SEEING ARIZONA, IMAGINING MARS: Deserts, Canals, Global Climate Change, and the American West

Author(s): Michael A. Amundson

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SEEING ARIZONA, IMAGINING MARS
Deserts, Canals, Global Climate Change, and the American West

By
Michael A. Amundson

WHEN SCIENTISTS TODAY study the planet Mars, they might send an interplanetary explorer such as NASA's *Spirit* or *Opportunity* rovers, use the Hubble Space Telescope or a terrestrial one like those at Palomar in California. Others might take an "inductive scientific" view by looking around at places on Earth, such as Iceland, that mimic processes believed to have acted on the red planet. Over a century ago, Mars scientist Percival Lowell looked to northern Arizona for the same reasons. In 1894, he brought his twenty-four-inch-diameter Clark refractor telescope to Flagstaff to study the red planet. Over the next twenty-two years, he also explored Arizona's canyons, deserts, petrified forests, and mountains to help imagine what Mars *must* be like. Combining these experiences, Lowell championed a theory that made Mars out to be very much like his adopted American West. Highly controversial yet incredibly popular in his day, Lowell believed that Mars was a dying planet, and to offset its desertification, intelligent Martians had constructed global-wide canals to transfer the planet's remaining water from its polar ice caps to the rest of the world. Lowell's canal theories have been totally discredited. But the reasons behind their historical popularity remain a point of historical debate among scholars. Lowell's canal theories resonated with Americans using water to battle aridity. We should, therefore, revisit his imaginings of the

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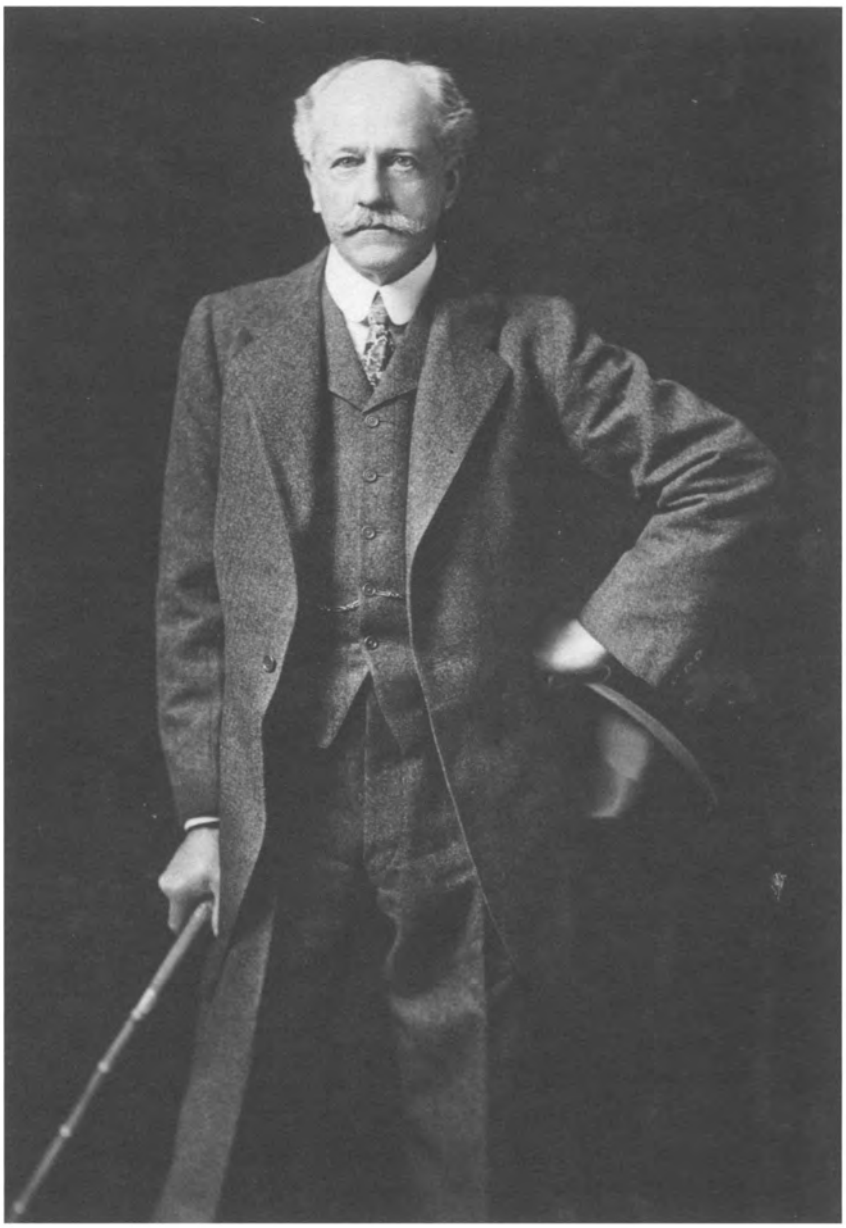
Michael Amundson is a professor of history at Northern Arizona University, Flagstaff. His recent book is *Talking Machine West: A History and Catalogue of Tin Pan Alley's Western Recordings, 1902–1918* (University of Oklahoma Press).



Percival Lowell with cane. 0049. Courtesy of Lowell Observatory Archives, Flagstaff.

planetary "other" as an opportunity to better understand our own ideas about deserts and irrigation in the modern American West.[1]

Most Martian histories follow the basic story of how Italian astronomer Giovani Schiaparelli made a new map of Mars in 1878 that connected dark surface areas with narrow lines that he called "canali," meaning in English "channels" or possibly "canals." Schiaparelli was not the first astronomer to have noted these features, but his map, showing them crisscrossing the planet, became the focus of much attention. French astronomer Camille Flammarion argued that, because the canals were artificial, Mars must be inhabited. Through the end of the nineteenth century, speculation over just what these canali might be and whether or not Mars was indeed populated rose to new heights among academics and, increasingly, the general public.[2]

