



*Journal of
Religion & Society*
Supplement Series

The Kripke Center

Supplement 11 (2015)

Religion and the Sciences

Opportunities and Challenges

Edited by Ronald A. Simkins and Thomas M. Kelly

11. Contested Spiritual Landscapes in Modern American Astronomy

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Introduction

On Columbus Day in 1992, a coalition of Western Apaches, environmentalists, and students stormed the University of Arizona's Steward Observatory to protest its involvement in the Mt. Graham International Observatory. Hoping to overshadow the University's planned activities commemorating the 500th anniversary of Columbus' voyage, the protesters blocked the observatory lobby for hours while chanting and beating drums to express their outrage over the construction of a new telescope on Mt. Graham. The telescope was to be named *Columbus*, a moniker that smacked of colonialism for many vocal critics of the project (Tiebel; Auslander). Because Mt. Graham is home to an endangered red squirrel and it is a sacred mountain for the San Carlos Apaches, the protesters declared that building the observatory was an act of cultural and environmental annihilation. The conflict

provided ample fodder for the local media, which vilified Mt. Graham astronomers as rapacious “star whores” (Dougherty). In 2002, Native Hawaiians and environmentalists filed a contested case against NASA’s proposed Keck Outrigger telescope project on the summit of Mauna Kea.¹ Located on the Big Island of Hawai’i, Mauna Kea is a dormant volcano that hosts some of the most advanced telescopes in the world, but it provides the only known habitat for the rare *Wēkiu* bug and is also considered the sacred center of creation to Native Hawaiians and the home of the snow goddess Poliahu. The Native/environmentalist alliance accused NASA, the University of Hawai’i, and the State of Hawai’i of willfully exterminating a species found nowhere else in the world and desecrating a sacred mountain in the name of science. In 2005, the Tohono O’odham Nation of southern Arizona filed a lawsuit against the National Science Foundation (NSF), challenging the right of the NSF and Kitt Peak National Observatory to build a newly proposed \$13 million telescope array on Kitt Peak, a mountain long known to be sacred to the Tohono O’odham (Allen; Tohono O’odham, 2006b).

Each episode of conflict in Arizona and Hawai’i was the product of disputes between astronomers and activists over telescope construction that had arisen independently at each site beginning in the late 20th century. Activists viewed Kitt Peak, Mauna Kea, and Mt. Graham as spiritually and ecologically valuable sites threatened by astronomical development, while astronomers were surprised and disturbed by the public animosity engendered by telescope construction.

This paper explores how competing narratives transformed three American astronomical observatories in Arizona and Hawai’i from scientific research facilities into contested spiritual landscapes. The dominant narratives of each community are found in sources ranging from activist and scientific literature to courtroom testimony and websites. This paper also focuses on the narratives that are imbedded in the material culture of observatory sites and educational centers. The communities invested in these mountains have drawn upon the discourse of “culture” when describing the significance of the mountains, whether the mountain is framed as a pristine wilderness environment, a locus of spiritual energy, or an ideal site for astronomy.

Focusing on how the cultural claims of activists have been pitted against the cultural claims of astronomers, this paper presents two main arguments. First, I argue that stories about the mountains’ significance – how the mountains were culturally constructed by various stakeholders – have profoundly constricted both scientific and spiritual uses of the mountains. Put simply, narratives have real consequences: from the loss of telescope projects to the denial of the mountain’s sacred status. Second, this paper shows that when scientists and Native groups produce mutually agreed-upon narratives, these communities in conflict achieve fruitful communication and collaboration. Regions of local coordination, or “trading zones,” occur when disparate communities adapt their dominant narratives to accommodate other perspectives (Galison: 802). Trading zones often manifest in visitors and educational centers, and I argue that trading zones have played a significant role in mediating some of

¹ See Board of Land and Natural Resources, State of Hawai’i. Contested Case Hearing. DLNR File No. HA-02-06, p. 22. Available at ftp.nist.gov.

these disputes. However, these attempts to submerge cultural gaps in a common discourse have also erased meaningful markers of cultural identity for some of the communities involved.

