopolitical conduit of scientific exchange. Hodges also tries to pull in the landscape connection by noting Nixon's own ostensible connection with them by pointing out that he was raised in the U.S. Southwest – Yorba Linda, California to be precise. Now part of the sprawling Los Angeles megalopolis, Nixon's hometown is not usually placed within the confines of Southwest map of deserts, and it differs in countless ways from Tucson's Sonoran desert, which in turn differs dramatically from Abu Dhabi's Arabian desert. Such nuances of physical geography are far less relevant here, though, because Hodges needs the "desert" and the "Southwest" to do a very particular kind of work: They must serve as a geopolitical bridge uniting himself, the U.S. government, Zayed, and the future state of which that man will eventually lead. In this sense, Hodges subjectifies himself as a geopolitical actor working in support of Zayed's aspirations of taking the helm when the UAE finally become independent. That is, he tries.

Unfortunately for Hodges, there were greater geopolitical forces constraining his efforts to woo Zayed and to make good on his promise to the aspiring leader. Specifically, U.S. government officials were not inclined to invite Zayed in the way that they had done with Saudi royal family members, who were invited to tour Arizona water and agricultural developments on a set of scientific tours in 1943 and 1947. And while the Saudis were representing an independent state at that point, and Sheikh Zayed could not make such a claim in 1970, the Ruler of Bahrain had recently visited the U.S. in 1969 – before that territory became independent in 1971. Sheikh Zayed was clearly expecting similar treatment for himself, not only given the well-publicized visits of the Saudi and Bahrain royalty who he saw as his equals, but also because British and other foreign governments had begun to host him as the leader of the Trucial States. When U.S. officials balked, the issue escalated beyond an injured ego; it became entangled with the Arizona project financing.

According to one State Department memo written by Richard W. Murphy, a future U.S. ambassador then working at the Middle East Bureau, Hodges began pressing different U.S. agencies for financial support at the same time of his efforts to secure Zayed's visit, including USAID in Fall 1970. When USAID declined support in November 1970 because the "project failed meet criteria of AID legislation, i.e. Abu Dhabi meets none of financial qualifications of an underdeveloped nation," Hodges telephoned the U.S. State Department officials. He told them that the rejection "greatly disturbed Ruler Abu Dhabi who feels our position has political implications reflecting adversely on him personally. Ruler apparently has suggested our position reflective of USG disinterest in Arabs generally."⁹ Hoping to get the U.S. government to fund the ERL project instead of taking the promised millions from his own pocket, Sheikh Zayed had begun to walk back his financial promises and then used the refusal of U.S. funds to himself refuse "to release to University Arizona promised counterpart funds and even to furnish sum equivalent to preliminary commitment."¹⁰

As a result of the USAID refusal, Hodges told officials that the financial situation was "critical" and if Zayed failed to "release funds this will put serious crimp in Arizona University budget and quite possibly lead to closing down of project."¹¹ Indeed, the situation was apparently serious enough that both University of Arizona President Richard Harvill and Dick Kassander had

⁹ UAE NARA 2937, Department of State Telegram: Abu Dhabi Arid Lands Research Center, University of Arizona Project, 3 December 1970, p. 1.

¹⁰ *ibid.* p. 2.

¹¹ *ibid.* p. 3.

gotten involved, and were communicating with the State Department officials in Dhahran. In one memo about a December 10 conversation between the parties, Harvill admits to having already extended university funds “to support project which it has no authorization to do.” Unsure of how the situation would resolve itself, the UA and State officials agreed that “nothing should be done to upset confidence on part Abu Dhabi leadership toward University personnel and project” and that the UA would “take further risk on behalf this project.” This promise aside, State Department officials were clearly frustrated and the author of this memo remarked in an FYI appended to it: “According to Hodges, who I feel is operating somewhat beyond his depth, Zayyid is also reportedly miffed that USG has not [...] invited him to visit United States.”¹²

