AN ABSTRACT OF THE DISSERTATION OF

Emily M. Simpson for the degree of Doctor of Philosophy in History of Science presented on June 12, 2018.

Title: Mars and Popular Astronomy, 1890-1910

Abstract approved:

Jacob D. Hamblin

Beginning in the late-nineteenth century, several dialogues emerged concerning life on Mars. Some supported the notion of an inhabited Mars, citing recent observations of the planet, while others, pointing to a lack of concrete evidence, denied the validity of such a bold hypothesis. The dialogues within and between different groups focused on three primary topics: the existence of artificial canals on Mars, evaluation of scientific values, and methods to contact Mars from Earth. Scientists and science popularizers recognized the power of popular media to legitimate and perpetuate their interpretations of Mars and employed several tools to promote their ideas, especially when those ideas proved controversial. These methods were the use of environmental conditions as scientific authority, the creation of popular public identities, and promotion of the power of technology to discover hidden truths of the universe.

Mars and Popular Astronomy draws upon resources in several manuscript and correspondence collections from archives housed at Lowell Observatory, Caltech, Huntington Library, and University of California, Santa Cruz. This study also relies on

contemporary newspapers and popular magazines. When pieced together, these documents reveal the tactics that scientists and science popularizers used in their efforts to define, create, and control popular science. They also show how competing interests overlapped and how participants in the debates grappled with definitions of scientific authority and the parameters for responsibility and accountability in science communication.

Mars and Popular Astronomy, 1890-1910

by

Emily M. Simpson

A DISSERTATION

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Presented June 12, 2018
Commencement June 2018

Doctor of Philosophy dissertation of Emily M. Simpson presented on June 12, 2018

APPROVED:

____

Major Professor, representing History of Science

____

Director of the School of History, Philosophy, and Religion

____

Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

____

Emily M. Simpson, Author

ACKNOWLEDGEMENTS

The author expresses sincere appreciation to the faculty of the History of Science department and the School of History, Philosophy, and Religion at Oregon State University. This is especially true of my major professor Jacob Darwin Hamblin and my committee members and mentors Anita Guerrini, Michael A. Osborne, and David Luft. In both a figurative and literal sense, I very much could not have done it without them and appreciate the immense help, guidance, and support they have given me as their student. Infinite thanks.

TABLE OF CONTENTS

Introduction

Channels and Signals

"A lady of the inanely inquisitive kind having met an eminent astronomer, implored permission to ask him *one* question," explained an 1896 article reprinted from the *Edinburgh Review* in popular and long-running US magazine *Littell's Living Age*. "Certainly, madam," the astronomer replied, cautiously, "if it isn't about Mars." [1] Unfortunately for both parties, the story explained, the question the lady intended to ask was indeed about Mars.

This is a sentiment likely shared by many in the present era as Mars once again becomes a topic of sensation and contention. Plans to travel to Mars and even to colonize it appear in the news, along with ever-expanding timetables, on a regular basis.[2] These projects have captured the imagination and interplanetary wanderlust of millions around the world. Many of those who write about, teach, or research in astronomy and related fields have, at times, felt much the same way as the astronomer in the story: anything but Mars. But as much as Mars is in the news today, the sensationalism and visibility of modern controversies are slight compared to the decades surrounding the turn of the twentieth century.

---

[1] "New Views About Mars," *Littell's Living Age*, Vol. 211, No. 2733 (1896), 533.

[2] NASA's *Insight* mission to explore the interior of Mars launched May 5, 2018. Several other Martian exploration missions are currently underway: ISRO (India) and MBRSC (United Arab Emirates) plan to launch orbiters in 2020 and 2022; NASA plans to send another rover in 2020, as does the European Space Agency (ESA) and China's CNSA; JAXA and NICT in Japan plans to send a satellite as well as a probe to the Martian Moon Phobos by 2024. Private companies SpaceX and Mars One promise crewed missions to Mars by 2024 and 2031, respectively. The SpaceX timelines for both preliminary launches and subsequent launches with human crews have been pushed back several times, from 2018, to 2020, and now 2024. Similarly, Mars One began with a target launch time in 2022, then 2026, and now 2031. These private missions are especially controversial.

The US and Western Europe in this era, the late-nineteenth and early-twentieth centuries, were ablaze with discussion and debate about Earth's red neighbor. Seemingly legitimate authorities, and their lists of evidence, were readily available for any who wanted to cite them to justify a belief that life on Mars was not only possible but scientifically proven. On December 9, 1906, the front page of the *New York Times* read in large bold letters, "There is Life on the Planet Mars."[3] It was equally possible, however, to shake one's head in astonishment and dismiss this so-called evidence, as well as those who produced it, as completely without justification or legitimacy. There were many people who accepted life on Mars as scientific fact, and some who used it as a basis for further speculation, but there were also many critics who argued against the notion entirely.

With such different interpretations in abundance, the debate about Martian inhabitation contained multiple conversations. Though the canals were an important part of the discourse, they were not the only element. This analysis looks at three major subjects within the larger debate over life on Mars at the turn of the twentieth century: the existence of artificial canals on Mars, the reactionary reevaluation of epistemological and ethical values from within professional science, and the potential ability for Earth and Mars to communicate.

These three conversations intersected within the territory of popular science. In doing so, they revealed a great deal of information about contemporary concepts of scientific authority, the responsibilities of scientists, and the creation and communication of popular astronomy. In the debate over Martian inhabitation, astronomers and science

[3] "There is Life on the Planet Mars," *New York Times* (New York, NY), December 9, 1906.

popularizers used popular magazines, newspapers, lectures, and other public media channels as tools of legitimacy for ideas that were either controversial or outright rejected by professional science. They framed these aberrant, some may say pseudoscientific, claims in ways that appealed to a wide readership: strong public personas, the superiority of clear atmospheres and nonurban environmental conditions, entertaining narratives, and the power of technology to breach a seemingly frail, gauzy wall between known and unknown.

The most widely-studied discourse within the debate over life on Mars was over the existence or nonexistence of artificial canals. The canal controversy originated in 1877 with the work of Italian astronomer Giovanni Schiaparelli (1825-1910).[4] Based on his observations beginning that year, Schiaparelli posited the existence of a grid-like pattern of linear markings that ran across the entire Martian globe. He drew a series of maps that showed these lines and labeled them 'canali.' Though Schiaparelli did not intend to claim these patterns as artificial in origin, those who translated this label to mean canals, rather than the more literal channels, thought them to be indicative of intelligent life on Mars.[5] One of the people who interpreted Schiaparelli's markings as artificial canals was Percival Lowell (1855-1916).[6] In 1894, after building a private

---

[4] This was also the year that Asaph Hall (1829-1907) confirmed the two satellites of Mars, Phobos and Deimos. This discovery, though they were thought to exist for some time prior, occurred at the US Naval Observatory in Washington, D.C. This event neither added to nor detracted from the debates over life on Mars, but it did enhance the general publicity of the planet.

[5] For the canal debate as a question of life on other planets, see Michael J. Crowe, *The Extraterrestrial Life Debate: The Idea of the Plurality of Worlds from Kant to Lowell*, (Cambridge: Cambridge University Press, 1986); Karl S. Guthke, *The Last Frontier: Imagining Other Worlds, from the Copernican Revolution to Modern Science Fiction*, trans. by Helen Atkins, (Ithaca, NY: Cornell University Press, 1990); Steven J. Dick, *The Biological Universe: The Twentieth Century Extraterrestrial Life Debate and the Limits of Science*, (Cambridge University Press, 1996); Robert Markley, *Dying Planet: Mars in Science and the Imagination*, (Durham, SC: Duke University Press, 2005).

[6] Several biographies of Percival Lowell are available, with different interpretations and perspectives. Some of them include: Louise Leonard, *Percival Lowell: An Afterglow*, (Boston: Gorham Press, 1921); A.

observatory in Flagstaff, Arizona, Lowell based his career on popularizing the canal debate and proving the existence of life on Mars.

A major theme that ran throughout Lowell's career as a popularizer of astronomy, as well as other conversations about life on Mars, was the use of atmosphere and elevation as a source of credibility to support scientific claims. The notion of atmosphere as authority was partly a result of emergent trends in astronomy, based on increasing air and light pollution, which moved observatories away from densely populated areas.[7] It also appealed to the era's fascination with wilderness, wildness, and especially the conquering of such untamed regions.[8]

Chapter One, "The Roosevelt of Astronomy," features the theme of environmental conditions as sources of scientific authority. This avenue of legitimacy through the authority of good seeing has been investigated by William Graves Hoyt and Maria Lane. The work of these scholars analyzes the formation, origins, and applications of atmosphere as authority. Hoyt, in *Lowell and Mars*, discusses Lowell's use of clear and steady atmospheric conditions as a tool to undermine his critics. In emphasizing atmospheric conditions and good seeing, according to Hoyt, Lowell created a source of power for himself by claiming that his observations stood as superior to those of other observatories with more tumultuous air currents, more water vapor, or a less stable

---

Lawrence Lowell, *Biography of Percival Lowell*, (New York: MacMillan Co., 1935); William Graves Hoyt, *Lowell and Mars*, (Tucson: The University of Arizona Press, 1976); David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin*, (Cambridge, MA: Harvard University Press, 2001).