Boston Brahmin Percival Lowell was at the center of this controversy. Heir to the family's textile mills, Lowell had shunned business for adventure, mountain climbing, and traveling and writing about Japan and Korea, before reading Flammarion's book on Mars in 1893. Sure that canali meant not simply channels but implied man-made canals, and thus intelligent life, Lowell set out to find the ideal spot to build an observatory from which to observe these canals during the upcoming 1894 Mars opposition, when the red planet would be closest to Earth. He knew that dry desert air meant better "seeing," so he focused his efforts on Arizona Territory, sending his associate A. E. Douglass throughout Arizona looking for just the right spot. After city fathers donated land on what came to be known as "Mars Hill," Lowell built his observatory in Flagstaff. Within two months, he set forth his theory on Martian life, and until his death twenty-two years later, Lowell continued to observe Mars, explore Arizona, and write about how he imagined Mars and its canals to be like his adopted home.[3]

The literature on Lowell and Mars, like the universe itself, is enormous and expanding. Most scientists suggest that Lowell set out to see exactly what he wanted to see and that many of his own contemporaries rejected his ideas. Some even argue that the "canals" were no more than reflections of Percival's own ocular blood vessels. All suggest Lowell extrapolated widely from his observations to comment on Mars' water, atmosphere, topography, flora, and even the social and political structure of Martian society.[4]

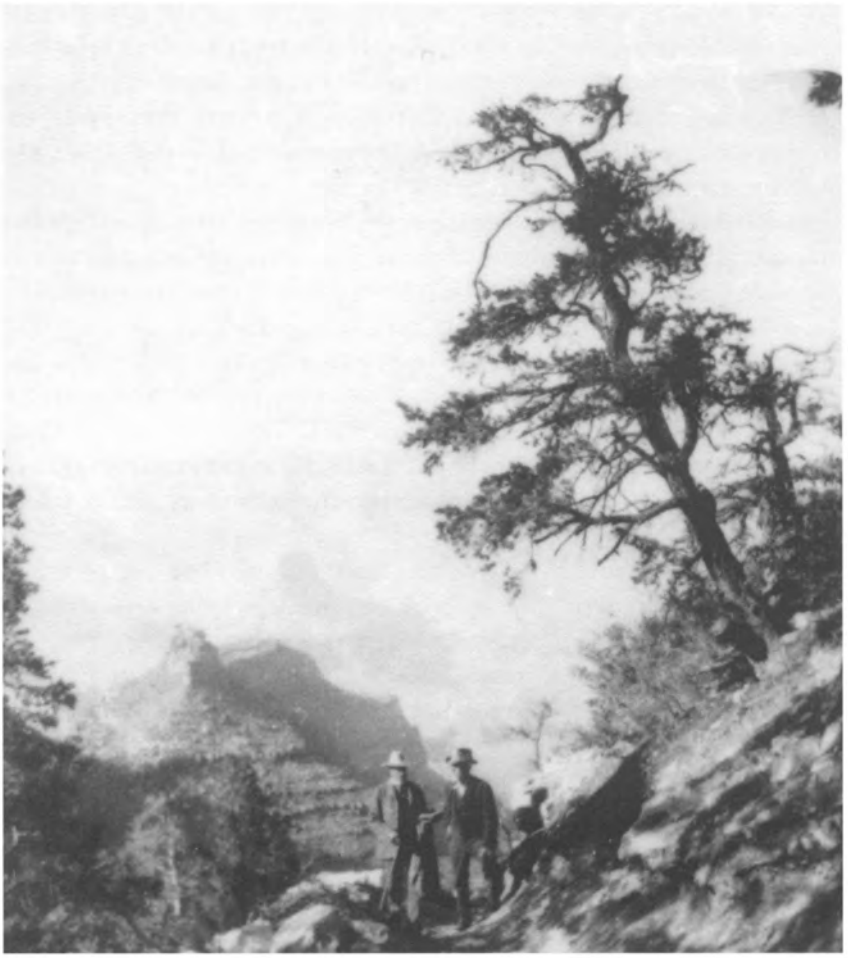
Other scholars offer subtler evaluations of the canal theory. In *Mapping Mars,* Oliver Morton shows the connections between Mars and the American West, noting both places' remoteness, aridity, and character-testing ruggedness. He also observes that many of Earth's Martian scientists have lived in Arizona and that science fiction writer Edgar Rice Burroughs created his Martian Barsoom stories' main character, John Carter, as having come from the mountains of northern Arizona. Historian Carl Abbott also connects the West to space, using science fiction in his book *Frontiers Past and Future.* English professor Robert Markley, in *Dying Planet,* discusses Lowell's theory of planetary evolution and Mars' desertification. He also notes that Lowell's first book, *Mars,* was published the same year that droughts decimated agriculture on America's Great Plains. In *Imagining Mars,* historian Robert Crossley suggests that "no figure is more central to the cultural and literary history of Mars" than Lowell and provides an overview of Lowell's Martian studies. Geographer K. Maria D. Lane further discusses how Lowell often used descriptions of landscapes that he saw in northern Arizona to make his points of comparison. Finally, historian George Basalla, in *Civilized Life in the Universe,* suggests that Lowell's views on the deserts of Arizona and Mars be examined in the wider context of the history of the American West, because the canal debate occurred during the same period (1877–1916) of America's growing concern with irrigating the West's arid lands. Finally, he reminds us that Martian waterways, like those in the West, were not transportation networks like the Suez and Panama canals, but irrigation systems, designed to move waters to arid regions for agriculture.[5]

Although these works provide a fertile context for examining Lowell and the Martian canals alongside the history of the American West, they neither provide much detail about Lowell's Arizona explorations nor explain much about how these observations of the region were reproduced and recreated as Martian landscapes in Lowell's popular speeches and writings. For example, Lowell's *Mars and Its Canals* went through many printings and was translated into German, French, Swedish, and Chinese. Nor have many scholars turned the argument around to ponder why understanding Mars could help us better understand the turn-of-the-century American West.[6]

Percival Lowell did not simply read about or imagine what places on Earth were like but instead explored them first hand as an avid mountain climber, walker, and naturalist. Back East, he had been an active member, and even president, of America's first hiking-and-climbing organization, the Appalachian Mountain Club. His Arizona secretary described him as "of the athletic type though not devoted to sports" and noted that "he stood on the tops of all the mountain peaks that came his way, and equally did he like descending to the abysms of canons." While in Japan, Lowell made several unguided mountain ascents, including Bandai and Mt. Fuji, and then described his treks in lectures and articles he wrote for the club magazine *Appalachia.*[7]