Although their individual testimonies on the matter are absent from the archival record, Sheikh Zayed probably *was* miffed and Hodges probably *was* operating beyond his depth.¹³ Each man was pursuing his own agenda, but hoping the other would be the key to facilitating it. The UAE was on the cusp of becoming an independent state and it was indeed clear by December 1970 that Zayed was the most likely man to unite the Trucial States after the British withdrawal one year later, in December 1971. But broader geopolitical forces were constraining their cooperation, as the U.S. government was wavering about how to treat the Ruler of Abu Dhabi and in general, how to approach the Trucial States’ pending reconfiguration. Another State Department memo adds further context to Zayed’s alleged irritation, noting that U.S. officials had been contacted by a “Lebanese intermediary” about arranging a visit to Washington, DC, for Zayed’s son, Khalifa bin Zayed Al Nahyan (the current President of the UAE), but that when this was not forthcoming, the Crown Prince decided to only visit Hawaii. This was disconcerting to those in State working to advance U.S. relations in the Arabian Peninsula, but they also knew the limits of protocol. They thus conclude by noting that should Zayed get a Washington invite, “if it occurs prior any change in his present status, [it] would be at appropriate level in Department and under same ground rules which governed 1969 visit of Bahrain Ruler.”¹⁴

While the waffling partly reflected concerns around protocol, it was more likely an issue of priority: The U.S. officials had closer ties with Saudi Arabia and Bahrain, and a far more diffuse network of advocates there in the corporate, scientific, and political spheres. The Trucial States’ status was ambiguous and the British were doing their own waffling around whether they would retain their presence in the region or not (Onley 2009). Carl Hodges and his greenhouse project in Abu Dhabi was routinely stamped for attention by the Science officers within the State Department and, viewed from the desk of Senator Fannin or President Nixon (if his eyes even encountered the draft letter penned in his name), probably appeared as more of an annoyance than an exciting prospect for cooperation in a region where future allegiances were already being clearly defined by ARAMCO and the deep ties that had been developing in Saudi Arabia since the 1940s (Jones 2010; Mitchell 1991; Vitalis 2007).

Hodges might have succeeded in inserting himself into this policy field to further his grand vision of making “man’s last great reserve, the deserts of the world” bloom, but the structural forces he came up against eventually squeezed him out of the political game. Instead, UA administrators searched for other financial support and, as promised, President Harvill took

¹² UAE NARA 2937, Department of State Telegram: Abu Dhabi Arid Lands Research Center, 10 December 1970

¹³ Despite repeated efforts over the course of months, I have not been able to reach Hodges or any other individuals involved in the ERL until it was closed in 2015. Though it was not the focus of my research, I learned that the level of institutional malfeasance was so great and personal conflicts so severe that getting these interviews would be impossible.

¹⁴ UAE NARA 2937, Department of State Telegram: Abu Dhabi Arid Lands Research Center, University of Arizona Project, 3 December 1970, p. 4.

additional risk on behalf of the project. The full details cannot be elaborated here, but the UA presidential correspondence files show how he, Kassander, and Hodges worked together to secure multiple loans in the name of the Abu Dhabi Research Center (for US \$683,000 from First National City Bank in Arizona and \$1.35 million from the Export-Import Bank of New York).¹⁵ The entire ordeal eventually reached a peaceful settlement, especially once Harvill stepped down as UA president and was replaced by John Schaeffer in July 1972. In Schaeffer's first correspondence with the Emirati partners, two weeks after assuming his post, he wrote to express "deep regret" that he had "inherited some misunderstandings." Hoping to "remove any possible tension between us," he set out a financial and logistical plan for the remainder of 1971 and noted in closing: "We would welcome the discussions of a new technical assistance contract with Abu Dhabi commencing January 1, 1972 because we believe the similarity of the climatic conditions of our two states make our association a potentially beneficial one."¹⁶ In smoothing ruffled feathers, Schaeffer returned to the desert as bridge. This geopolitical narrative built on the environmental story of commonality worked for a time, though the relationship had ended by 1974.¹⁷ Sheikh Zayed and his newly independent government of the United Arab Emirates came to see new possibilities for that spot in the Abu Dhabi desert (today the site of the emirate's new Louvre museum) and agricultural interests elsewhere sought to reassert their influence and claim the greenhouses for themselves – eventually they were dismantled and sent inland to Al Ain.