The Tohono O'odham Nation and Kitt Peak National Observatory

Kitt Peak is located squarely on the Tohono O'odham reservation, and the mountain was leased from the tribe by the NSF in the late 1950s to establish the Kitt Peak National Observatory (KPNO).² Though tribal leaders initially refused to comply with the terms of the lease, the Tribal Council later signed an agreement approving the perpetual lease of Kitt Peak to the NSF. Since 1958, two dozen telescopes have been built on the summit of Kitt Peak on land leased from the Tohono O'odham Tribal Council "as long as the land is used for astronomical study and research and related scientific purposes."³ For the Tohono O'odham, Kitt Peak is a sacred mountain called *Iolkam Du 'ag* that figures prominently in their creation story. Through the lease, the sacredness of Kitt Peak was formally acknowledged, and the tribe received certain economic concessions, such as the sale of baskets at the observatory's visitor center.

The KPNO Visitor's Center has long been an important locus of social and material exchange between the observatory and O'odham communities. In the early years of its operation, the Visitor Center successfully bridged the cultural gaps between these communities through the efforts of one dedicated staff member, Elizabeth Estrada. Estrada acted as a cultural ambassador between astronomers and the O'odham in order to facilitate the sale of O'odham baskets, ultimately revitalizing the declining cultural tradition of O'odham basket-making (National Optical Astronomy Observatories). After Estrada passed away, direct social and economic exchange dwindled, and the KPNO Visitor Center was reduced to a largely symbolic zone of mediation.

Given the reduced personal interaction between members of the O'odham community and the KPNO community following Estrada's death, it is perhaps not surprising that cultural gaps between the O'odham and the observatory widened in subsequent decades. Still, after years of seemingly amicable relations between the Tohono O'odham and the Kitt Peak astronomy community, many astronomers were blindsided when the Tohono O'odham Nation challenged the nearly 50-year lease agreement with the NSF in 2005. The Nation filed a lawsuit against the NSF seeking an injunction against a proposed telescope array and a complete revocation of the lease. In the tribe's lawsuit, the Nation claimed that the NSF had violated United States cultural, historic, and environmental preservation laws, including Section 106 of the National Historic Preservation Act. The lawsuit also articulated a new narrative about the lease negotiation in which the tribe claimed its interests had been unfairly represented in the 1950s (Norrell; Lourdes; Tohono O'odham 2006a).

² Until 1986, the Tohono O'odham were known as the Papago, but the tribe reclaimed its ancestral name Tohono O'odham in 1986 for political and cultural reasons.

³ Papago Tribal Council Resolution No. 976. The lease was formalized through a law passed by the 85th Congress (Public Law 85-816, 72 Stat. 981, August 28, 1958).

Why had the Tohono O’odham waited so long to voice their objections to the lease? The slow maturation of the Native American rights movements initiated in the 1970s yields some insight into this question, which perplexed many astronomers when the lawsuit was filed. The 1978 American Indian Religious Freedom Act guaranteed access to sacred sites, and other federal laws such as the National Environmental Policy and National Historic Preservation Acts mandated further investigation of the tribe’s claim on the mountain. Still, gaining access to and preserving sacred sites had become a cultural and political movement among indigenous groups across the United States only as recently as the 1990s.⁴ The Tohono O’odham of the 2000s were far more politically and socially empowered than previous generations, and the Nation’s concerns were well validated when the Advisory Council on Historic Preservation found in favor of the tribe. The telescope array was ultimately relocated to another mountain.⁵

Tribal narratives recasting the observatory as an agent of cultural oppression had effectively cost the astronomers their telescope. To some tribal members, however, this “victory” was and remains overshadowed by the threat of the existing telescopes to the spiritual integrity of the mountain (Tohono O’odham 2006a: 2). The two communities are still divided in many ways by culturally divergent visions of the mountain’s use and significance, but a visit to Kitt Peak reveals that tensions between the O’odham and the observatory are deeply submerged in a visual discourse of mutual respect.