In Arizona, Lowell explored much of the scenic country around Flagstaff. To the north, he climbed the San Francisco Peaks and visited Turkey Tanks, Sunset and Strawberry craters, Wupatki Ruins, the Grand Falls of the Little Colorado River, and the Hopi Mesas. To the east, he visited Meteor Crater and hiked in the Painted Desert and Petrified Forests near Holbrook, as well as camped and fished in the White Mountains farther south. To the southeast, he climbed Anderson Mesa and Mormon Mountain. To the southwest, he fished in Oak Creek Canyon, visited Prescott, and explored the even more rugged Sycamore Canyon farther west. Lowell's best friend in the area, and exploring partner, was Judge Edward M. Doe of Flagstaff. The astronomer's "greatest delight was to dine with him [Doe], picnic, climb the mountains, [and] scan the canons." Even at his observatory, Lowell often left "his computations for a bit of exercise on the mesa (now called Mars Hill) to explore a canon nearby," and was "enraptured" by the "zest of the scenes" he discovered. On one such trip into the Petrified Forest, Lowell described his descent into a grove of ancient trees as being like a trip back in time, descriptively noting that "when we left Winslow for the plain of the Little Colorado the cottonwoods along its banks stood clad in ineffable yellow mixed here and there with an orange tint. Against the blue the effect was singularly beautiful, perhaps the more so for the contrast of the ocherish desert all about."[8]

The two decades following the founding of Lowell Observatory in Flagstaff, in 1894, mark the peak of the Martian canal theory and overlap with the most intense period of irrigation development in the American West. Percival Lowell published three books,



Percival Lowell and Professor Edward Morse on Grand Canyon Trail. 0121q. Courtesy of Lowell Observatory Archives, Flagstaff.

Mars (1895), *Mars and Its Canals* (1906), and *Mars as the Abode of Life* (1908). Lowell's friend Edward Morse, director of the Peabody Museum and member of the National Academy of Science, also published a book supporting Lowell in 1906 called *Mars and Its Mystery.* Western water historians should recognize this timeline. Although Native Americans and Mormons had been irrigating parts of the West before the Civil War, the great national push began with the passing of the Desert Land Act in 1877, the publication of John

Wesley Powell's *Report on the Arid Lands* in 1878, the formation of the National Irrigation Congress in 1891, historian Frederick Jackson Turner's frontier thesis in 1893, the 1894 Carey Act, the publication of William E. Smythe's *The Conquest of Arid America* in 1900, and, most important, the 1902 Newlands Act, which brought federal money to western reclamation.[9]

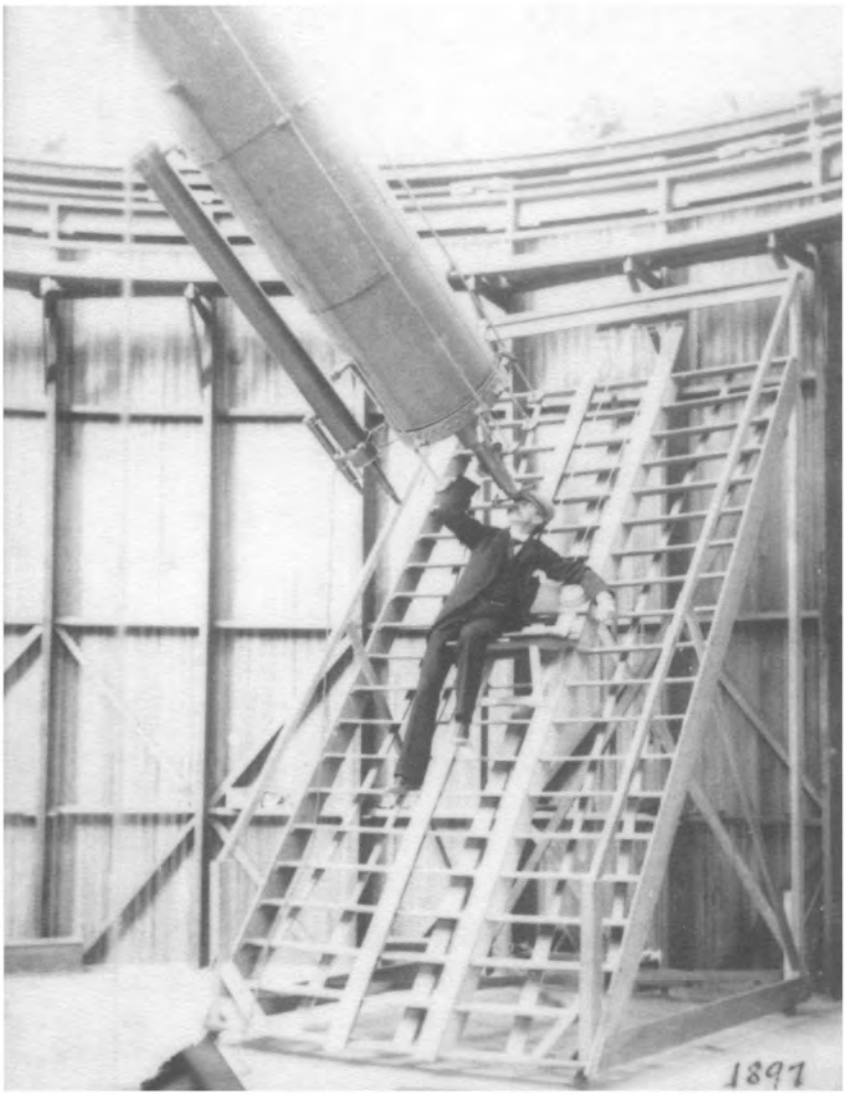
In *Mars*, Lowell provided a logical argument for an irrigation-based civilization. He suggested that Martian conditions were suitable for life, that there was a lack of water, and, therefore, if "beings of sufficient intelligence inhabited it, *they would have to resort to irrigation to support life.*" He later added that "irrigation . . . must be the all engrossing Martian pursuit." He then noted there just happened to be a "network of markings" that looked like, and just happened to be in, the place where an irrigation system should exist. Finally, he reported that spots next to these lines were the "oases" produced by irrigation.[10]