Discussion: Desert imaginaries and geopolitics

The relationship between Sheikh Zayed, the University of Arizona, and the U.S. government spotlights the role of scientists and scientific institutions working to extend American influence in the Arabian Peninsula as a region undergoing a patchy and uneven transition from British imperial hegemony to a new, state-based geopolitical order. Of course, scientists have always operated within a broader geopolitical sphere, which is, like Michel Foucault's (1982, 789) famous definition of capillary power, "a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme it constrains or forbids absolutely." In understanding both the opportunities and constraints defining the relationship between the U.S. and Emirati actors, it is essential to situate this story in the geopolitical context of shifting imperial relations in the Arabian Peninsula – the rise of new states in the region, the retreat or realignment of British colonial institutions and actors, and the rise of new American technocratic and capitalist forms of imperialism. This shifting order was moving in the direction of a new political geography of independent states in the Arabian Peninsula. To make sense of how UA staff and their Emirati partners were working in concert, it is necessary to see their relationship as both *arising from* this geopolitical context and *resulting in* its shifting configuration.

Likewise, in the intertwining of the political lives of figures like Sheikh Zayed and Carl Hodges, and his allies (or opponents) in the bureaucracies of the University of Arizona and the U.S. government, the "desert" becomes a strategic site to both facilitate and justify political, financial, and scientific flows and exchange between Arizona and the Arabian Peninsula. As noted above, these geopolitical framings of the desert run against a simplistic Western framing of the

¹⁵ For the loan documents and extensive correspondence on this, see UA Special Collections, Harvill Presidential Correspondence Files, 1970-1971, Environmental Research Center.

¹⁶ Letter from President John P. Schaeffer to Khalifa Al-Yusef, Chairman, Arid Lands Research Center Committee, Abu Dhabi, July 14, 1971. UA Special Collections, Schaeffer Presidential Correspondence Files, 1971-1972, Environmental Research Center.

¹⁷ For more about the dismantling of the UA project, see Koch 2019.

desert as deficient or aberrant. Rather, from these actors' perspective, the "desert" construct is precisely the discursive resource they need to realize their goals (venal and otherwise, scientific or not), and build geopolitical connections through the institutional openings of arid lands science. This is, of course, not unique to this case study: scientists and experts from across the globe have long put their local know-how to work in the service of empire.

Yet the story of UA researchers and administrators suggests a need to look more carefully at how scientists use environmental narratives to construct themselves as experts and, in so doing, become geopolitical agents. As scientists transcend borders through the technological networks that they work within and develop anew, Barry (2001, 59) stressed, "this does not necessarily lead to the eradication of borders as such. New ones are produced." Indeed, by working in service of formal political powers, such as the British empire or the U.S. government, experts are also navigating the territorializations of political power specific to those institutions. But as with any actor, they are not confined to reproducing this order: They may also find themselves, like Hodges did, in a position to advance a new order. While the ERL project was far from responsible for legitimating Sheikh Zayed's ultimate claim to be the leader of the UAE as a new country uniting the Trucial States, it bolstered his effort to present himself as a modern and benevolent leader interested in the good of his people, and as a leader esteemed by the international community, and he had hoped, someone important enough to receive an invitation to Washington from the U.S. government.

Although the leading figures in this story were only partially successful in achieving their specific goals, the case illustrates how, across the life of this project, they consistently turned to the idea of the "desert" to discursively bridge the U.S. and the emirate of Abu Dhabi. This was evident at the outset of the UA-Abu Dhabi partnership, neatly summarized in the 1968 letter of agreement, in which the Emirati government representative Sayed M.H. Juma explains their support for the greenhouse project: "It is our hope that Abu Dhabi can set an example of the desirability of using government resources for progressive development of our arid lands. I am well aware that the University of Arizona is a world leader in the area of arid lands research, and would very much like to have this project integrated into the total arid lands research and development project of the University of Arizona."¹⁸ Keyed into the UA effort to leverage its arid lands expertise, the Emirati officials found willing partners in support of the reconfiguration of new territorializations of political power in the Arabian Peninsula.

The "desert" has served as a kind of binding glue uniting Arizona and the Arabian Peninsula – indeterminate but eminently useful for certain actors across time and space. Operating as a "sociotechnical imaginary" in Sheila Jasanoff's (2015, 23) formulation, such desert imaginaries "not only help to reconfigure actors' sense of the possible spaces of action but also their sense of the rightness of action, at scales ranging from locality to nation to continent and to the planet itself." Indeed, the political lives of deserts are just as multi-scalar as the humans that breathe life into these imaginaries and put them to work – in the name of science, the state, and all range of other agendas. The greenhouses may have been one project among Zayed's diverse efforts to showcase his fitness to lead an independent UAE, but it was spectacular and, judging from the parade of visiting dignitaries brought to tour it (including countless world leaders, Muhammad Ali, and others), it served his interests well (Koch 2019). Making the desert bloom was indeed a common interest of both parties.