[7] Lick Observatory, founded in 1888, was the first permanent mountaintop observatory in the world. Helen Wright, *James Lick's Monument: The Saga of Captain Richard Floyd and the Building of the Lick Observatory* (Cambridge: Cambridge University Press, 1987); For more on light pollution see John McNeil, *Something New Under the Sun: An Environmental History of the Twentieth-Century World*, (New York: Norton, 2000).

[8] Roderick Nash, *Wilderness and the American Mind*, (New Haven, CT: Yale University Press, 2001). Fourth edition. Originally published 1973.

climate.[9] Lane, in *Geographies of Mars*, also points to the use of atmosphere, elevation, and climate as a major source of scientific authority for Lowell. She demonstrates how the application of environmental and topographical arguments reflected paradigms that Lowell borrowed from the fields of geography and earth sciences.[10]

As a newcomer, an amateur, and an individual who held ideas that were openly rejected by prominent astronomers, Lowell needed a way to create expertise for himself outside the parameters of professional science. He turned to popular audiences. [11] In writing for such audiences, Lowell made use of the argument that his observations were superior to those of his critics because of the superiority of environmental conditions at his observatory in Flagstaff.[12] Because Lowell made these claims resonate with public audiences through a distinct persona, he undermined those who criticized him and his theories. Lick Observatory (1888), atop Mt. Hamilton, CA held similar, if not stronger, claims to clear and steady air. But Lowell incorporated atmospheric legitimacy claims into a broader identity that appealed to readers and was able to embody and present such

[9] See Hoyt, *Lowell and Mars*

[10] See K. Maria D. Lane, *Geographies of Mars*: *Seeing and Knowing the Red Planet*, (Chicago: University of Chicago Press, 2011).

[11] Issues of Lowell's popular appeal are dealt with in Hoyt, *Lowell and Mars*; William Sheehan, *Planets and Perception: Telescopic Views and Interpretations: 1609-1909*, (Tucson: The University of Arizona Press, 1988) and *The Planet Mars: A History of Observations and Discovery*, (Tucson: The University of Arizona Press, 1996); William Lowell Putnam et al., *The Explorers of Mars Hill: A Centennial History of Lowell Observatory*, (West Kennebunk, ME: Phoenix Publishing for Lowell Observatory, 1994); K. Maria D. Lane, *Geographies of Mars*.

[12] For more on Lowell's use of elevation as credibility see K. Maria D. Lane, "Astronomers at Altitude: Mountain Geography and the Cultivation of Scientific Legitimacy," in Denis E. Cosgrove and Veronica Della Dora (eds.), *High Places: Cultural Geographies of Mountains and Ice*, (London: I.B Tauris, 2008). For more on the role of elevation in science see Charlotte Bigg, David Aubin, and Philipp Felsch, "The Laboratory of Nature: Science in the Mountains–Mountains in Science, from the Late Eighteenth to the Early Twentieth Century,'' *Science in Context*, Vol. 22, No. 3, (2009); Michael Reidy, "John Tyndall's Vertical Physics: From Rock Quarries to Icy Peaks," *Physics in Perspective*, Vol. 12, No. 2 (2010): 122-145.

authority more effectively than his critics at Lick Observatory outside San Jose, California.

Professional scientists, at Lick and elsewhere, made up the second discourse of the Martian controversy. These individuals, citing lack of evidence and scientific rigor, rejected Lowell and his ideas, as well as others who supported theories of life on Mars. In the debate over Martian life, they saw sensationalism, exploitation and lack of rigor take hold of what should have been a scientific problem.[13] But the conversation went far beyond the topic of Martians. As Michael Gordin explained in *The Pseudo-Science Wars* (2012), issues of demarcation often lead to a reevaluation of scientific values and definitions from within the realms of established science.[14] The Mars debate engendered, perhaps necessitated, such an appraisal of scientific values and responsibilities from within the astronomical community. It also caused professional astronomers to rethink the value of public outreach. These conversations from within the ranks of professional science are the topic of the second chapter, "The Responsibilities of a Scientist."

Another theme that reappeared throughout the three primary conversations about life on Mars, perhaps even more than legitimacy claims, was the importance of popular media and science communication. H.G. Wells noted in *War of the Worlds* (1898), a novel based on the Martian inhabitation controversy, it was difficult to overestimate "the

---

[13] For a thorough discussion of Lowell and the notion of objective research see Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books 2007). For more on some of the Mars critics see Alfred Russell Wallace, *Is Mars Habitable: A Critical Examination of Professor Lowell's Book "Mars and Its Canals, With an Alternative Explanation* (London: MacMillan & Co, 1907); Donald E. Osterbrok et al., *Eye on the Sky: Lick Observatory's First Century,* (Berkeley: University of California Press, 1988); Albert E. Moyer, *A Scientist's Voice in American Culture: Simon Newcomb and the Rhetoric of Scientific Method,* (Berkeley: University of California Press, 1992).
[14] Michael D. Gordin, *The Pseudo-Science Wars: Immanuel Velikovsky and the Birth of the Modern Fringe*, (Chicago: University of Chicago Press, 2012).

abundance and enterprise of our nineteenth-century papers."[15] Newspapers and popular magazines were in abundance. As Marcel LaFollette describes in *Making Science Our Own* (1990), these publications served as "information sources about the world of science that were easily accessible to millions of readers in all parts of the country and from all walks of life."[16] As science increasingly distanced itself from other vocations, through professionalization, specialized journals, and technical language, popular print became an increasingly important source for science news.[17] This importance meant that these publications possessed a great deal of power to present science in ways that both informed and entertained their readers.[18] In the case of the Martian debate, it was often, and understandably, more interesting to consumers to read about life on Mars rather than scientific methodology and the nature of evidence. Critics of Martian inhabitation were at a distinct disadvantage in their ability to appeal to large audiences.

Those who proposed methods to contact Martians, however, did not share this disadvantage in popular appeal. Chapter three, "Communicating with Mars," deals with a second conversation, separate from Lowell and canals, that emerged in the popular media of the era. This discourse involved the issue of interplanetary communication between humans and Martians. The Martian communication debate began in 1890, when Lick Observatory recorded bright projections emanating from the surface of Mars. Many

---

[15] H.G. Wells, *The War of the Worlds*, ed. by Martin A. Danahay, (Toronto: Broadview Press, 2003), 46. Originally published 1898.
[16] Marcel LaFollette, *Making Science Our Own: Public Images of Science 1910-1955*. (Chicago: University of Chicago Press, 1990), 3.
[17] Ibid., 18. For increasing professionalization and distancing from public affairs see John C. Burnham, *How Superstition Won and Science Lost: Popularizing Science and Health in the United States*, (New Brunswick: Rutgers University Press, 1987) and Theodore Porter, "How Science Became Technical," *Isis*, Vol. 100, No. 2 (2009): 292-309.
[18] See David Y. Hughes, "*The War of the Worlds* in the Yellow Press," *Journalism & Mass Communication Quarterly*, Vol. 43, No. 4, (1966): 639-646.

interpreted these to be light signals directed toward Earth and got to work on the task of answering them. *Mars & Popular Science* begins with the year 1890 because of these initial observations and because, by this time, canal theory had translated from a debate within professional science to a matter of popular discussion and media coverage.

The discussion of the best means to establish communication with Mars was a debate that occurred separately from the topic of canals, though the two shared a great deal of conceptual interchange. Inherent in the debate over signals, just as canals, were issues of science communication, legitimacy claims based on elevation and atmosphere, and the meaning and definition of scientific evidence. These similarities often cause scholars to group the two conversations into one, treating the issue of Martian communication as a subset of the canal controversy.[19] But, in addition to these common themes, Martian signals also contained elements that were unique to the subject and unlike those of the canal controversy. These distinctive factors included a different set of participants, a pronounced dialogue about the promise of technology, and ties to the contemporary explorations of psychical research and spiritualism.