Lowell's utopian view of the Martian psyche was not unlike Powell's watershed democracies or Frederick Jackson Turner's innovative frontiersman. First, he suggested that the irrigation works' complexity pointed to intelligent life and a mindset more comprehensive than our own. He further argued that the planet-wide project suggested a lack of "party politics" and that the Martian canals hint at "the existence of beings who are in advance of, not behind us, in the journey of life." In 1895, a newspaper in Prescott, Arizona, even picked up on an Albuquerque editorial that suggested that the "inhabitants of Mars understand irrigation perfectly" and that it was "too bad that Mars cannot be represented at our National Irrigation Congress."[11]

The *Boston Post* discussed the similarities between Earth and Mars in a nearly full-page story called "The People of Mars," which appeared on May 31, 1896, and discussed the construction of Lowell's new twenty-four-inch telescope and what was already known of the red planet. The newspaper even included a large sketch by the *Post*'s artist of "A Summer Scene on Mars" that features three very earthling-like couples, wearing togas and walking in a lush jungle. In the near distance, another couple appeared to be trying to dislodge a coconut from a palm tree, while a large city sits at the base of a mountain on the far horizon. Following on this theme, the article explained that Mars was "much like the earth" and pointed

"A Summer Scene on Mars," Boston Post, *May 31, 1896.*

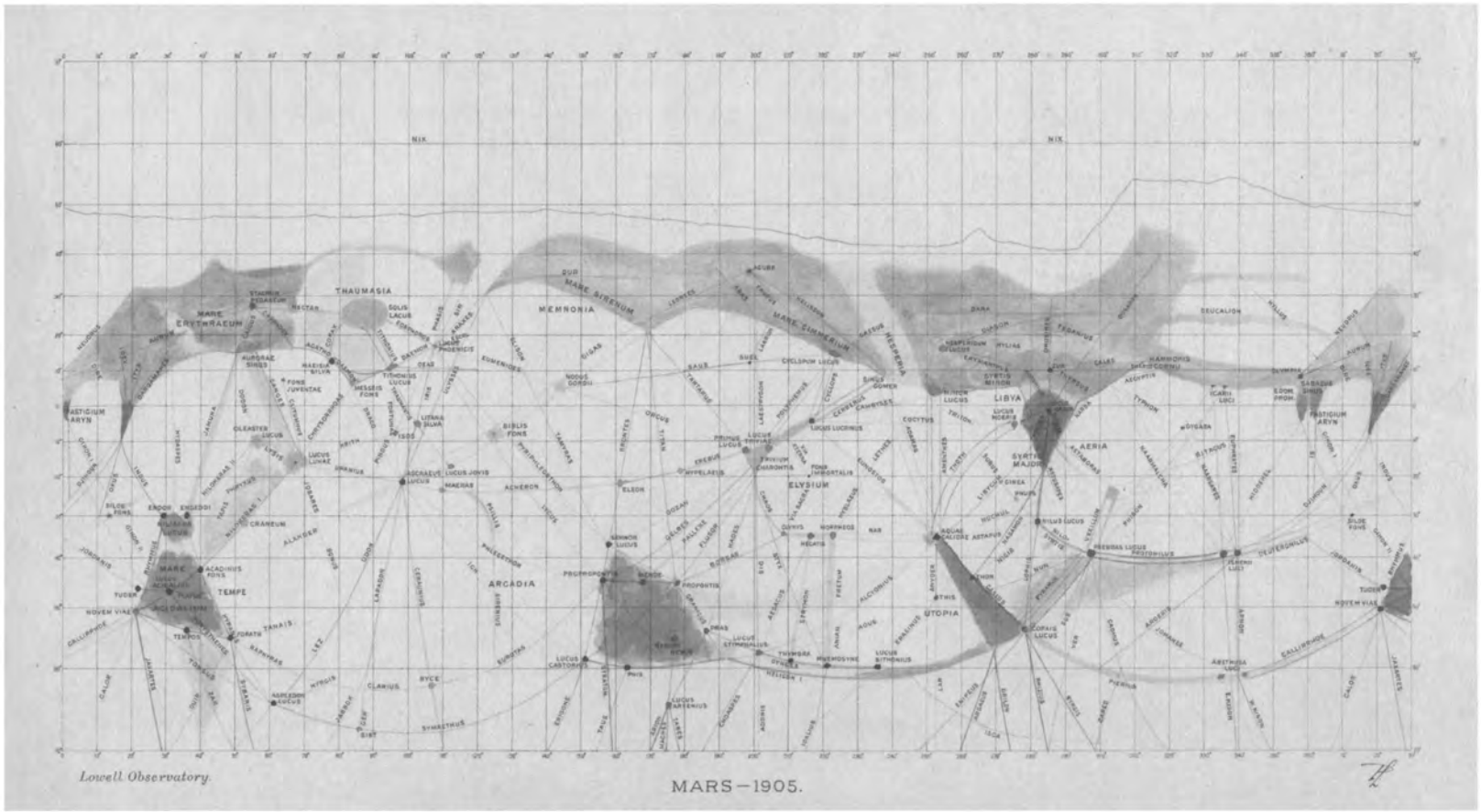
out features in the American West, such as the Humboldt Sink, the Great Salt Lake, and the Salton Lake, as places slowly becoming more and more arid, concluding that "thus upon the western half of our country has been wrought the same world evolution, the drying up of water that has occurred on Mars." The difference was that Mars was older than the Earth and therefore more advanced in its march to aridity. To stave off this decline, the *Post* noted "already the vanguard of pioneers in this country are grappling with the Martian problem" and "many have tried to picture the future of the arid West when irrigation has worked its miracle



Percival Lowell observing at telescope. 0003a. Courtesy of Lowell Observatory Archives, Flagstaff.

of reclamation, but in the far-off planet we see the actual picture of an irrigated world."[12]

In an extraordinary page-one article published in the local Flagstaff newspaper, the *Coconino Weekly Sun*, on August 6, 1896,