¹⁸ Letter from Sayed M.H. Juma (D.G. Planning & Coordination for the State of Abu Dhabi) to UA President Richard A. Harvill, December 28, 1968, Letter No. 348/68, UA Special Collections, Harvill Presidential Correspondence Files, 1970-1971, Environmental Research Center.

Conclusion

For the territorial state system to become the dominant geopolitical order it is today, it had to be *built*. In analyzing the long but little known history binding Arizona and Arabia, I have sought to illustrate how taking *deserts* rather than *states* as an entry-point offers a unique lens on geopolitics, state-making, and empire in both places. This particular desert-to-desert case study may seem exceptional to some observers, but it points to a broader set of processes built through the technopolitical networks of scientists and expertise linking the world's arid lands. Variably-defined experts or scientists have always worked in the service of the modernist state, helping to territorialize its authority – both in desert settings and beyond. But one need only look to the U.S. Agricultural Missions in Saudi Arabia in the 1940s to see that arid lands exchanges have always been a key part of U.S.-Gulf relations. Viewed through the lens of deserts, it is apparent that American empire in the Middle East was built on a diverse set of political economies extending beyond oil and arms deals – including, as we increasingly see today, through institutions of science and higher education (Koch 2014; Koch and Vora 2019; Vora 2018).

As one avenue for contemporary actors to conduct these alternative exchanges, the “desert” had to be *narrated* as a place of cooperation and mutual understanding – forming the geographic imaginary through which individuals in both places came to justify their common projects and geopolitical interventions. And though these actors have leveraged their agendas through stories about the shared challenges and aspirations of arid environments, it is important to note how they consistently ignore the significance of the desert's materiality. The differences between the Sonoran and Arabian deserts could not trouble the actors in this story; to do so would undercut its utility as geopolitical frame of unity. Of course the materiality of arid lands matters, but from this perspective, the “desert” is not just an abstract construction nor a material reality. It is necessarily both – a technozone that situated actors strategically navigate and deploy to realize specific projects and agendas. It is through tracing these strategic maneuvers that we begin to understand the *political* lives of deserts, and what they mean and have meant for geography over time.

References

- Agnew, J. 2003. *Geopolitics: Re-visioning world politics*. New York: Routledge.
- Ahram, A. 2015. Development, counterinsurgency, and the destruction of the Iraqi marshes. *International Journal of Middle East Studies* 47 (3):447-466.
- Akhter, M. 2015. The hydropolitical Cold War: The Indus Waters Treaty and state formation in Pakistan. *Political Geography* 46 (0):65-75.
- Akhter, M., and K. Ormerod. 2015. The irrigation technozone: State power, expertise, and agrarian development in the U.S. West and British Punjab, 1880–1920. *Geoforum* 60:123-132.
- Alatout, S. 2006. Towards a bio-territorial conception of power: Territory, population, and environmental narratives in Palestine and Israel. *Political Geography* 25 (6):601-621.
- . 2008. “States” of scarcity: Water, space, and identity politics in Israel, 1948–59. *Environment and Planning D: Society and Space* 26 (6):959-982.
- . 2014. From river to border: The Jordan between empire and nation-state. In *Routledge handbook of science, technology and society*, eds. D. Kleinman and K. Moore, 307-331. New York: Routledge.