Like the psychical energy spiritualists sought to understand, popular science is a nebulous entity. It is extremely difficult to define and equally difficult to locate the point at which professional science ends and popular science begins. In addition to these difficulties, there exist multiple forms of public science discourse depending on the given context. The definitions and applications of popular science change according to time, place, and the values of the societies which produce it. In *Understanding Popular*

---

[19] Examples of discussions that treat Martian signals as a subset of the canal controversy include Hoyt, *Lowell and Mars*; Sheehan, *Planets and Perception,* and Lane, *Geographies of Mars*. For a more detailed description of these representations, see Chapter Three, "Communicating with Mars."

Science (2006), Peter Broks discusses such historical challenges in great depth. He points to the complicated nature of popular science and the wide breadth of contextual situations that it encompasses as being what makes it a valuable topic to analyze and discuss. According to Broks,

> The very fact that it [popular science] covers such a diversity of beliefs, practices, artefacts, and contexts forces us to acknowledge the complex interrelationship of knowledge, culture and society.[20]

In other words, just because it is difficult to define does not mean that scholars should not discuss it. A recognition of its complex nature can be a benefit in understanding science and society and the liminal spaces between.

Taking into consideration the context and setting of this discussion, the term popular science can mean materials (written, verbal, and visual) that the authors or originators intended to be read, encountered, or otherwise understood by a general population not working within the given scientific field. It is possible to place these basic parameters, of intended audience and distribution, because contemporary practitioners of science and science popularizers placed them on their own work. This was an era in which professionalization and specialization was becoming more important in demarcating and defining science.[21] Therefore, when a person produced an article, book, photographic series, lecture, etc. he or she had in mind whether the intention was to enter into the professional discourse, through publication in the increasing numbers of

[20] Peter Broks, *Understanding Popular Science,* (New York: Open University Press 2006), 2.
[21] Ibid., 28; See also; Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Public Culture" *History of Science*, Vol. 32 (1994): 237-267 and Porter, "How Science Became Technical."

specialized journals, or to step outside of professional science to reach a general reader through the many popular magazines and newspapers available.

Chapters four and five, "Elevation Showdown" and "Farewell to Mars," deal with conflicts between different groups and conversations. In the fourth chapter, Lick Observatory and Lowell Observatory, long-time rivals, come into direct competition with one another over the existence of water vapor on Mars. In an attempt to have the final word on whether water vapor existed in the Martian atmosphere or not, they set up competing mountain expeditions to secure the best data.[22] The fifth chapter, "Farewell to Mars," discusses the waning years of the Martian craze. During this time, 1909-1910, new evidence emerged to refute the existence of life on Mars and popular support for the theory dissipated. Additionally, Lowell's position as a popular authority yielded to a new dominant persona and location. George Ellery Hale (1868-1938) and Mount Wilson Observatory (1904) emerged as the new model and focus of attention.[23] In doing so, however, Hale and Mt. Wilson adhered to some of the precedents set by Lowell and other Martian life enthusiasts. The analysis ends in 1910, after this new evidence became public knowledge and changes began happening in popular opinion. Or, in some cases, die-hard supporters of life on Mars dug in their heels and rejected such changes.

The notions of channels on and signals from Mars originated from seemingly ordered and ordinary telescopic observations within the confines of standard scientific practices. They began as lines and projections, not looked for but noticed. However,

[22] See Lane, "Astronomers at Altitude."
[23] See Helen Wright, *Explorer of the Universe: A Biography of George Ellery Hale* (New York: E.P Dutton & Co, Inc, 1966) and Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America*, (New York: Alfred A. Knopf, 1978).

these phenomena ended up as anything but routine as they evolved into topics of popular discourse. Poet and novelist Ellen Thorneycroft Fowler (1860-1929) wrote in 1892,

> Shall we find what here we have sought in vain –
> Fulfilling ideals where once we failed?
> With the crooked made straight and the rough made plain,
> Will difficult mountains at last be scaled?
> Shall we cleanse our ways and redeem our worth –
> Repair the old wastes and retrieve each blunder?
> Shall we meet in Mars all we missed on Earth,
> I wonder?[24]

But was Mars truly a paradise or a second chance, a place to make real the unfulfilled dreams of humanity? H.G. Wells had a much different view of Mars-Earth relations that involved interplanetary invasion, heat rays, and accidental genocide.[25] Whether Mars redeemed humanity or tried to disintegrate it, potential evidence for life on another planet, and the possibility of communication or travel, conjured profound feelings and boundless imaginings of scores of people who looked to science to provoke as much as to explain.

---

[24] Helen Thorneycroft Fowler, “The Planet Mars,” *Current Literature*. Vol. XI, No. 4 (1892): 431
[25] H.G. Wells, *War of the Worlds*.

Chapter One

The Roosevelt of Astronomy

In November 1907 a scientific news article in the *New York Times* conferred to Percival Lowell (1855-1916), founder of Lowell Observatory (1894) and primary advocate for the theory of artificial canals on Mars, the provocative and timely designation as the "Roosevelt of astronomy."[26] To counter Lowell and his firebrand sensibilities stood the "old fogies" of professional astronomy who, according to the author, considered it "etiquette" to criticize Lowell and his theories.[27] By contrasting this figure, the "Roosevelt of astronomy," to the scientific elite the author stressed Lowell's public appeal and his existence outside of the establishments of professional science. But there were many other qualities Lowell possessed that could have also played a part in inspiring such a description. The author may have had in mind Lowell's reputation for stubbornness, his self-proclaimed ruggedness in taming the Arizona wilderness in the name of science, his famous family, or perhaps just his prominent mustache. Though the nickname did not seem to catch on, the comparison to Theodore Roosevelt (1858-1919) encapsulated much of Lowell's scientific identity and the public image that he cultivated for himself throughout his career as an astronomer and popularizer of science.

In 1877, during a favorable opposition, respected Italian astronomer Giovanni Schiaparelli (1835-1910) sketched a map of Mars that sparked the beginning of a popular science debate that would last decades.[28] A planet's opposition is defined by its

---

[26] "Current Astronomy" *New York Times* (New York, NY), Nov 13, 1907.
[27] Ibid.
[28] For general history of Lowell and the canal debate, see William Graves Hoyt, *Lowell and Mars* (Tucson: The University of Arizona Press, 1976). *Lowell and Mars* was published the year *Viking* I and II landed on

alignment relative to the Earth and the sun. During an opposition, Mars, Earth, and the sun line up in a straight line extending from the center. Mars is on one side of the Earth and the sun is on the direct opposite side. If the solar system were a bicycle wheel, the sun would be the center of the wheel, of course, and Earth and Mars would be on the same spoke.

These alignments occur in cycles and are important in observing Mars. An opposition happens approximately every twenty-six months.[29] Oppositions are the best time to observe Mars because the two planets are closest to one another and face each other directly. However, the distance between the two planets varies from opposition to opposition, from as close as about thirty-five million miles to as far as about sixty million. The entire opposition cycle, from closest to farthest, happens in fifteen-year periods. When an opposition brings Mars in the closer range of the cycle, it is called a "favorable opposition" or a "near approach." The 1877 opposition, the one that inspired Schiaparelli's maps as well as the discovery of Phobos and Deimos, the moons of Mars, was in the most favorable range. The next nearest approach occurred in 1892.

The maps that Schiaparelli drew during the near approach of 1877 featured mysteriously geometrical lines zig-zagging across the planet's surface. Though he meant to describe the lines as channels, some who saw the maps misinterpreted them as canals –

Mars, marking a resurgence in popularity in research relating to Mars. See also William Sheehan, *The Planet Mars: A History of Observations and Discovery* (Tucson: The University of Arizona Press, 1996). For an institutional history of Lowell Observatory, see William Lowell Putnam et al., *The Explorers of Mars Hill: A Centennial History of Lowell Observatory* (West Kennebunk, ME: Phoenix Publishing for Lowell Observatory, 1994). For an account written by staff member and later director of Lowell Observatory, as well as the chief photographer on the 1907 expedition, see Earl C. Slipher, *A Photographic Story of Mars, 1905-1961* (Flagstaff: Lowell Observatory, 1962).

[29] It does not happen every calendar year because of the large difference in orbital periods for the two planets. Earth: 365, Mars: 687.

a much more loaded term.[30] Despite the visibility and persistence of the Martian canal debate in popular culture, however, it was never the consensus of the scientific community that the canals existed. In fact, the majority of American and European astronomers either actively disagreed or were skeptically aloof regarding the existence of Martian canals. The debate was kept alive mostly by the popularization efforts of Camille Flammarion (1842-1925) until 1894, and then by Percival Lowell (1855-1916).