The Martian canals, seen in Lowell's 1905 map, provided "proof of the world-wide sagacity of its builders . . . only a universal necessity such as water could well be the underlying cause." Quotation from Percival Lowell, Mars and Its Canals *(New York: Macmillan Company, 1906).*

editor C. M. Funston picked up on this discussion of Martian irrigation and compared it not only to the West but to Arizona Territory. He wrote that the "Martians are pleasant people, intellectual and peculiarly congenial to us Arizonans. Mars is almost one grand Arizona without the canyons or mountains—or Flagstaff." Funston continued, "We of Arizona should feel distinctly friendly to those new acquaintances of ours, for they are liable to give us some valuable pointers in the way of irrigation." He then described Lowell's depiction of Martian canals, "diverging from the poles to the equator, tapping the melting snows of the polar regions." Noting that they are "all a uniform distance apart, and be under one grand management," he proposed that "this Arizona should do." Six years before President Theodore Roosevelt signed the Federal Reclamation Act, Funston suggested a government takeover of Arizona irrigation through centralized planning. "The territory should forthwith annul all corporation and farmers' canals, and go in on the Martian plan," he argued. "Buckey O'Neill can furnish any little ideas that may be lacking on how to accomplish it, in the way of raising money from the government and of condemning existing canals. All being in readiness, *the Mars system could be introduced to Arizona.*"[13]

The reference to Buckey O'Neill may seem curious, but in 1896 the future Prescott mayor and Rough Rider had long supported centralized irrigation and was running on the Populist ticket to be Arizona's territorial delegate to Congress. As such, O'Neill endorsed the Populist standard bearer, William Jennings Bryan, and the party's famous Omaha platform, including the initiative and the free coinage of silver at the ratio of 16:1. He also pushed for "government aid in development of irrigation facilities and regulation of water service canals." O'Neill had been an early investor in the Buckeye canal and, as his biographer has stated, argued that Congress had "appropriated for the rivers, harbors, and waterways of the East . . . to promote agriculture . . . so why not do something to promote agriculture in the Arid West." In fact, on Independence Day 1896, O'Neill wrote a long article for the *Arizona Republican* outlining a federal reclamation act that he had submitted to the National Irrigation Congress.[14]

This connection between what Lowell believed was occurring on Mars and what O'Neill was suggesting for Arizona was not lost on editor Funston, who connected the dots while boosting Flagstaff

at the same time. In addition to the page-one story about Lowell and Mars, Funston published on page two of the same paper a story about the National Irrigation Congress, which noted that O'Neill had discussed the subject of "State Control of Water." If Congress adopted O'Neill's reclamation plan, and brought Martian centralized irrigation to Arizona, perhaps, the editor proposed, Flagstaff and its mountains could serve as a water source for the territory and a communications hub between planets. Funston suggested that, instead of tapping into Earth's North Pole by digging a canal from the ice cap, Arizonans could draw "upon our San Francisco Peaks for melting snows," which would "assure plenty of gravity for the canals." He believed that "a dozen or score" of canals could be dug from Flagstaff in all directions, supplying water for the territory and bringing a million dollars into the town's coffers. Such an effort would replicate Martian hydrologies in the American Southwest and make the desert bloom, making "Flagstaff solid with the Martians."[15]

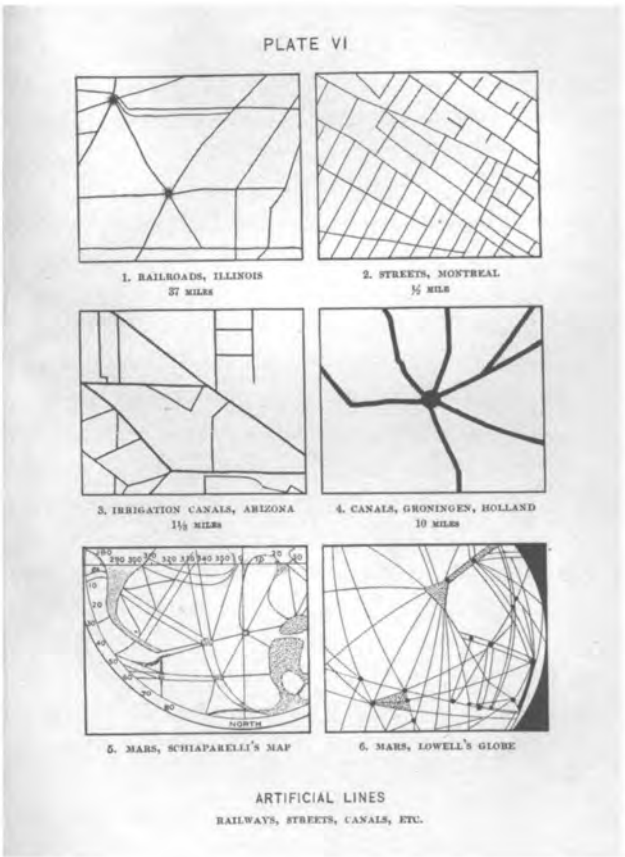
Funston even suggested that the people of the Red Planet were no doubt viewing Earth through their own telescopes. When they "saw a system of canals like their own . . . and near that point a handsome town among the pines, they would at once conclude that in that town were the only intelligent people on earth." And if that were not enough, Funston proposed that perhaps Flagstaff could use irrigation to become a communication center between Earth and Mars. "There would be a distinction," he wrote, "to be known all over two worlds." Coming back down to Earth a bit, Funston made a final appeal connecting two of northern Arizona's favorite sons, Buckey O'Neill and Percival Lowell—"all there is to do is just co-operate with Buckey and get those government bonds, and *put Martian canals in Arizona.*"[16]

Comparison between Martian canals and irrigation in the American West also raised discussions of the Law of Prior Appropriation, which granted water rights based on time of application and use, rather than proximity to the source. The *Arizona Republican* noted that "Mr. Lowell has been unable to determine, so far, whether irrigation on the planet Mars is attended by any difficulties which have beset the industry in some parts of the west." It reminded readers that Lowell did not "tell us, for example, whether the 'priority rights' irrigators have on Mars have the first whack at

the water in the canals, nor whether it has been necessary to form a water user's association in order to protect the interests of all concerned." In a thinly veiled comparison to the transition from the corporate failings of the government-corporate partnership of the Carey Act to the hope of the all-government Federal Reclamation Act, the *Republican* suggested that, "presumably, irrigation on Mars is done by the Martian government." The newspaper concluded that the "vast scale" of the Martian canal system "upon which the work has been carried out precludes the theory that private enterprise was sufficient for the task."[17]