- Ashutosh, I. 2017. The geography and area studies interface from the Second World War to the Cold War. *Geographical Review* 107 (4):705-721.
- Barnes, J. 2009. Managing the waters of Ba'th country: The politics of water scarcity in Syria. *Geopolitics* 14 (3):510-530.
- . 2012. Pumping possibility: Agricultural expansion through desert reclamation in Egypt. *Social Studies of Science* 42 (4):517-538.
- Barnes, T., and M. Farish. 2006. Between regions: Science, militarism, and American geography from World War to Cold War. *Annals of the Association of American Geographers* 96 (4):807-826.
- Barry, A. 2001. *Political machines: Governing a technological society*. London: Athlone Press.
- Biasillo, R., and C. da Silva. 2019. Cultivating arid soils in Libya and Brazil during World War Two: The two-fold war between colonial and neo-colonial experiences. *Global Environment* 12 (1):154-181.
- Blackhawk, N. 2006. *Violence over the land: Indians and empires in the early American West*. Cambridge, MA: Harvard University Press.
- Bowen-Jones, H., and R. Dutton. 1983. *Agriculture in the Arabian Peninsula*. London: Economist Intelligence Unit.
- Burtner, M. 2012. *Crafting and consuming an American Sonoran Desert: Global visions, regional nature and national meaning*. PhD dissertation, History, University of Arizona, Tucson.
- Business Week*. 1970. Tiling the desert under plastic skies. *Business Week* (May 9): 92-94.
- Crary, D. 1951. Recent agricultural developments in Saudi Arabia. *Geographical Review* 41 (3):366-383.
- Cressey, G. 1957. Water in the desert. *Annals of the Association of American Geographers* 47 (2):105-124.
- Crone, N. 1969. UA team to build Arabian plant. *Tucson Daily Citizen*, February 27. Accessed June 16, 2019. <https://newspaperarchive.com/tucson-daily-citizen-feb-27-1969-p-25/>.
- Davis, D. 2004. Desert 'wastes' of the Maghreb: Desertification narratives in French colonial environmental history of North Africa. *cultural geographies* 11 (4):359-387.
- . 2007. *Resurrecting the granary of Rome: Environmental history and French colonial expansion in North Africa*. Athens, OH: Ohio University Press.
- . 2016. *The arid lands: History, power, knowledge*. Cambridge, MA: The MIT Press.
- . 2019. From the divine to the desertified: The foundational case of deserts in the Middle East. *Global Environment* 12 (1):56-83.
- Davis, D., and E. Burke. 2011. *Environmental imaginaries of the Middle East and North Africa*. Athens: Ohio University Press.
- Dennehy, J. 2019. First farmer of Saadiyat Island tells of miracle crop growth in the Abu Dhabi desert. *The National*, March 27. Accessed June 10, 2019. <https://www.thenational.ae/uae/heritage/first-farmer-of-saadiyat-island-tells-of-miracle-crop-growth-in-the-abu-dhabi-desert-1.841900>
- Derr, J. 2019. *The lived Nile: Environment, disease, and material colonial economy in Egypt*. Stanford, CA: Stanford University Press.
- Doel, R. 1997. Scientists as policymakers, advisors, and intelligence agents: Linking contemporary diplomatic history with the history of contemporary science. In *The Historiography of contemporary science and technology*, ed. T. Söderqvist, 215-244. Amsterdam: Harwood Academic.