Trading Zones and the Kitt Peak Visitor’s Center

At the Visitor Center on the summit of Kitt Peak, O’odham and astronomical uses of the mountain are equally represented. Scientific and indigenous cultures are seamlessly blended into tourist commodities as woven Tohono O’odham baskets are sold alongside stargazing books and space toys. Mugs and magnets are emblazoned with both the observatory’s logo and the Tohono O’odham “man in the maze” symbol, a metaphor that encourages seeking greater meaning in life. Just outside the Visitor Center, the O’odham have been incorporated into the visual landscape of the observatory through a large circular mural painted on an old telescope mirror blank by a Tohono O’odham artist. Showing scenes of O’odham harvesting the fruit of the saguaro cactus for the Rain Ceremony and making baskets and pottery under a starry sky dotted with oversized planets, the mural suggests that elements of traditional O’odham cultural practices are not at all distinct from astronomical culture. These material façades of accommodation at the KPNO Visitor Center indicate that the cultural worlds of the O’odham and the astronomers are, at the very least, compatible. And indeed, the astronomy and O’odham communities do converge at Kitt Peak in meaningful ways. The trading zones of the Visitor Center extend well past gift shop

⁴ The American Indian Religious Freedom Act (AIRFA), Public Law No. 95-341, 92 Stat. 469 (Aug. 11, 1978); National Environmental Policy Act of 1969; EPA Order 1110.2; The Endangered Species Act of 1973, P.L. 93-205. AIRFA was widely criticized by many Native American groups for failing to enforce its provisions. The first Native American Sacred Mountains conference was held in 1990, the same year that the Native American Graves Protection and Repatriation Act (NAGPRA) was signed into law by President George Bush.

⁵ Section 106 of the National Historic Preservation Act consultation report determined that construction had an “adverse effect” on Kitt Peak. Project leaders decided to relocate the VERITAS array to Mt. Hopkins in southern Arizona (see Nau, Barnes, and Fowler).

sales or works of art. KPNO preferentially hires Tohono O'odham staff, so tribal members are part of the KPNO community, and the Visitor Center hosts educational outreach programs that are exclusively designed for members of the Tohono O'odham Nation. Astronomers *have* made extensive efforts to represent O'odham interests at Kitt Peak, but the mural and other features of the Visitor Center nonetheless gloss over the troubled history of conflicting cultural and legal interpretations of the mountain's use and significance. The hybridization of astronomical and indigenous cultures evident at Kitt Peak is even more dramatic across the Pacific Ocean on the Big Island of Hawai'i.

Native Hawaiians and Mauna Kea International Observatory

On the Big Island of Hawai'i, the University of Hawai'i manages over a dozen of the world's most sophisticated telescopes built on land that was ceded to the United States government from the Hawaiian Kingdom in 1898. Mauna Kea became a contested landscape soon after the first telescopes appeared in the late 1960s and early 1970s due to environmentalist concerns about the rare *Wēkei* bug and the mountain's unique ecosystem. For the first time in the history of the discipline, astronomers were asked to assess the impact of their science on the mountain environment by a concerned group of citizen environmentalists (Mull; Hawaii Tribune-Herald). Astronomers directly engaged with the local community and modified old narratives that focused solely on the intrinsic value of astronomy as the pursuit of knowledge. At public hearings, astronomers argued that astronomy was a clean, environmentally-*friendly* science (for summaries of oral comments, see Mauna Kea 1973).

Though astronomers at Mauna Kea always acknowledged that the mountain was sacred to Native Hawaiians, Native Hawaiians only joined the anti-observatory campaign in the late 1990s. Why, some astronomers openly wondered, did Native Hawaiians wait roughly thirty years to protest further development of their sacred mountain? In part, this seemingly sudden opposition was due to the reclamation of political and cultural identity known as the Hawaiian Renaissance, a nationalist movement that began in the 1970s that developed into a broad network of politically mobilized sovereignty activists and cultural practitioners by the late 1990s (Kanahele). Native Hawaiian activists reacted strongly to NASA's 1999 proposal for an interferometer telescope project on Mauna Kea.

Designed to surround the existing twin Keck telescopes on the summit, NASA's proposal consisted of several small telescopes working in conjunction that were named "Outriggers." Some Native Hawaiians instantly took issue with the name, a deliberate reference to the outriggers, the support structures of canoes used in traditional Polynesian navigation. Astronomers saw Mauna Kea as an ideal site for the Outrigger telescopes, which would contribute to NASA's "Origins" Program, dedicated to the search for life in the universe (Mauna Kea 2002). According to the Native Hawaiian creation chant known as the *Kumulipo*, Mauna Kea itself is the place where all life originated. As the Native Hawaiian activist group *Hui Malama I Na Kupuna O Hawai'i Nei* (Group Caring for the Ancestors of Hawai'i, "Hui Malama") explained, oral history provided Native Hawaiians with "layers upon layers of answers to questions about our origins that we find more than satisfies our own curiosity as to where we come from" (Mauna Kea 2002: 2) NASA eventually pulled the funding on the Outriggers and a judge reversed the permit for the project in 2006.