By the time Percival Lowell published *Mars and Its Canals* in 1906, the astronomer seemed even more in line with John Wesley Powell and the *Arizona Republican*'s editor when he argued that, because the Martian irrigation system encompassed the entire planet, it was an "organized entity" or "community of interest." This further suggested the "necessarily intelligent and non-bellicose character of the community" that took on such a global task. The Phoenix newspaper proposed that, sooner or later, "the remainder [of the population] must find it more advantageous to work together for the common good." The canals provided "proof of the world-wide sagacity of its builders," suggesting "that only a universal necessity such as *water* could well be the underlying cause."[18]

Lowell's descriptions of Mars also echoed the landscape of the American West. Most famously, in his second book, *Mars and Its Canals*, the astronomer wrote that the "reddish-ochre tracts" on Mars "seem to be nothing but ground, or in other words, deserts." After first alluding to the Sahara, Lowell proposed that Mars' best counterpart on Earth was the Painted Desert of northern Arizona. Specifically, Lowell noted that "to one standing on the summit of the San Francisco Peaks . . . the resemblance of [the desert's] lambent saffron to the telescopic tints of the Martian globe is strikingly impressive." He described the juxtaposition of the forest and desert as similar to views of Mars through the telescope, even suggesting that Arizona's Painted Desert, when seen from afar, "is Martian in look." Finally, commenting on what he perceived as vegetation adjacent to the Martian canals, Lowell described them as looking like the "cottonwoods along the banks of the Little Colorado River." The popular press picked up on



Comparison of railroad, street, and canal lines. Edward S. Morse, Mars and Its Mystery *(Boston, 1906), following p. 112.*

these comparisons when, in 1907, the San Francisco *Call* ran a picture of the Grand Canyon, in a story about Lowell, with the caption "Grand Canyon of the Colorado, which must look to the Martians like one of their great canals."[19]

Two years later, in *Mars as the Abode of Life,* Lowell examined the length of Martian summers, the coldness of its winters, and the thinness of its air by once again comparing these characteristics to the San Francisco Peaks of northern Arizona and the work of zoologist C. Hart Merriam. Starting in the desert lands to the east, Merriam had explored and mapped the peaks in 1889 and found that plants and animals had adapted to the various life

zones encountered as one rose in elevation. During several camping trips in the area in 1907, Lowell conducted his own field work, comparing temperatures and plant varieties to prove Merriam's point and extrapolate it for Mars. Lowell next interspersed geological maps with photographs of the desert and pine trees and concluded that the varieties of environments on the tallest mountains in Arizona meant life could exist in similar harsh environments on Mars.[20]

Leading scientist Edward S. Morse also visited Lowell's observatory in Flagstaff. Morse championed the Bostonian's work, similarly using Arizona for his Martian comparisons. In his 1906 book, *Mars and Its Mystery*, Morse included two sets of photographic plates comparing "natural lines" of cracks and fissures on earth and the moon with "artificial lines" seen from above. For examples, he referred to mud cracks on the shore of Roger's Lake southwest of Flagstaff, and Earth cracks as seen from a height of ten feet atop a "mesa in Arizona." He then compared these fissures to irrigation canals as viewed from a mile and a half distance from Phoenix and Lowell's map of the Martian canals as seen from Earth. From these comparisons, Morse concurred with Lowell's theories that the lines observed on the red planet were not natural in origin and must have been made by Martian hands.[21]

Morse next examined the seasonal effects of the Martian canals on new growth by comparing them to a riparian scene in Arizona. Morse noted that if an observer stood on the mountains northeast of Phoenix and followed the Gila River through the desert toward Phoenix, the actual irrigation ditches could not be seen. However, their effects—the colors of plants emerging from the desert and plain—would be reminiscent of the Martian canals observed from Lowell Observatory. He further suggested that, if it were possible to furnish a Martian with a telescope to observe Earth, the observer would "undoubtedly correlate the irrigating regions of Arizona as similar in nature to his own canals." Finally, Morse argued that, if we could observe the American West from Mars, we would find "railroads . . . or again the *work of the United States Reclamation Bureau* running its irrigating canals in various directions through that great region."[22]

An examination of how historians of "that great region" might re-examine Lowell and his work in the broader contexts of western

history contributes to a reassessment of our understanding of Mars and the American West. In addition to the arguments already made on irrigation, a look at the broader socio-cultural connections of reclamation, deserts, and climate change is in order.

Lowell clearly made an argument for the cultural and political implications of using water to reclaim the desert when he suggested that Martians had to be an advanced, peace-loving people in order to build and maintain global irrigation canals. This broader view certainly fits within western water historiography. Although Lowell's transglobal canals resemble the Bureau of Reclamation's trans-basin "large plan" that Marc Reisner discusses in *Cadillac Desert*, it really does not resonate well with the major historiographical arguments of recent western water writers, including Reisner, Donald Worster's oligarchic "hydraulic society," or Mark Fiege's complex *Irrigated Eden*. Instead, Lowell fits alongside Progressive reclamationists such as John Wesley Powell, William E. Smythe, and Theodore Roosevelt who felt that irrigation and the Newlands Act would breed democracy and equality. Perhaps we could even paraphrase Gifford Pinchot's utilitarian model of resource allocation for public benefit by suggesting that the red planet's canals provided "the greatest good for the greatest number"—of Martians![23]