Lowell received neither education nor training in astronomy.[31] Instead, his credibility as an expert and his identity as a scientist were connected always to his diligence as an observer and especially to the public persona that he developed and rendered to the reading audience through his popular books and media outreach. By 1907, three decades after the Martian canal controversy began, Lowell had become a household name in the United States and abroad by means of his regular, resolute, and widely disseminated insistence on a populated Mars. Scientific terms like opposition and atmospheric distortion (the level that the earth's atmosphere interferes with the light-capturing abilities of telescope lenses) had become common terms in newspaper articles and popular magazines. The public engagement that Lowell practiced did not amount simply to publicity or fame. Instead, it was a major source of his credibility as a scientist.

One particular event highlighted the importance of publicity and public reputation to Lowell and his work in astronomy. This event was the 1907 Lowell Expedition to the Andes, undertaken primarily to photograph Mars and its canals during that year's opposition. By examining this expedition, Lowell's public image reveals itself as both

[30] Owing to a mistranslation of the Italian
[31] However, he earned a Bachelor's in Mathematics from Harvard in 1876.

very purposeful and extremely important to him. It was important enough to plan and fund a transcontinental astronomical expedition to court public support and provide conclusive evidence not for himself nor for the scientific community, but primarily for mass reproduction and public consumption.

Outsider and Outdoorsman

Lowell was a member of the Lowell textile family of Massachusetts and inherited the wealth and status that went along with the circumstances of his birth. He attended Harvard where he received a bachelor's degree in mathematics in 1876. After graduation, he worked in the family business operating a cotton mill but found himself ill-suited for that world. He decided to travel instead, and wrote about his observations and experiences. From 1882-1893, Lowell travelled throughout Japan and Korea and wrote four popular books about his experiences.[32] Though these books were successful, at some point during his travels Lowell encountered Schiaparelli's map and was so impressed by the idea of life on Mars that he would later dedicate a book to Schiaparelli, naming him "The Columbus of a New Planetary World."[33] Reeling with the possibility of extraterrestrial civilization, Lowell turned his attention to astronomy wholeheartedly and by 1894 he had used his substantial personal wealth and connections to build his own observatory outside of Flagstaff, Arizona to study Mars and its potential for life.

[32] Though this phase of Lowell's life is often glossed over, historian David Strauss discusses Lowell's cultural studies in Asia as being very influential on his later ideas concerning life on Mars. Lowell's experience observing and documenting other cultures led to his interest not only in the planet but the social conditions of its inhabitants. See David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin* (Cambridge, MA: Harvard University Press, 2001).

[33] Lowell, *Mars and Its Canals*, (New York: The MacMillan Company, 1906), v.

During the time that he spent at Flagstaff, Lowell cultivated a close connection to the relatively rugged environment of northern Arizona and incorporated this relationship into his persona as the "Roosevelt of Astronomy." The first biography of Lowell, written in 1921 by assistant, secretary, and close friend Louise Lenard (1867-1937), documented Lowell's climbing nearby mountains (the San Francisco Peaks) and spending a significant amount of his daytime hours exploring the local landscape.[34] Lowell's brother, Harvard president A. Lawrence Lowell (1856-1943), painted a similar picture in his 1936 biography. According to his brother, "Percival greatly enjoyed the scenery about Flagstaff."[35] This enjoyment, the brother related, included frequent picnics, hikes, and sightseeing trips to local caves, the Petrified Forest, and the Grand Canyon. According to his early biographers and close associates, Percival Lowell was every bit the vigorous outdoorsman, a quality that Roosevelt frequently promoted as the archetype of American self-sufficiency and masculinity.[36]

Outdoor life was more than a simple pastime, however, since Lowell also wrote scientific articles about the landscape of Arizona.[37] In January 1909, Lowell published "The Plateau of the San Francisco Peaks in Its Effect on Tree Life" in two parts in the *Bulletin of the American Geographical Society*.[38] In 1911, Lowell submitted another manuscript to the same publication entitled "Petrified Forest," though the *Bulletin* did not

---

[34] See Louise Leonard, *Percival Lowell: An Afterglow* (Boston: Gorham Press, 1921).
[35] A. Lawrence Lowell, *Biography of Percival Lowell* (New York: MacMillan Co., 1935), 75.
[36] See Aida D. Donald, *Lion in the White House: A Life of Theodore Roosevelt* (New York: Basic Books, 2007) and the comprehensive biography Nathan Miller, *Theodore Roosevelt: A Life* (New York: William Morrow & Co, 1992)
[37] See K. Maria D. Lane, *Geographies of Mars: Seeing and Knowing the Red Planet* (Chicago: University of Chicago Press, 2010).
[38] Percival Lowell, "The Plateau of the San Francisco Peaks in its Effect on Tree Life in Two Parts," *Bulletin of the American Geographical Society*, Vol. 41, No. 6 (1909): 257-270, 365-382. For more on Lowell's work in geography see Lane, *Geographies of Mars*.

publish this article.[39] Additionally, Lowell interspersed information and descriptions of places in Arizona within his astronomical works to draw analogy with the Martian landscape. For example, *Mars as the Abode of Life* (1908) contained two photos of the Petrified Forest, photos and diagrams of the San Francisco Peaks, and a photo of the road leading up the mesa to the observatory, a panorama of the Arizona desert, and a Douglas Fir.[40] Lowell drew both pleasure and scientific inspiration from his surroundings. He also drew a distinct and culturally viable persona to further his scientific claims and identity as a popular scientist.

In addition to bolstering his public persona of outdoorsman and observer, Lowell also used the environment and location of his observatory to underscore his identity as an outsider on the fringes of accepted scientific norms and practices. This is because Flagstaff, although not as remote as Lowell sometimes portrayed it, was nonetheless both physically and metaphorically removed from the primary scientific hubs of the East Coast and Washington D.C. It was also, to a lesser but still notable extent, removed from the growing scientific communities of the West Coast.

This physical separation was purposeful on Lowell's part and mirrored what Lowell wanted to portray to readers as a wide ideological distance between himself and the corridors of established astronomy. Before opening the observatory, Lowell sent assistant Andrew Douglass (1867-1962) on an expedition to the American Southwest to test various sites for steady atmosphere and good seeing. From the time Lowell began his career in astronomy, he was never lacking for critics who repeatedly accused him of

---

[39] Percival Lowell to the Editor of the American Geographical Society, January 16, 1911, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[40] Percival Lowell, *Mars as the Abode of Life* (New York: MacMillan, 1908)

doing bad science. One of the primary complaints emanating from the astronomical community was that Lowell, in observing Martian canals, did nothing more than see exactly what he wanted to see. This type of criticism was not without justification, as Lowell made it very clear from the onset that he intended to use his observatory to prove the existence of Martian canals. About a week before the observatory saw first light, Lowell gave an account of his plans to the Boston Scientific Society (as reported in the *Boston Commonwealth*), describing them as "an investigation into the condition of life in other worlds, including last but not least their habitability by beings like or unlike man."[41] He expected to document the Martian canals not only because the scientific community was "on the eve of a pretty definite discovery in the matter" but also because the canal theory was not only possible, but the most probable of potential theories.[42] According to Lowell, the existence of Martian canals was not just likely. Instead, it was "self-evident" that the channel lines were the result of "some sort of intelligent beings."[43]

This announcement met with vexation from many professional astronomers who cited bias, lack of rigor, and the nonexistence of actual evidence to support such a bold claim as life on Mars being "self-evident."[44] None were more incensed by Lowell's claims for his new observatory than Edward S. Holden (1846-1914), director of Lick Observatory (1888) in Mount Hamilton, California. In reaction to the *Commonwealth's* article on Lowell's address to the Boston Scientific Society, Holden called Lowell's

---

[41] "The Lowell Observatory" *Boston Commonwealth* (Boston, MA) May 26,1894.
[42] Ibid.
[43] Ibid.
[44] See particularly Edward S. Holden, "Men of Mars," *Los Angeles Times* (Los Angeles, CA), July 22, 1894 and Edward S. Holden, "The Lowell Observatory, in Arizona," *Publications of the Astronomical Society of the Pacific* Vol. 6, No. 36 (1894): 160-169.

assertions "misleading" and "unfortunate."[45] Holden feared that Lowell was, purposefully or not, deluding the reading public through overstatements, distortions, and misrepresentations. He was showing none of the caution that public science dictated. Holden concluded,

> But I also think that nearly every living astronomer will agree with me in saying, as I do, that there is no reasonable probability whatever of any such settlement at the present time.[46]

In citing "every living astronomer" as being in opposition to Lowell and his theories, Holden delegitimized Lowell to the point of his not even being an astronomer at all.[47] As Maria Lane describes in her book *Geographies of Mars* (2010), Lowell's "propensity for taking quasi-scientific arguments directly to popular audiences" went against contemporary trends toward professionalization, demarcation, and specialization.[48] Furthermore, as Lane describes, by alienating and downright irritating prominent colleagues, "Lowell inspired numerous assaults against his own and his observatory's legitimacy."[49]