The contested case demonstrated that Native Hawaiian narratives about Mauna Kea's sacredness could stall or otherwise severely limit telescope development. Increased public scrutiny of the University of Hawai'i's management of the Mauna Kea Science Reserve continued throughout the 1990s, making it clear to the astronomy community that the future of cutting-edge astronomy on Mauna Kea was at stake (Mauna Kea 2000). Astronomers had to find some way to bridge cultural gaps between astronomers and Native Hawaiians, and they turned their attention to producing new narratives about the mountain's use and significance.

With the development of a new master plan in 2000 to address Mauna Kea's ecological, scientific, and spiritual resources, astronomers began to describe astronomy as the same science that once guided Polynesians to the Hawaiian Islands. According to this view, embracing astronomy on Mauna Kea was not a betrayal of cultural identity; it was an embrace of the spirit of exploration and discovery that had led to the settlement of the islands in the first place. The new narrative emphasis on celestial knowledge shared by ancient Polynesian and modern astronomical communities was underscored by a pamphlet prepared by the University of Hawai'i on its 2000 master plan. The pamphlet compared managing Mauna Kea's diverse resources to a "voyage of discovery," calling to mind Polynesian navigation. More explicitly, each page of the master plan informational pamphlet bore an iconic image of a Polynesian canoe, famous to Native Hawaiians as a potent symbol of the Hawaiian Renaissance. By appropriating such a powerful symbol of Hawaiian exploration, the pamphlet effectively homogenized indigenous and scientific modes of exploration into one common cultural enterprise. This narrative trend toward merging Native Hawaiian and astronomical interpretations of the mountain's significance was even more pronounced in a later draft of the master plan that explained, "For the Hawaiian people Mauna Kea is their cultural connection or *piko* (umbilical cord) to *Papa* and *Wākea*, it is the beginning and the end. For the astronomical community Mauna Kea is the scientific umbilical cord to the mysteries of the universe" (Mauna Kea 2009). By invoking "culture" in their narratives about astronomy on the mountain, the Mauna Kea astronomy suggested that scientific activities on Mauna Kea's summit now warranted just as much protection as religious activities on the summit. As one University of Hawai'i professor put it, "If Queen Lili'uokalani had lived today, she might have been an astronomer . . . Science, too, is a culture, an ancient one whose roots go back to the dawn of human civilization. Calls from some Native Hawaiian and environmental groups for the dismantling of telescopes on Mauna Kea or banning future development there are also culturally insensitive because they ignore the kinship astronomers feel with the mountain as they explore the cosmos in what is ultimately a spiritual quest for them, too" (West).

Trading Zones at 'Imiloa: Connecting Earth and Sky

In 2006, the Mauna Kea astronomy community received a \$28 million endorsement of the view that astronomers and Native Hawaiians shared a common culture when it came to reverence of Mauna Kea. "Imiloa," a word that means "to explore" in Hawaiian, is the name of an astronomy education center generously funded by NASA and other federal grants. Known formally as the University of Hawai'i's "Imiloa Astronomy Center," 'Imiloa is the product of an ongoing collaboration between astronomers and Native Hawaiian

cultural consultants (‘Imiloa Astronomy Center of Hawai‘i). According to Master Polynesian Navigator Nainoa Thompson, “‘Imiloa was designed as a center of integrated values, and indeed, ‘Imiloa’ materially embodies the narrative that astronomers and Native Hawaiians share a common spirit of ‘exploration,’ ‘discovery,’ and ‘origins’” (quoted in Gemini Observatory).