Lowell's views on the desert and global climate change also place him within the western historiography of his day, but this analysis takes a little more explanation. As a scientist, Lowell believed in planetary evolution and saw well-watered planets like Earth as younger than barren bodies like the moon. Planets like Mars, increasingly full of deserts and hanging on to what precious water could be moved about the planet, were older and declining. This declensionist attitude clearly was present in Lowell's description of his trek into the Petrified Forest discussed earlier, as well as in an often-quoted passage from *Mars as the Abode of Life:* "the cosmic circumstance about them which is most terrible is not that deserts are, but that deserts have begun to be. Not as local, evitable evils only are they to be pictured, but as the general unescapable death grip on our world. They mark the beginning of the end." Lowell sought out deserts in Arizona and Chile for their calm air and excellent observing conditions, not their unique ecologies that contemporaries Mary Austin or John Van Dyke found so interesting. This

utilitarian attitude saw little use for the desert and clearly placed Lowell alongside other nineteenth-century Americans, such as John C. Frémont and Mark Twain, who loathed the desert. Historian Patricia Limerick, in her book *Desert Passages,* refers to this group as writers whose "dislike of the unimproved desert predominates." Indeed, in *Mars and Its Canals,* Lowell wrote, "pitiless as our deserts are, they are but faint forecasts of the state of things existent on Mars . . . what a terrible significance for everything Martian lies in that single word: *desert.*"[24]

Lowell championed irrigation to combat the desert, and this attitude places the Martian scientist squarely in line with Earth's irrigation prophet, William E. Smythe. Lowell and Smythe are idealistic brothers, disdaining the unimproved desert for an improved, irrigated one. Both men were born in Massachusetts, Lowell in 1855 and Smythe six years later. Both moved to the arid West, Lowell to Arizona and Smythe to Nebraska. There, through their own observations, they wrote popular, turn-of-the-century books about irrigation's importance in overcoming deserts and its broader implications for society. Indeed, Lowell published *Mars and Its Canals* just one year after Smythe revised and published *The Conquest of Arid America.* Their parallels continue into their writings. Although Smythe saw deserts more as the unfinished handiwork of God while Lowell viewed them as the inevitable results of planetary evolution, both men argued that irrigation was the key to "drive back the desert inch by inch." Of aridity, Smythe simply stated that its "chief blessing" was that it "compels the use of irrigation. And irrigation is a miracle!" Within this miracle, Limerick's summation of Smythe's ethos eerily sounds like Lowell's description of Martian canal builders: "the recalcitrance of nature in deserts would provide the necessity for planning and cooperation among settlers."[25]

Percival Lowell too often is regarded as an amateur astronomer who let his own pre-judgements cloud his observations to the point that today his science is completely dismissed. On the contrary, Lowell's ideas about planetary observation continue to inspire, and perhaps his views on Mars can better help us understand the West and the world. To start, we might take a hint from "The Million-Year Picnic," the final story of Ray Bradbury's *The Martian Chronicles,* which presents another Martian view of the hydraulic

frontier where earthlings escape atomic war at home by resettling a Mars stripped of its original inhabitants by a plague planted by previous Earth visitors. Never having seen its original inhabitants, the main characters peer into one of the red planet's canals and finally view Martians—i.e., themselves—reflected in the flowing waters. This idea symbolizes as well Percival Lowell's relationship with irrigation canals, deserts, and climate change. As he gazed at those Martian canals, he saw not only the red planet but the West reflected back to him.[26]

NOTES

1 "Robots on Mars Search and Catalog Red Planet," transcript, *Talk of the Nation Science Friday*, September 19, 2008, available online at http://www.npr.org/templates/transcript/transcript.php?storyId=94802645 (accessed January 26, 2010). Robert Markley, *Dying Planet: Mars in Science and the Imagination* (Durham, N.C., 2005), 68, discusses Lowell's "inductive" approach to planetology.

2. The historiography on Mars and its history reaches nearly to the Red Planet. A few places to begin include Markus Hotakainen, *Mars: From Myth and Mystery to Recent Discoveries* (New York, 2008); John M. Boyce, *The Smithsonian Book of Mars* (Washington, D.C., 2002); Martin Caidin and Jay Barbree with Susan Wright, *Destination Mars: In Art, Myth and Science* (New York, 1997); William Sheehan, *The Planet Mars: A History of Observation and Discovery* (Tucson, Ariz., 1996); William Sheehan, *Planets and Perception: Telescopic Views and Interpretations, 1609–1909* (Tucson, Ariz., 1988); and Carl Sagan, *Cosmos* (New York, 1980).

3. One historian suggests that Percival conceived of the Martian canals based on the waterways of Lowell, Massachusetts, the textile mill town named for his family. See Don Lago, "The Canals of Lowell," *Griffith Observer*, August 1985, pp. 2–11. The best biographies of Lowell include David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin* (Cambridge, Mass., 2001); William Lowell Putnam, *The Explorers of Mars Hill: A Centennial History of Lowell Observatory, 1894–1994* (West Kennebunk, Maine, 1994); William Graves Hoyt, *Lowell and Mars* (Tucson, Ariz., 1976); and Sheehan, *Planets and Perceptions.*

4. See especially Strauss, *Percival Lowell*; Hoyt, *Lowell and Mars*; and Sheehan, *Planets and Perceptions.*

5. Robert Crossley, *Imagining Mars: A Literary History* (Middletown, Conn., 2011), 68–89; Oliver Morton, *Mapping Mars: Science, Imagination, and the Birth of a World* (New York, 2002); Markley, *Dying Planet*; Kristina Maria Doyle Lane, "Imaginative Geographies of Mars: The Science and Significance of the Red Planet, 1877–1910" (Ph.D. dissertation, University of Texas, 2006); K. Maria D. Lane, "Geographers of Mars: Cartographic Inscription and Exploration Narrative in Late Victorian Representations of the Red Planet," *Isis* 96 (2005): 477–506; K. Maria D. Lane, *Geographies of Mars: Seeing and Knowing the Red Planet* (Chicago, 2011); Carl Abbott, *Frontiers Past and Future: Science Fiction and the American West* (Lawrence, Kans., 2006); George Basalla, *Civilized Life in the Universe: Scientists on Intelligent Extraterrestrials* (New York, 2006).

6. Hoyt, *Lowell and Mars*, 153–54.

7. Putnam, *Mars Hill*, 89; Wrexie Louise Leonard, *Percival Lowell, An Afterglow* (Boston, 1921), 30; Leonard, *Percival Lowell*, 32; William Lowell Putnam, "The Mountaineering Heritage of Lowell Observatory," *Lowell Observer: The Quarterly Newsletter of Lowell Observatory*, Summer 2009, pp. 6–7.