Lowell countered this sort of criticism and exclusion by appealing to the public and by creating a persona for himself that turned his outsider position into an advantage rather than an obstacle. In a 1905 manuscript draft titled "Means, Methods, and Mistakes in the Study of Planetary Evolution" Lowell accused those who opposed him of being overly conservative and outdated.[50] Following antiquated styles and models, "it is but

---

[45] Edward S. Holden, "The Lowell Observatory, In Arizona," *Publications of the Astronomical Society of the Pacific* Vol 6, No. 36 (1894): 160.
[46] Ibid.
[47] Ibid., 164-5.
[48] Lane, *Geographies of Mars*, 76.
[49] Ibid.
[50] Percival Lowell, "Means Methods and Mistakes in the Study of Planetary Evolution" *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory, 3.

natural that many men in the profession should conservatively view askance what seems to them discoveries too strange to be true."[51] According to Lowell, the men of the old regime were unacquainted with his practices and therefore unequipped to judge his conclusions. Furthermore, the old-fashioned views of his critics along with their elite positions in professional science led to their looking down upon alternate theories (or alternate facts, some might say). Lowell believed that "the conservative can hardly bring himself to believe that he does not know all there is to be known."[52] After all, according to the *New York Times* article that named him the "Roosevelt of Astronomy," these critics were the "old fogies" of the scientific world.[53] Apparently, given this dichotomy, the argument that Lowell's critics were behind the times had some amount of currency with the media and the public.

By comparing Lowell's attitude toward public outreach to those of some of his colleagues and harshest critics, Lowell's outsider status became even more pronounced. Saturday nights were public nights at the Lick Observatory, but the presence of visitors annoyed the staff for decades. William Wallace Campbell (1862-1938), director of Lick Observatory from 1900-1930, described his experiences with visitors in a syndicated news article published in January 1907. Campbell estimated that, since he started work at Lick in 1898, he had helped about 30,000 people to use telescopes on Lick's public nights. However, he judged that "while substantially everybody is eager to acquire astronomical knowledge…the fundamental facts of science are known to comparatively

---

[51] Ibid.
[52] Ibid., 4.
[53] "Current Astronomy" *New York Times* (New York, NY), Nov 13, 1907

few."[54] Out of the thousands of visitors that passed through the Lick during Campbell's time, only "a small majority could tell me the difference between a planet and a star, but those who had a fair comprehension of the solar system were rare indeed."[55] A decade later, in 1917, public nights were still causing problems at Lick. Heber D. Curtis (1872-1942) complained of visitors inadvertently trying to climb out onto the dome and suggested putting up signs not for the safety of visitors, but rather to relieve the person in charge of having to stop them "at least twenty times on an average evening."[56] It was not particularly surprising that, given the way some astronomers viewed public relations, people in general favored Lowell who wrote for them and cared about their opinions. In an age where professionalization and specialization were widening the gap between science and the public and many scientists saw public relations as an annoyance, Lowell was able to appeal to and entertain his readers far better than the average professional astronomer.

Flagstaff and the Lowell Observatory fit seamlessly into Lowell's projected persona of an outsider, as well as the archetype of the lone genius. In Lowell's most popular book *Mars and Its Canals* (1906), Lowell created a metaphor for the role of his observatory compared to others in the US and Europe. He compared other observatories to temples; they were built by the professional ranks and could be found in or near large cities. In the wilderness, on the other hand, one found Lowell and his astronomical "monastery" in isolation from the institutions and power dynamics of professional

[54] W.W. Campbell, "The Solar System," *Albuquerque Evening Citizen* (Albuquerque, NM), January 22, 1907.
[55] Ibid.
[56] HDC, "Saturday Night Visitors," *Lick Observatory Records: Correspondence,* University Archives, University of California, Santa Cruz.

science.[57] According to Lowell, in relation to astronomy, he designed his observatory to "commune with its spirit" while the temples of the professional astronomers merely "communicate the letter of its law."[58] Lowell elaborated on this picture of his isolation in the "untrod wilderness" and of his experiences as a lone genius with only "the frosty stars for mute companionship."[59] The narrative became even more romanticized as the stillness of his studies was interrupted by "some long unearthly howl, like the wail of a lost soul" that broke "the slumber of the mesa forest" and revealed "the prowling presence of a stray coyote."[60] In this untamed and lonely setting, Lowell noted the capacity to "almost to forget one's self a man for the solemn awe of one's surroundings."[61]

In *Mars and Its Canals* (1906), Lowell professed to see the solitude and natural wonder of the wilderness as the only fitting "portal" for his "quest" toward "communion with another world."[62] Wilderness became an important element in Lowell's persona. [63] Lowell portrayed himself as a lone genius in the wilderness, the latest addition to a long line of misunderstood prophets going against the grain of established institutions. In 1909, Lowell delivered a lecture at the Massachusetts Institute of Technology (MIT) for the hundredth anniversary of Charles Darwin's (1809-1882) birth. He did not miss the chance to draw similarities between the famous naturalist and himself. Lowell expounded once more on the topic of solitude as "the loneliness of greatness is the price

[57] Lowell, *Mars and Its Canals*, 7.
[58] Ibid., 7-8.
[59] Ibid., 8.
[60] Ibid
[61] Ibid.
[62] Ibid.
[63] See Lane, *Geographies of Mars,* 85-88. Lowell Observatory is very near Flagstaff and a major railroad, but Lowell nonetheless presented the location as wilderness.

men make the genius pay - for posthumous renown."[64] Lowell identified with Darwin. As Sheehan describes, "He [Lowell] saw himself as a persecuted pioneer like Darwin, struggling against conservative resistance to one of the maser ideas of the age."[65] It was clear that Lowell, through these narratives of isolation, had no intention to rely on the support of his colleagues. Instead, he sought after a different kind of legitimization – one to be found through his relationship with popular audiences.

Optical Illusions & Photographs

The idea that the Martian canals could be explained as optical illusions had been circulating in Western Europe from the time of Schiaparelli's first observations in 1877 but, between July 1902 and May 1903, Walter Maunder (1851-1928) of the Royal Observatory, Greenwich, led an experiment that gave the optical illusion theory some added weight. [66] Maunder and his associates recruited groups of young boys, aged 12-14 years, from a nearby school to visit the observatory and take part in an experiment relating to the visual properties of Mars as seen at a distance. Maunder and the observatory staff gave the children pencils and paper and displayed to them, at varied distances between 15 and 62 feet, drawings of Mars *without* canal lines. When asked to render what they saw, the boys frequently drew the geometrical lines of the controversial canals despite their not being on the images themselves.

[64] Percival Lowell, "The Revelation of Evolution: Address on Darwin's Centennial," *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory, 25. Speech dated February 12, 1909.
[65] Sheehan, Planets and Perception, 5
[66] See Nathaniel E. Green, "Observations of Mars, at Madeira, in August and September 1877" *Memoirs of the Royal Astronomical Society* 44 (1879): 123-140. Maunder recognized Green as the first to publish the idea of canals as optical illusions.

Maunder published the results of the Greenwich experiments in June 1903 through the Royal Astronomical Society. According to Maunder and his colleagues, given that such canal-like lines appeared so regularly in the children's drawings, it was

> …impossible to escape the conclusion that markings having all the characteristics of the canals of Mars can be seen by perfectly unbiased and keen-sighted observers upon objects where no marking of such a character actually exists.[67]

The experiments concluded that the straight lines were not lines at all, but the eye's and brain's attempt to make sense of the boundaries of different colors and shades as seen from very far away.[68] The Maunder experiment, as it came to be referred, became influential as a logical and highly plausible explanation for why Lowell saw canals and so many others simply did not.