- El Mallakh, R. 1970. The challenge of affluence: Abu Dhabi. *Middle East Journal* 24 (2):135-146.
- . 1981. *The economic development of the United Arab Emirates*. New York: St. Martin's Press.
- Ellis, M. 2018. *Desert borderland: The making of modern Egypt and Libya*. Stanford, CA: Stanford University Press.
- Elshakry, M. 2015. Introduction: Historicizing science and the modern state. *International Journal of Middle East Studies* 47 (3):555-558.
- Farish, M. 2010. *The contours of America's Cold War*. Minneapolis, MN: University of Minnesota Press.
- Farmer, T., and J. Barnes. 2018. Environment and society in the Middle East and North Africa: Introduction. *International Journal of Middle East Studies* 50 (3):375-382.
- Finkelstein, E. 1972. UA sets Abu Dhabi table. *Tucson Daily Citizen*, August 18. Accessed June 16, 2019. <https://newspaperarchive.com/tucson-daily-citizen-aug-18-1972-p-14/>.
- Finn, J. 1998. *Tracing the veins: Of copper, culture, and community from Butte to Chuquicamata*. Berkeley, CA: University of California Press.
- Fortini, E. 2018. Timeframe: Cultivating a culture of crop growth in Abu Dhabi in 1969. *The National*, October 4. Accessed June 16, 2019. <https://www.thenational.ae/arts-culture/timeframe-cultivating-culture-of-crop-growth-in-abu-dhabi-in-1969-1.776845#5>
- Foucault, M. 1982. The subject and power. *Critical Inquiry* 8 (4):777-795.
- Francaviglia, R. 2011. *Go east, young man: Imagining the American West as the Orient*. Logan, UT: Utah State University Press.
- Fuccaro, N. 2009. *Histories of city and state in the Persian Gulf: Manama since 1800*. Cambridge, MA: Cambridge University Press.
- Geiger, R. 1993. *Research and relevant knowledge: American research universities since World War II*. New York: Oxford University Press.
- George, A. 1979. "Making the desert bloom": A myth examined. *Journal of Palestine Studies* 8 (2):88-100.
- Hecht, G., and P. Edwards. 2010. The technopolitics of Cold War: Toward a transregional perspective. In *Essays on twentieth-century history*, ed. M. Adas, 271-314. Philadelphia, PA: Temple University Press.
- Heslop, K. 2014. Making the desert blossom: Spreading the gospel of irrigation. *Journal of the Southwest* 56 (1):29-51.
- Hightower, V. 2015. From barren wasteland into productive space: Abu Dhabi's environmental development projects, 1971-2004. Paper presented at the Middle East Studies Association Annual Meeting, Denver, CO.
- Hillinger, C. 1969. Gardens in the desert: Sheik looks to the future. *Willoughby News Herald*, May 14. Accessed June 10, 2019. <https://newspaperarchive.com/willoughby-news-herald-may-14-1969-p-22/>.
- Hodge, J. 2007. *Triumph of the expert: Agrarian doctrines of development and the legacies of British colonialism*. Athens, OH: Ohio University Press.
- Hodges, C. 1975. Desert food factories. *Technology Review* 77 (3):33-39.
- Isenberg, A. 2019. "A land of hardship and distress": Camels, North American deserts and the limits of conquest. *Global Environment* 12 (1):84-101.
- Isenberg, A., K. Morrissey, and L. Warren. 2019. Imperial deserts. *Global Environment* 12 (1):8-21.

- Jasanoff, S. 2004. *States of knowledge: The co-production of science and social order*. New York: Routledge.
- . 2015. Future imperfect: Science, technology, and the imaginations of modernity. In *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*, eds. S. Jasanoff and S.-H. Kim, 1-33. Chicago, IL: University of Chicago Press.
- Jensen, M. 2017. In memoriam: Richard Kassander, UA's first VP for Research. *UA@Work*, September 19. Accessed July 8, 2019. <https://uaatwork.arizona.edu/lqp/memoriam-richard-kassander-uas-first-vp-research>.
- Jones, T. 2010. *Desert kingdom: How oil and water forged modern Saudi Arabia*. Cambridge, MA: Harvard University Press.
- Joseph, S. 2018. Farming the desert: Agriculture in the oil frontier, the case of the United Arab Emirates, 1940s to 1990s. *British Journal of Middle Eastern Studies* 45 (5):678-694.
- Joseph, S., and B. Howarth. 2015. Fertile sands: Colonial politics and the development of land and water resources in the Trucial States, mid- to late 20th century. *The Arab World Geographer* 18 (3):139-168.
- Khalili, L. 2018. The infrastructural power of the military: The geoeconomic role of the US Army Corps of Engineers in the Arabian Peninsula. *European Journal of International Relations* 24 (4):911-933.
- Koch, N. 2014. The shifting geopolitics of higher education: Inter/nationalizing elite universities in Kazakhstan, Saudi Arabia, and beyond. *Geoforum* 56:46-54.
- . 2015. The violence of spectacle: Statist schemes to green the desert and constructing Astana and Ashgabat as urban oases. *Social & Cultural Geography* 16 (6):675-697.
- . 2019. AgTech in Arabia: 'Spectacular forgetting' and the technopolitics of greening the desert. *Journal of Political Ecology* 26 (1):666-686.
- Koch, N., and N. Vora. 2019. Laboratories of liberalism: American higher education in the Arabian Peninsula and the discursive production of authoritarianism. *Minerva* 57 (4):549-564.
- Kuletz, V. 1998. *The tainted desert: Environmental ruin in the American West*. New York: Routledge.
- Latham, M. 2011. *The right kind of revolution: Modernization, development, and U.S. foreign policy from the Cold War to the present*. Ithaca, NY: Cornell University Press.
- Latour, B. 1987. *Science in action: How to follow scientists and engineers through society*. Milton Keynes, UK: Open University Press.
- Legrenzi, M. 2015. *The GCC and the international relations of the Gulf: Diplomacy, security and economic coordination in a changing Middle East*. London: I.B. Tauris.
- Low, M. 2015. Ottoman infrastructures of the Saudi hydro-state: The technopolitics of pilgrimage and potable water in the Hijaz. *Comparative Studies in Society and History* 57 (4):942-974.
- . 2020. Desert dreams of drinking the sea, consumed by the Cold War: Transnational flows of desalination and energy from the Pacific to the Persian Gulf. *Environment and History* 57 (4):942-974. <https://doi.org/10.3197/096734018X15254461646549>
- MacLean, M. 2017. *Spatial transformations and the emergence of "the national": Infrastructures and the formation of the United Arab Emirates, 1950-1980*. PhD dissertation, History, New York University, New York.