Similar to the Kitt Peak Visitor Center exhibits featuring basketry from the Tohono O’odham Nation, the cultural displays at ‘Imiloa represent a trading zone where, as the center’s website advertises, “astronomy meets Hawaiian culture” (www.imiloahawaii.org). At ‘Imiloa, a display on the Hawaiian origin story, the *Kumulipo*, is complemented by a short film explaining the Big Bang theory of the origin of the universe. Models of astronomical observatories are presented alongside traditional Hawaiian canoes to highlight that both can be viewed as instruments of exploration. Visitors are essentially immersed in the narrative that has been widely adopted within the Mauna Kea astronomy community: both cultures share the common spirit of *exploration* and possess knowledge systems that come to bear on the *origins* of life in the universe.

‘Imiloa is designed for the general public, but its entertainment value does not lessen its role as a significant merger of the physical and cultural spaces of astronomers and Native Hawaiians. ‘Imiloa’s embodiment of the narrative of unity in the scientific and indigenous appreciation of the night skies is the direct result of a protracted cross-cultural dialogue between astronomers and Native Hawaiians. Further, ‘Imiloa hosts an astronomer in residence and is the site of numerous community outreach programs and cultural enrichment workshops, offering the astronomy and Native Hawaiian communities a forum for continued cultural exchange.

However, the material and social trading zones of ‘Imiloa are only made possible by erasing distinct markers of cultural identity for members of Native Hawaiian and astronomy communities. The Keck Outrigger controversy exposed clear tensions over radically divergent conceptions of origins, for example, but the cultural and historical meanings of terms such as “origins” and “exploration” are obscured by ‘Imiloa’s trading zones. Astronomers do not accept the *Kumulipo* as a reliable account of the creation of the universe. Similarly, Native Hawaiian cultural practitioners do not regard collecting photons with multimillion dollar instruments equivalent to navigating uncharted seas using naked eye observation of the stars. Simplifying or manipulating conceptual meanings may seem a trivial loss when compared to the gain of establishing a fruitful cross-cultural dialogue, but the costs of this shared discourse may be high.

The identity of a particular cultural group is often tied to the way in which it constructs meaning, and for Native groups, these meanings are often associated with the natural landscape. In Native American and Native Hawaiian oral history traditions concerned with promoting beneficial changes in an individual’s behavior, narratives are intimately connected to particular environmental features. A collective past – and a common cultural identity – may be linked to an element of the physical landscape. Since story and site are so closely intertwined, the geographical landscape effectively invokes the moral landscape of the community. As anthropologist of the Western Apache Keith Basso explains, “mountains and arroyos step in symbolically for grandmothers and uncles” (43). Thus, if Native

Hawaiians conceptualize their origins as genealogically linked to Mauna Kea, the center of creation, they are bound to honor the mountain as a respected ancestor. If astronomers, on the other hand, conceptualize origins as the product of the Big Bang, they are perhaps freer to view the universe (and Mauna Kea's place within it) with a certain scientific detachment. Does 'Imiloa foster communication between the estranged communities of Native Hawaiians and astronomers? Undoubtedly, yes. By validating the narrative that astronomical and Native Hawaiian views of the mountain are compatible, even analogous, 'Imiloa necessarily sacrifices the unique and culturally embedded underpinnings of indigenous and scientific identities.

Mt. Graham International Observatory and the San Carlos Apache

The bitter battle to build a new observatory on Mt. Graham beginning in the early 1980s has many parallels to the Mauna Kea conflict. Mt. Graham was once part of the San Carlos Apache reservation, but is now part of the Coronado National Forest. University of Arizona astronomers hoped to partner with the Vatican Observatory Foundation and other research institutions to build the world's biggest telescope on the summit, but there was one rather small problem: the Mt. Graham Red Squirrel resides only in the old growth conifer forests at the summit, and because the squirrel was close to extinction, environmental groups were outraged by the observatory proposal in 1984.⁶

The observatory became the subject of intense public scrutiny as Arizona newspapers began to print editorials and cartoons about the controversial project that frequently ridiculed astronomers (Dougherty; *Arizona Daily Star* 1990; Vanderpool). Two divergent narratives about Mt. Graham soon emerged. Environmentalists depicted Mt. Graham as a pristine wilderness area, but astronomers pointed out that the mountain landscape was already far from pristine due to its long history of logging and seasonal recreation (Walsh, Angeet and Strittmatter).⁷