One of the biggest names in American science, Naval Observatory director Simon Newcomb (1835-1909), subscribed to the optical illusion theory. In late March of 1903, even before the Maunder experiment was published, Newcomb wrote to Lowell of his belief that the lines of the canals were most likely distortions of actual Martian features and that, as Newcomb wrote, "if we could observe Mars at 100th its present distance, we should put a different interpretation on the appearance presented." [69] But Newcomb did not necessarily believe, in 1903, that all the lines represented by canal theorists were imaginary. Some may be real. As Newcomb described to Lowell, his position was "a

---

[67] J.E. Evans and E. Walter Maunder, "Experiments as to the Actuality of the 'Canals' Observed on Mars" *Monthly Notices of the Royal Astronomical Society* 63 (1903): 497.
[68] Ibid, 489. For more on the experiment see Maunder's separate article. E. Walter Maunder, "The Canals of Mars" *Knowledge* Vol. 36, No. 217 (1903): 249-251.
[69] Simon Newcomb to Percival Lowell March 23, 1903, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

compromise between those of the men who think the whole thing an illusion and those who think that the drawings perfectly represent the phenomena."[70]

Lowell and Newcomb discussed the theory of optical illusion again in 1907, after Newcomb delivered a paper on the topic to the American Philosophical Society. Newcomb was no longer as moderate in his views about the canals as optical illusions. He wrote to Lowell that he had "made a number of experiments in vision of a much greater variety than those which you have made." [71] At Flagstaff, Lowell and his staff had been performing their own versions of the Maunder experiment in attempt to get different results and thus refute the evidence against the reality of canal lines. Newcomb clearly did not take Lowell's experiments seriously. His own trials had yielded results that were "striking in showing the extent to which the interpretation put upon faint objects by practiced eyes was liable to deviate from reality."[72] The appearance of lines on the surface of Mars, Newcomb deduced, were "the result of psychological interpretation."[73]

Lowell responded to Newcomb a little over a week later. He addressed Newcomb's slight estimation of his research into optical illusions. As Lowell related,

> I fancy you are mistaken in supposing that your experiments are more extended, as you say, than those made here, as for years we have engaged in such experiments, having constructed disks with all manner of markings.[74]

---

[70] Simon Newcomb to Percival Lowell, March 3, 1903, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[71] Simon Newcomb to Percival Lowell, May 4, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[72] Ibid.
[73] Ibid.
[74] Percival Lowell to Simon Newcomb, May 15, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

Based on the series of experiments at Flagstaff, Lowell claimed to provide “exact data” that Newcomb’s notion of the canal lines as being nothing more than “psychic synthesis of other markings” was a false one.[75] In these experiments, Lowell and his assistants simulated, through scaled drawings, the appearance of 8-mile-wide canals as seen through a 26-inch telescope. Five observers (Lowell did not indicate who these observers were) saw breaks or gaps in the lines when they were present and did not when looking at a drawing with lines that had no gaps. This, to Lowell, proved that if there were irregularities in the canal lines that they would be visible to observers. Newcomb wrote back to Lowell, claiming that these experiments were too simplistic and proved little to nothing regarding whether the lines existed in the first place.[76]

The Maunder experiments and the support they found by leading astronomers undermined the credibility of Lowell’s drawings of Mars and furthered his alienation from professional astronomy. But that was not to deter Lowell for long in his quest to prove the existence of life on Mars and defeat his critics within the circles of established science. During the next approach of Mars, beginning in May 1905, Lowell’s assistant Carl Otto Lampland (1873-1951) successfully rendered a series of small yet relatively clear photographs of Mars that some believed showed the canals. The photographs of Mars that existed prior to Lampland’s 1905 series were blurry and very nearly unrecognizable.[77] Up to that point, Mars and other planets had been particularly tricky to photograph because of long exposure times coupled with interference from the Earth’s

---

[75] Ibid.
[76] Simon Newcomb to Percival Lowell, May 23, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[77] Edward S. Holden of Lick Obsy. produced a series of photographs of Mars from1888-1892.

atmosphere. Contemporary photographic technology and methods worked well for capturing light, as in stellar photography, but rendering the surface definition of a planet was virtually impossible.

Lampland's photographs of Mars during the 1905 opposition (700 in total) were a huge technical accomplishment for him and a great achievement in the field of astronomical photography. Perhaps more important to Lowell, however, were their potential ability to vindicate over a decade's worth of theories, criticism, struggles, and boasts about the nature of the Martian surface. Who, after all, could argue with photographic evidence?

About two weeks after the 1905 approach began, Lowell announced to the world the photographic confirmation of Martian canals. [78] He wasted little time getting the news to the public. Lowell saw Lampland's photographs, though small and difficult to make out, as the breakthrough he had been needing to win the canal debate and to win out, as an amateur and an outsider, against the world of professional science that excluded him.[79] There was no doubt in Lowell's mind that the photographs proved the existence of canals on Mars. In a 1906 paper for the Royal Society, Lowell expressed how after building the observatory, performing years of painstaking observations, and crusading for the existence of Martian canals, he at last had "first hand objective proof of their reality."[80] In the same 1906 paper, Lowell recognized Lampland's "thought,

---

[78] Lowell telegraphed Harvard College Observatory (HCO), as was the custom for new discoveries, on May 27, 1905. NYT reported on it the next day on the front page with the headline "Photograph Mars Canals."
[79] For more on the changing importance of objectivity in science and Lowell's quest for objective data see Lorraine Daston and Peter Galison, *Objectivity* (Brooklyn: Zone Books, 2010).
[80] Percival Lowell, "First Photographs of the Canals of Mars," *Proceedings of the Royal Society* Vol. 77, No. 515 (1906): 132.

assiduity, and skill" in rendering the photographs, but he by no means missed the opportunity to boast about his observatory and its superior atmosphere. [81]

Since atmospheric distortion had been a significant hurdle in planetary photography before Lampland's latest achievements, the need to remind his readers of the good seeing at Flagstaff must have seemed self-evident to Lowell.[82] In doing so, Lowell made a characteristically bold claim by calling his 24-inch refractor "the most space-penetrating glass at present in use."[83]

The late-nineteenth and early-twentieth centuries experienced a rapid growth in telescope size, and astronomers very much enjoyed talking about the associated increases in magnification capabilities. The size of a telescope is defined by the aperture, or more simply the diameter, of its primary lens or mirror. This primary lens or mirror is also called the objective. It is the light-gathering surface of the telescope and the part that is positioned on the opposite end of the eyepiece. In a refracting telescope, the objective is a lens. In a reflecting telescope, it is a mirror. When a telescope of this period was referred to as a 26-inch refractor, like the one that discovered the moons of Mars, it meant that it had a lens as its objective surface and that lens measured 26 inches in diameter. If, on the other hand, one was to discuss a 60-inch reflector, that telescope had a mirror as its primary light-gathering surface and that mirror measured 60 inches across. Because it had a significantly larger surface with which to gather light, the 60-inch reflector was much more powerful than the 26-inch refractor and could produce much higher magnifications and capture objects at greater distance.

---

[81] Lowell, *Mars and Its Canals*, 277.
[82] The previous photographs were taken at Lick, also known for good atmospheric conditions.
[83] Lowell, "First Photographs of the Canals of Mars," 132,

By 1905, the 36-inch refractor at Lick Observatory and the 40-inch refractor at Yerkes Observatory (still on of the two largest refractors in the world today) were both in operation and the 60-inch reflector destined for Mount Wilson was being built. Nonetheless, Lowell claimed to have the most powerful telescope in the world at Flagstaff by means of the superiority in atmospheric conditions.[84] As Lowell explained, the advantages of his telescope over all the other much larger ones lay partly in the quality of the lenses, "but chiefly to the air."[85] This tied into the appeal that Lowell frequently launched, that the good seeing at Flagstaff allowed for better observations than at other observatories.[86]

It seemed this argument was paying dividends by 1905. According to Lane, by the dawn of the twentieth century, the "association of mountain landscapes with good astronomy" was firmly in place.[87] Furthermore,

> Those observatories in remote mountain locations were automatically taken seriously, even with smaller telescopes and less-experienced astronomers.[88]

This added authority was what Lowell was counting on in advancing this argument. Of course, Mars Hill was not an actual mountain, but this legitimization through location was exactly what Lowell sought through physical attributes of his location and the role it played in his scientific identity.

Contrary to Lowell's expectations, however, the 1905 photographs did not turn out to be the proof he had hoped for because they were too small and finely detailed to be

---

[84] Lane, *Geographies of Mars*, 76.
[85] Ibid, 133.
[86] Ibid., Particularly Chapter Three "Representing Scientific Sites."
[87] Ibid., 69.
[88] Ibid, 71.

effectively reproduced for a mass market. The public, of course, was his target audience and his main source of support. Therefore, it was primarily the public arena in which he sought to present his ideas as well as his proof. He wanted to take his case to the court of public opinion, not the halls of scientific deliberation. The inability to do so was quite a blow. Lowell was able to reach a small percentage of the interested public through a 1906 exhibition of select prints at MIT. This exhibition garnered a significant measure of support for Lowell and his theories, but could never reach as large of an audience as he wanted through print media.[89]

The Lowell Expedition to the Andes

Lowell, however, did not give up on the idea that if he could only get the photographs to the public that the canal debate would at last be settled. He wrote of the certainty of the photographic evidence in the second and most popular of his books on Mars, *Mars and Its Canals* (1906). In this book, Lowell included a chapter about photographing the canals in 1905. In this section, he described the difficulties involved in producing the photographs and reminded the reader of their importance in authenticating his theories. According to Lowell, "The evidence of the camera has thus one important advantage over other astronomic documents: it is impersonally trustworthy in what it states."[90] He concluded the chapter on the 1905 photographs, "Thus did the

[89] Hoyt, *Lowell and Mars*, 186.
[90] Percival Lowell, *Mars and Its Canals*, 272.

canals at last speak for their own reality themselves."[91] They spoke, even if you had no way of hearing them - yet.