- McGinley, S. 2018. UA-led \$3.9M project to focus on date palm production in Oman. *UANews*, December 20. Accessed July 6, 2019. <https://uanews.arizona.edu/story/ualed-39m-project-focus-date-palm-production-oman>.
- Meeks, E. 2007. *Border citizens: The making of Indians, Mexicans, and Anglos in Arizona*. Austin, TX: University of Texas Press.
- Melamid, A. 1957. The political geography of the Gulf of Aqaba. *Annals of the Association of American Geographers* 47 (3):231-240.
- Melillo, E. 2015. *Strangers on familiar soil: Rediscovering the Chile-California connection*. New Haven, CT: Yale University Press.
- Mikhail, A. 2012. *Water on sand: Environmental histories of the Middle East and North Africa*. New York: Oxford University Press.
- Mitchell, T. 1991. The limits of the state: Beyond statist approaches and their critics. *The American Political Science Review* 85 (1):77-96.
- Moisio, S., N. Koch, A. Jonas, C. Lizotte, and J. Luukkonen. Forthcoming. *Handbook on the changing geographies of the state: New spaces of geopolitics*. Northampton, UK: Edward Elgar.
- Morrissey, K., and M. Burtner. 2019. Global imaginary of arid lands: Early twentieth-century United States botanists in Africa. *Global Environment* 12 (1):102-133.
- Murphy, A. 2013. Territory's continuing allure. *Annals of the Association of American Geographers* 103 (5):1212-1226.
- Negri, S. 1987. Carl Hodges and the ERL: A wunderkind at the wonderworks. *Arizona Highways* 63(5): 12-18.
- NET. 1965. Sun, sand, and sea. *Spectrum*, 29. National Education Television and KUAT-TV. Accessed January 15, 2020. https://americanarchive.org/catalog/cpb-aacip_512-804xg9g316.
- O'Lear, S. 2020. *A research agenda for environmental geopolitics*. Northampton, UK: Edward Elgar.
- Onley, J. 2007. *The Arabian frontier of the British Raj: Merchants, rulers, and the British in the nineteenth-century Gulf*. New York: Oxford University Press.
- . 2009. Britain and the Gulf Shaikhdoms, 1820–1971: The politics of protection. Doha: Center for International and Regional Studies, Georgetown University School of Foreign Service in Qatar.
- Ouis, P. 2002. 'Greening the Emirates': The modern construction of nature in the United Arab Emirates. *cultural geographies* 9 (3):334-347.
- Pigott, S. 2018. The future of farming takes root. *UANews*, March 21. Accessed July 6, 2019. <https://uanews.arizona.edu/story/future-farming-takes-root>.
- Pinkerton, A., S. Young, and K. Dodds. 2011. Postcards from heaven: Critical geographies of the Cold War military-industrial-academic complex. *Antipode* 43 (3):820-844.
- Pritchard, S. 2012. From hydroimperialism to hydrocapitalism: "French" hydraulics in France, North Africa, and beyond. *Social Studies of Science* 42 (4):591-615.
- Robinson, S. 2018. *Ocean science and the British Cold War state*. New York: Springer.
- Sack, R. 1986. *Human territoriality: Its theory and history*. Cambridge: Cambridge University Press.
- Sanchez-Lopez, M. 2019. From a white desert to the largest world deposit of lithium: Symbolic meanings and materialities of the Uyuni Salt Flat in Bolivia. *Antipode* 51 (4): 1318-1339.
- Sanger, R. 1954. *The Arabian Peninsula*. Ithaca: Cornell University Press.