Declaring the Sacred

Shortly after a Sierra Club lawsuit brought the project to a standstill, a new activist group, the Apache Survival Coalition, formed in 1990. According to this allied group of Apaches and environmentalists, Mt. Graham was sacred to the San Carlos Apaches, who had been blindsided by the observatory proposal.⁸ Astronomers questioned why Apaches had not disclosed Mt. Graham's sacred status during the preceding years of observatory planning. Coalition members countered that traditional religious knowledge had always been closely guarded from outsiders. The tribe had been reluctant to make Mt. Graham's

⁶ See Warshall for a discussion of the politicization of the Mt. Graham Red Squirrel from a biologist opposed to telescope development. Activist groups that were opposed to the Mt. Graham International Observatory in the 1980s include Earth First!, the National Audubon Society, the Sierra Club, and numerous other conservation groups.

⁷ The University of Arizona produced a fact sheet addressing the pristine argument in 1989.

⁸ Apache Survival Coalition leader Ola Cassadore Davis testified on the spiritual significance of Mt. Graham in Testimony to the United Nations' Sub-Commission on Prevention of Discrimination and Protection of Minorities, Working Group on Indigenous Peoples (July 28, 1999).

sacredness a matter of public record (Leavelle: 157). Through activist literature, however, religious knowledge that was once limited to tribal members became widely disseminated. Described as home to Apache Crown Dancers who assume both human and spirit form, Mt. Graham was also referred to as a portal for prayer that had been sacred “since time immemorial.”⁹ For some Apaches, the observatory was the culmination of 500 years of cultural oppression inaugurated by the arrival of Columbus in North America. Citing laws such as the AIRFA, the National Environmental Policy Act, and the National Historic Preservation Act, the Apache Survival Coalition called for telescope construction to halt immediately (Thompson; Cummings).

Given the legal fortification of such federal protections, the narrative framing Mt. Graham as a sacred site threatened to derail a \$60 million telescope project, and in 1992, Mt. Graham astronomers offered a contrasting narrative by challenging the very notion that the mountain was sacred to the Apaches.

Denying the Sacred

Jesuit astronomer George Coyne saw the Vatican telescope as a means of gaining deeper insight into the mysteries of God’s creation. Coyne, who was Director of the Vatican Observatory and Associate Director of the University of Arizona’s Steward Observatory during the height of the Mt. Graham controversy, believed that building a telescope on Mt. Graham was critical to advancing the Vatican’s scientific and theological agenda. In a 1992 affidavit on behalf of the University of Arizona and the Vatican, Coyne declared, “We are not convinced by any of the arguments thus far presented that Mt. Graham as a whole possesses such a sacred character that it precludes responsible and legitimate use of the land . . . In fact, we believe that responsible and legitimate use of the land enhances its sacred character.” Appealing to a shared appreciation of Mt. Graham as a platform for spiritual activity, Coyne added, “We invite our Apache brothers and sisters to join in finding the Spirit of the Mountains reflected in the brilliance of the night skies.” According to Father Coyne, the Mt. Graham astronomy community and the Vatican were equally invested in the scientific and spiritual value of the land.

Once Jesuit astronomers invested in what was casually termed the “Pope Scope” on Mt. Graham officially denounced the sacredness of the mountain to the Apaches, narratives increasingly began to surface in activist literature and reservation publications depicting the observatory as a colonialist project. According to Tribal spokesman Ernest Victor, “If you go back to the time of Christopher Columbus, religion was used as a front for white people to get what they wanted.” Placing the blame squarely on the Vatican, Victor insisted, “this is a war right now between the Vatican and the Apaches” (Hansen). Tribal member Sandra Rambler affirmed, “Why are the priests in court claiming Apaches’ religious beliefs are invalid instead of moving their telescope to another place? The Vatican continues the destruction of native cultures that Columbus started, and this is shocking and unacceptable” (*Arizona Daily Star*). Apaches and environmentalists fought telescope construction on Mt. Graham through a series of lawsuits during the 1990s on the grounds that Mt. Graham was

⁹ Descriptions of Mt. Graham’s significance to Apaches frequently contain the phrase “since time immemorial” (see, for example, Kitcheyan; Davis 1990).

both a sacred site and home to endangered squirrels (Betsy Brandt Papers). Though the lawsuits were ultimately dismissed by the Phoenix U.S. District Court, the litigation generated negative media coverage of the observatory project as well as lengthy delays in construction.