When the next opposition, in 1907, was drawing near the possibility of new and better information, particularly photographs, was a subject for the newspapers. The opposition that summer would be one of the closest approaches of Mars since the canal debate began thirty years prior. As early as January 1907, the overall tone of press coverage concerning Mars seemed to be hopeful that the coming opposition would decide the canal debate once and for all. After three decades of deliberation, perhaps an answer would finally come! A January 6 article in the *San Francisco Call* asked in its headline "Will the New Year Solve the Riddle of Mars?"[92] Also in January, popular science writer Mary Proctor (1862-1957) wrote in a *New York Times* article that the reality of the canals, in her opinion, had already been "definitely settled by means of photography" even if their origin and purpose was still unsolved. [93] However, measured acceptance, hesitation, and expectations of further data would not decide the debate. Nor would it sate Lowell in his quest to prove life on Mars.

If the public wanted final proof, Lowell was determined to give it to them. Frustrated by the inability to publish canal photographs, Lowell remained, as William Graves Hoyt describes in *Lowell and Mars* (1976), "convinced that they could be made to appear on the printed page"[94] Undeterred by continued skepticism and ever fueled by his own particularly resilient brand of optimism, Lowell answered the call for decisive

---

[91] Ibid., 277.
[92] "Will the New Year Solve the Riddle of Mars?" *San Francisco Call* (San Francisco, CA) January 6, 1907.
[93] Mary Proctor, "Astronomers are Alert as Mars Draws Near" *New York Times* (New York, NY) Jan 13, 1907.
[94] Hoyt, *Lowell and Mars*, 186.

information in a big way. In mid-March, as he was leaving Boston for Flagstaff for observing season, Lowell announced that he would be sending an expedition to South America to observe and photograph Mars at the zenith of its opposition.

There were few if any scientific reasons to pursue an expedition to photograph Martian canals in South America. Lowell, Lampland, and the rest of the observatory staff were already convinced by the 1905 photographs, even long before them, so no one at Flagstaff expected the expedition to produce any new revelations about the surface of Mars. The Andean desert was positioned for better viewing of the opposition, but this did not affect the photographs taken there by Lowell's expedition, which were still very low in resolution and magnification.[95] Meanwhile, back home in Flagstaff, Lowell and Lampland produced 3,000 images of Mars during the 1907 opposition season.[96] This was plenty to keep them busy in their canal work. On June 9, Lowell wrote to the expedition party that he and Lampland had already photographed 121 canals so far during the approach of Mars.[97] If they were counting canals by the dozen at Flagstaff, then why have an expensive and strenuous trek to South America with a large telescope and all its apparatus in tow?

In doing just that, or rather hiring others to do it, Lowell's primary interest was to create a spectacle, to garner publicity, and ultimately to publish the expedition photos for mass consumption.[98] Revealing these photos to a reading public made eager by the romance and adventure of an exotic expedition would provide Lowell with a major

---

[95] See Hoyt, *Lowell and Mars* and Lane, *Geographies of Mars*.
[96] Hoyt, *Lowell and Mars*, 191.
[97] Percival Lowell to David Peck Todd, June 9, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory
[98] Lane, *Geographies of Mars*, 118.

victory in the canal debate. As Lane puts it, this was an era when expeditions like Lowell's "were especially interesting to popular audiences."[99] Further, as Lane describes, by knowing the potential of an expedition to capture the public imagination, Lowell assumed that "a well-publicized expedition to carry out science in dramatic mountain landscapes would be perceived automatically as a legitimate endeavor."[100] Lowell wanted the attention of the public and he wanted the incontestable proof that had narrowly eluded him in 1905. He strove for vindication from an adoring and awe-stricken audience while his critics in professional astronomy ate crow. Lowell certainly got the attention he wanted. As Hoyt describes in *Lowell and Mars* (1976), "this astronomical adventure, this journey to a remote region of one planet to explore the mysteries of another, captured the interest of countless thousands around the world,"[101]

On May 11, 1907, the well-publicized Lowell expedition embarked from New York on its journey to the South America under the leadership of a director that embodied the overall purpose of the undertaking, David Peck Todd (1855-1939) of Amherst College. Accompanying Todd from Amherst was a new 18-inch Clark refractor as well as his wife Mabel Loomis Todd (1856-1932) and one of his graduate students, R.G. Eaglesfield. Chief photographer Earl C. Slipher (1883-1964) was the only person from Lowell Observatory to go on the expedition.[102] A.G. Ilse, an engineer from Alvin Clark & Sons, came along to help with instruments and equipment. The choice of Todd as the leader of this small expedition party demonstrates once again Lowell's motives for

---

[99] Ibid.
[100] Ibid.
[101] Hoyt, *Lowell and Mars*, 189.
[102] The younger brother of Vesto M. Slipher (1875-1969), also employed at Lowell Observatory

the expedition. Todd was not an expert on Mars. Todd was an expert on expeditions. By 1907, Todd had already been on seven astronomical expeditions to study eclipses and the transit of Venus. However, Todd had never published anything on the topic of Mars nor had he studied the planet in any depth. Because of his choice to entrust the expedition to someone who had no expertise in Mars, but had extensive experience expeditioning, Lowell clearly prioritized the expedition aspect over study of the planet.[103]

In 1907, the Panama Canal was a hot topic and one associated inextricably with Roosevelt's administration. The Lowell expedition, sent by the "Roosevelt of Astronomy," travelled aboard a ship named *Panama* heading for their first destination – Colon, Panama. The expedition party toured the Canal Zone before boarding another ship on May 22 to take them the rest of the way to Peru, where they would then travel by land and survey potential observation sites. In 1903 the US aided Panama in its independence from Colombia and, after a series of political maneuvers, took over construction of the Panama Canal in 1904. In 1907, the building of the canal was well underway (though it would not be finished until 1914) and thousands of articles about the project and the region appeared in American newspapers that year. The topics of reports ranged from finance, politics, engineering details, to the plight of the laborers suffering from disease and a lack of clean drinking water. It is possible (but not likely given Lowell's interest in making headlines) that the name of the ship and the destination were merely coincidence. Nevertheless, canals of all types were big news in 1907.

[103] In 1882 Todd photographed the transit of Venus. This expedition was funded by Lick Observatory. Lampland trained E.C. Slipher in his techniques and adapted a camera for the expedition modeled after the one he used at Flagstaff.

The Lowell expedition, by association, became a part of the ongoing Panama story. The parallels between the Martian canals and the Panama Canal project had already been made earlier in the year, perhaps prompting Lowell to push the connection further. In January, an article in the *Los Angeles Herald* wondered if after the Martians spent generations building canals across their entire planet whether they might wonder about "all the fuss and bother this country is making of digging, in their eyes, a mere little trench across the isthmus of Panama."[104] If only humans possessed the physical prowess of the Martians, they could "perform as much work as fifty or sixty terrestrial ditch-diggers" and even "keep pace with a powerful Panama dredger."[105] On May 5, a little less than a week before the expedition set sail, an article in the *Los Angeles Times* exclaimed a similar lament,

> Fancy a company of Martian laborers, imported from their distant planet to dig the Panama Canal. How the dirt would fly![106]

Beyond simply the canal connection, however, there were also deeper sociocultural implications involved in the comparison between the canals of Mars and that of Panama. Both represented the domination over nature in the extreme. Mars, as a civilization of advanced engineering on a planetary scale, represented the type of scientific and technological progress to which many in the late-nineteenth and early-twentieth century aspired. This sort of world-alteration and dominion over nature was also the impetus

---

[104] "To Spy the Martians When Earth is Nearest" *Los Angeles Herald*, January 15, 1907.
[105] Ibid.
[106] "Irrigating an Arid World" *Los Angeles Times*, May 05, 1907.

behind Roosevelt's plans on the isthmus.[107] Both Mars and Panama shone with the power of science and technology in all its glory.[108]

In 1911, during a speech at the University of California, Roosevelt admitted and boasted of his flouting the traditional mechanisms of diplomacy and foreign relations in his treatment of Colombia and acquisition of the Canal Zone. According to Roosevelt,