- Sayre, N. 2017. *The politics of scale: A history of rangeland science*. Chicago, IL: University of Chicago Press.
- Smith, B. 2015. *Market orientalism: Cultural economy and the Arab Gulf States*. Syracuse: Syracuse University Press.
- Sneddon, C. 2012. The ‘sinew of development’: Cold War geopolitics, technical expertise, and water resource development in Southeast Asia, 1954–1975. *Social Studies of Science* 42 (4):564-590.
- . 2015. *Concrete revolution: Large dams, Cold War geopolitics, and the US Bureau of Reclamation*. Chicago, IL: University of Chicago Press.
- Sokolove, M. 2019. Why is there so much Saudi money in American universities? *The New York Times Magazine*, July 3. Accessed July 6, 2019. <https://www.nytimes.com/2019/07/03/magazine/saudi-arabia-american-universities.html>.
- Squire, V. 2015. Reshaping critical geopolitics? The materialist challenge. *Review of International Studies* 41 (1):139-159.
- Sundberg, J. 2011. Diabolic caminos in the desert and cat fights on the Río: A posthumanist political ecology of boundary enforcement in the United States–Mexico borderlands. *Annals of the Association of American Geographers* 101 (2):318-336.
- Tesdell, O. 2015. Territoriality and the technics of drylands science in Palestine and North America. *International Journal of Middle East Studies* 47 (3):570-573.
- . 2017. Wild wheat to productive drylands: Global scientific practice and the agroecological remaking of Palestine. *Geoforum* 78:43-51.
- Thomas, B. 1969. UofA official denies any conflict of interest. *Phoenix Arizona Republic*, October 19. Accessed June 16, 2019. <https://newspaperarchive.com/phoenix-arizona-republic-oct-19-1969-p-51/>.
- Time*. 1967. Science - technology: Diesels in the desert. *Time*, 8 September, 90 (10): 32.
- Twitchell, K. 1944. Water resources of Saudi Arabia. *Geographical Review* 34 (3):365-386.
- . 1958. *Saudi Arabia, with an account of the development of its natural resources*. Princeton, NJ: Princeton University Press.
- van der Meulen, D. 1957. *The wells of Ibn Sa‘ud*. New York: Praeger.
- VanderMeer, P. 2010. *Desert visions and the making of Phoenix, 1860-2009*. Albuquerque, NM: University of New Mexico Press.
- Verdery, K. 1999. *The political lives of dead bodies: Reburial and postsocialist change*. New York: Columbia University Press.
- Verhoeven, H. 2018. *Environmental politics in the Middle East: Local struggles, global connections*. Oxford: Oxford University Press.
- Vitalis, R. 2007. *America’s kingdom: Mythmaking on the Saudi oil frontier*. Stanford, CA: Stanford University Press.
- Vora, N. 2018. *Teach for Arabia: American universities, liberalism, and transnational Qatar*. Stanford, CA: Stanford University Press.
- Vora, N. and N. Koch. 2015. Everyday inclusions: Rethinking ethnocracy, kafala, and belonging in the Arabian Peninsula. *Studies in Ethnicity and Nationalism* 15(3): 540-552.
- Voyles, T. 2015. *Wastelanding: Legacies of uranium mining in Navajo country*. Minneapolis, MN: University of Minnesota Press.
- Winichakul, T. 1994. *Siam mapped: A history of the geo-body of a nation*. Honolulu, HI: University of Hawaii Press.
- Woertz, E. 2013. *Oil for food: The global food crisis and the Middle East*. Oxford: Oxford

University Press.

Worster, D. 1985. *Rivers of empire: Water, aridity, and the growth of the American West*. New York: Pantheon.

Zacharias, A. 2017. How the Digdagga experimental farm in RAK revolutionised regional agriculture in the 1960s. *The National*, August 18. Accessed June 16, 2019.

<https://www.thenational.ae/arts-culture/how-the-digdagga-experimental-farm-in-rak-revolutionised-regional-agriculture-in-the-1960s-1.620705>.

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