8. The Flagstaff newspaper reported on several of Lowell's fishing expeditions to nearby Oak Creek and his visit to Prescott. See *Coconino Sun*, June 1, 1905; ibid., May 26, 1906;

"Trout Season Opens," ibid., June 2, 1906; ibid., July 1, 1905. Another issue of the paper reported a trip by Lowell and Judge Edward Doe to see the Moqui (Hopi) Snake Dance. See ibid., August 24, 1901. Percival Lowell, "The Plateau of the San Francisco Peak in Its Effects on Tree Life, Part 1," *Bulletin of the American Geographical Society* 41 (1909): 257–70; Percival Lowell, "The Plateau of the San Francisco Peak in Its Effects on Tree Life, Part 2," ibid. 41 (1909): 365–82; William Lowell Putnam, *Percival Lowell's Big Red Car* (Jefferson, N.C., 2002), 105–9; Leonard, *Percival Lowell*, 19, 23, 32; Percival Lowell, "The Newly Discovered Petrified Forest of Northern Arizona," unpublished manuscript, Lowell Observatory Archives, Flagstaff, Arizona.

9. Richard White, *"It's Your Misfortune and None of My Own": A New History of the American West* (Norman, Okla., 1991), 402–6; Thomas Sheridan, *Arizona: A History* (Tucson, Ariz., 1995).

10. Percival Lowell, *Mars* (New York, 1895), 120, 201. Emphasis added.

11. Ibid., 208–9; *Weekly Journal-Miner* (Prescott, Ariz.), June 12, 1895.

12. "The People of Mars," *Post* (Boston), May 31, 1896.

13. "Good Evening Mars: Flagstaff Has the Pleasure of Meeting a Neighbor," *Coconino Weekly Sun*, August 6, 1896. Emphasis added.

14. Dale L. Walker, *Rough Rider: Buckey O'Neill of Arizona* (1975; repr., Lincoln, Nebr., 1997), 58–59. In an article that begins "Handsome Buckey O'Neill arrived in town Friday morning," the *Arizona Republican* (Phoenix), October 8, 1893, wrote that O'Neill's "ideas upon the subject of the ownership of irrigating canals by the people are pregnant with true and disinterested patriotism." See also, "Territorial Populists," ibid., February 23, 1896; "Water Solution," ibid., July 4, 1896. When O'Neill secured the Populist candidacy in late August, the *Coconino Sun* described the party's platform on irrigation as it might have described its view on railroads, when it wrote that the Populist Party "advocates the Government reclamation and irrigation of the arid lands, and Government control of all water supplies [and] declares canals but common carriers." "Buckey Is the Chosen," *Coconino Weekly Sun*, August 27, 1896. The following month, the *Arizona Republican* reported that the Tucson *Star* had simplified the matter in a way that would have made William Jennings Bryan proud, when it reported "Buckey O'Neill is running on the two issues of reclamation of our arid lands and free silver, which will no doubt draw considerable support to him." "Tucson *Star*," *Arizona Republican*, September 24, 1896. Then, in an open letter published in the *Star* to Democratic delegate nominee Mark A. Smith, O'Neill laid out his Populist agenda for irrigation, arguing that "Arizona as an agricultural community has reached its extreme limit without assistance from the general government to reclaim and make productive the public lands." "Political Advertisement: An Open Letter," *Star*, October 16, 1896. Despite these efforts, O'Neill placed third in the November election, with Democrat Smith winning the contest.

15. "The Irrigationists" and "Good Evening Mars: Flagstaff Has the Pleasure of Meeting a Neighbor," *Coconino Weekly Sun*, August 6, 1896.

16. "Good Evening Mars: Flagstaff Has the Pleasure of Meeting a Neighbor," *Coconino Weekly Sun*, August 6, 1896. Emphasis added.

17. "An Arizona Discovery," *Arizona Republican*, March 29, 1904.

18. Powell visited Flagstaff as a guest of lumberman D. M. Riordan in 1891, three years before Lowell established his observatory. See http://www.nps.gov/media/photo/gallery.htm?id=F7BE1F5D-155D-451F-679F22A39AD87BEA (accessed August 8, 2014). The Lowell Observatory Archives contain no correspondence between the two men, nor does it contain any of Powell's publications. Similarly, published works on Powell, such as Donald Worster's biography, *A River Running West: The Life of John Wesley Powell* (New York, 2002), or Wallace Stegner's *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West* (Boston, 1954), contain no reference to Lowell. Percival Lowell, *Mars and Its Canals* (New York, 1906), 376–78. Emphasis added.

19. Lowell, *Mars and Its Canals*, 149–50; Carl Von Mosen, "The Mystery of the Great Red Star," *Call* (San Francisco), August 18, 1907.

20. Percival Lowell, *Mars as the Abode of Life* (New York, 1908), 90–110; Putnam, *Explorers of Mars Hill*; See also Hoyt, *Lowell and Mars*, 157.

21. Straus, *Percival Lowell*, 203–10; Edward S. Morse, *Mars and Its Mystery* (Boston, 1906), 109–14.

22. Morse, *Mars and Its Mystery*, 118, 141–43. Emphasis added.

23. Basalla, *Civilized Life*, 83–87; Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water*, rev. ed. (New York, 1993); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York, 1985), 4–7; Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle, 1999), 3–41.

24. Percival Lowell, *The Evolution of Worlds* (New York, 1910); Lowell, *Mars as the Abode of Life*, 124; Mary Austin, *Land of Little Rain* (Boston, 1903); Patricia Nelson Limerick, *Desert Passages: Encounters with the American Deserts* (Albuquerque, 1985), 91–113; Lowell, *Mars and Its Canals*, 157–58. For a broader discussion, see Hoyt, *Lowell and Mars*, 157–60.

25. Limerick, *Desert Passages*, 10, 88 (quotation); William E. Smythe, *The Conquest of Arid America* (New York, 1900), 40; Lowell, *Mars as the Abode of Life*, 124.

26. Morton, *Mapping Mars*, 156; Ray Bradbury, *The Martian Chronicles* (New York, 1950).