Due to the bitter legal battles over the mountain, and perhaps in part due to Father Coyne's dismissal of Apache spiritual beliefs, the rift between the Native and scientific communities at Mt. Graham is more pronounced than at the other two sites of conflict. Unlike the open acknowledgement of the mountain's sacred status at Kitt Peak and Mauna Kea, the Mt. Graham astronomy community as a whole has never formally recognized the sacredness of Mt. Graham to the Apaches. Consequently, while the visitor centers at Mauna Kea and KPNO have served as forums for cultural exchange, the visual landscape of the Mt. Graham International Observatory suggests that the mountain is scientifically, not culturally, significant.

Located at the base of Mt. Graham in Safford, Arizona, Mt. Graham's visitor center is called the Eastern Arizona Discovery Park. The visitor center's name was immediately questioned by Apache activists when the center was first under development in the mid-1990s. Apache Survival Coalition leader, Ola Cassadore Davis, believed the Discovery Center glorified "the white colonizers" by featuring exhibits on Arizona's pioneer days and emphasizing "Discovery" as a key theme. As Davis explained, the Discovery Center "exalts this desecration of our sacred Apache mountain as the 'second age of discovery,' 500 years after Columbus" (1994). Incorporating the themes of "exploration" and "discovery" at 'Imiloa proved instrumental to bridging cultural gaps between Native Hawaiians and astronomers, but the Discovery Park's emphasis on "discovery" only drove a further wedge between Apaches and the Mt. Graham astronomy community.

The Discovery Park does not feature direct references to the San Carlos Apaches, reflecting the absence of trading zones between the Apache and astronomy communities at Mt. Graham. Inside the Discovery Park educational center, the display cases include a small diorama depicting the Apache "Legend of the Lazy Coyote" alongside similar displays on creation myths around the world, but there are no other indications that this mountain is significant to the Apaches. At the summit of Mt. Graham, a small placard near the entrance to the observatory complex informs visitors that "this area is considered sacred by several Native American tribes, including the White Mountain Apache and San Carlos Apache, and is a precious and irreplaceable part of our national heritage. Please do not disturb this beautiful mountain's natural and cultural objects. Their removal, destruction, or defacement is prohibited by federal law." Once visitors have moved passed the entry gate, however, there are no further reminders of the mountain's spiritual significance.

Conclusion: Narratives and Contested Spiritual Landscapes

Narratives emphasizing the sacred have critically shaped these still-unfolding debates on the meaning and control of the mountain landscapes at Kitt Peak, Mauna Kea, and Mt. Graham. Whether describing the mountain as a temple for science or a temple of the gods, divergent narratives about the sacred geography of the mountains were leveraged in ways that limited both scientific and spiritual activities. For the Native populations invested in these mountains, the telescopes have been framed as instruments not of science, but of

power and conquest. Perceived as the pet projects of white men, telescopes became a threatening symbol of cultural genocide linked to a colonialist past, while astronomers maintained that they were not trying to subjugate Native beliefs to scientific inquiry, nor were they ruthlessly destroying the environment: these particular mountains simply offered a high, clear platform for large telescopes.

In each history of conflict, the presence or absence of trading zones was contingent upon the production and translation of narratives across different sites and historical moments. Astronomers at Kitt Peak and Mauna Kea gradually refashioned their narratives to encompass science as a cultural activity and sought to interweave scientific and Native perspectives. Instead of depicting the mountains merely as ideal observing sites, the KPNO Visitor Center and ʻImiloa both highlight the mountains as spiritually significant sites to the Tohono Oʻodham and Native Hawaiians, respectively. These more culturally inclusive narratives have thus manifested in trading zones at Kitt Peak and Mauna Kea. Yet Mt. Graham astronomers continue to envision themselves primarily as taking part in a valuable scientific enterprise on a mountain that is well-suited for astronomy. In other words, the intransigence of astronomers' narratives appears to have mirrored astronomers' resistance to negotiation and compromise, both contributing to and reflecting the absence of trading zones at Mt. Graham. Defining the same mountain as an ideal observing site, a pristine ecosystem, or a spiritual temple has clearly played a pivotal role in the making of contested spiritual landscapes, but these competing narratives have also opened up novel opportunities for cross-cultural dialogue on the intersections of spirituality and science.

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