> I am interested in the Panama Canal because I started it. If I had followed traditional, conservative methods I would have submitted a dignified State paper of probably 200 pages to Congress and the debates on it would have been going on yet: but I took the Canal Zone and let Congress debate; and while the debate goes on the canal does also.[109]

These words were spoken with a self-assurance not unlike Lowell's, who claimed life on Mars to be "self-evident" two weeks before he began studying the planet.[110] A *New York Times* article reporting on Roosevelt's Panama speech called his approach "the doctrine of the one man in power, the man on horseback," invoking the masculine and murderously intrepid image of Roosevelt's campaigns in Cuba.[111] This "man on horseback" image was not far off from Lowell's persona nor of what Lane termed the "masculine persona of the explorer-scientist."[112]

Lowell's keen interest in publicity and the publication of expedition photographs manifested early as he carried out negotiations with magazines over rights to publish long before the expedition ended. Lowell was carrying out these negotiations in July 1907; but he would not receive any actual prints from the expedition until September. Lowell

---

[107] See John Major, *Prize Possession: The United States and the Panama Canal: 1903-1979*, (Cambridge: Cambridge University Press, 1993).
[108] See Lane, *Geographies of Mars*, particularly 13-19.
[109] "Roosevelt Boasts of Canal" *New York Times*, Mar 24, 1911.
[110] "The Lowell Observatory" *Boston Commonwealth* (Boston, MA) May 26,1894.
[111] Ibid.
[112] Lane, *Geographies of Mars,* 134.

wrote to Todd on July 26 about his excitement at Todd's recent telegram relating the expedition's success in photographing canals. Lowell was so enthusiastic and delighted by reading the good news that, as he recalls to Todd, his hair stood on end and he got a lump in his throat.[113] Lowell was not the only person that was excited about the expedition, however, as he informed Todd in the same letter, "The world, to judge from the English and American papers, is on the qui vive about the expedition as well as about Mars." [114] Taking advantage of the hype, Lowell was negotiating deals with leading magazines for first rights to print the photos. As he told Todd in his July 26 letter, these publishers were cabling Lowell regularly offering "vague but huge sums" to be the first to print the photos from the expedition. [115] With over two months left until the expedition returned, Lowell was already working on a magazine deal to publish the photographs.[116]

Because publication of the photos was top priority for Lowell, the photographs were being readied for mass distribution within four days after the expedition's homecoming. The negatives and original photographs did not even return to Flagstaff before they made their way to the press. On October 1 (the expedition returned October 2) Lowell wrote to Earl C. Slipher, chief photographer and the only of the expedition party under his permanent employ, with directions concerning the publication of the expedition photographs. In his letter, Lowell directed Slipher to make his way to *Century* magazine in New York, the winner of publication rights, and to stay on at the magazine

---

[113] Percival Lowell to David Peck Todd, July 26, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[114] Ibid.
[115] Ibid.
[116] Lowell writes to Earl C. Slipher on September 6 to let Slipher know that he received the prints and congratulate him on their quality.

to help with printing. On October 6, Slipher wrote back to let Lowell know that he had indeed followed instructions and the work was proceeding as to Lowell's wishes.[117] The publication of the photographs was such an important issue that Lowell and Todd would have a falling out over them in the months to come.[118] Lowell, as the "Roosevelt of Astronomy" wanted to bring the decision over the existence of life on Mars directly to the people, his support base, as soon as possible. By printing the photographs in popular media immediately, Lowell circumvented the gatekeepers of professional astronomy to gain ground in the canal debate much like Roosevelt admittedly circumvented Congress to push his agenda in Panama.[119]

Conclusion: Dynamics of Popular Science

The example of Percival Lowell, the "Roosevelt of Astronomy," challenges the top-down paradigm of popular science by revealing a public participation in science beyond that of passive consumer. Instead, Lowell invited readers to act as participants in the demarcation of science and the legitimization of the ideas and people who appealed to them. In many common views, the definition of popular science follows a mechanism wherein scientific ideas travel unidirectionally from expert to non-expert. An expert creates scientific knowledge, the knowledge undergoes some manner of popularization or

[117] Earl C. Slipher to Percival Lowell, October 6, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[118] Todd had a separate publication deal with *Cosmopolitan* and was eager to gain access to the expedition photographs. Lowell refused to allow Todd to use the photographs until after he and *Century* were finished with them. For more on the argument between Todd and Lowell see Lane, *Geographies of Mars*, 118-20.
[119] Percival Lowell to Earl C. Slipher, October 1, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

simplification, and then a passive audience receives the transmission. In this conception of popular science, the formation of research goals and the production of new scientific knowledge are, therefore, inherently disconnected from the eventual audiences who only encounter the products of the initial scientific process somewhere down the line.

In his article "How Science Became Technical," Theodore Porter traces the origin of this estrangement between science and the public to Lowell's era, the decades surrounding the turn of the twentieth century. At this time, As Porter explains, the idealized expert began to play a larger role in sociocultural perceptions of science. Scientific communities increasingly relied on technical knowledge and specialized language as defining characteristics of their respective fields and as a way by which to separate legitimate science from the illegitimate. [120] Through the course of the twentieth century, inaccessibility became an intrinsic feature of the way people saw science and, perhaps more influentially, how science saw itself. Roger Cooter and Stephen Pumfrey, writing in 1994 on historiographical conceptions of public science, included systemic inaccessibility as part of what they call the "cultural hegemony of science."[121] As Cooter and Pumfrey point out, this move towards control and dominance on the part of the expert depended on exclusivity and ensuring that "productions of scientific knowledge were insulated from non-scientists and from the public at large."[122] The authors contend that generations of scientists and historians have been responsible in part for extending

[120] Theodore M. Porter, "How Science Became Technical," *Isis* Vol. 100, No. 2 (2009): 292-309
[121] Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Public Culture" *History of Science* Vol. 32 (1994), 239.
[122] Ibid, 240.

well into the twentieth century the same elitism and opacity that Porter discusses as beginning in Lowell's era.

In this larger context of the redefinition of science through professionalization, specialization, and inaccessibility, the public persona of Percival Lowell stands as an anomaly and the 1907 Lowell Expedition to the Andes as a keen example of science as public spectacle. In an era in which professional science began to close ranks and withdraw from public engagement, Lowell instead sought after and relied upon public support to establish his authority as an expert on Mars. Like Roosevelt, it was the popular vote, the common man, that mattered most to Lowell and in 1907 he funded an unnecessary scientific expedition to South America to garner publicity and win that support once and for all. The public cried out for proof through publishable photographs and Lowell did his best to answer the demand. As Porter notes, it was an era when science was beginning to define itself by inaccessibility.[123] Yet unlike astronomers at Lick and other large observatories, by appealing to the public instead of professional circles, Lowell invited the general reader to take part in the canal debate as well as the construction and distribution of scientific knowledge.

Lowell is a highly visible example of the mutual and complex nature of public science in the context of American astronomy.[124] The role of popularization in science is a complex topic and historians of science have defined the process of creating and distributing public science in very different ways. Recent scholarship in the history of popular science self-consciously questions or complicates the top-down model of the

[123] See Porter, "How Science Became Technical"
[124] Lane, *Geographies of Mars,* 9.

expert elite to present more complex and dynamic interpretations in its place.[125] Several foundational texts emerged in the 1980s, especially concerning the example of British science in the early modern and Victorian eras.[126] A key feature of these and other reinterpretations of public science is an increased agency on the part of the public. The audience is not passive, but rather playing a mutual role in the production of knowledge by providing to the scientists who engage them much needed support, funding, legitimacy, inspiration, and authority.[127] Lowell depended upon his public audience and the persona that he presented to them. In return for his efforts, the reading public bolstered and legitimized Lowell's identity as an expert on Mars.

---

[125] For a thorough discussion of these historiographical changes see the above-referenced article by Cooter and Pumfrey as well as Andreas W. Baum "Varieties of Popular Science and the Transformations of Public Knowledge: Some Historical Reflections." *Isis* Vol. 100, No. 2 (2009): 319-332. This article is part of a Focus section entitled "Historicizing 'Popular Science'." Other included articles by Jonathan R. Topham, Ralph O'Conner, Katherine Pandora, and Bernadette Bensaude-Vincent also make good reference points for understanding changing definitions of public science.

[126] Some early and foundational works to rethink the top-down model were Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985), Roger Cooter, *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain* (Cambridge: Cambridge University Press, 1984) and Jan Golinksi, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge: Cambridge University Press, 1992).

[127] For examples of the power of audiences see Shapin and Schaffer, *Leviathan and the Air Pump* and Jan Golinksi, *Science as Public Culture*. Victorian science offers many examples as well, some of which are James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press, 2003), Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2009), Iwan Rhys Morus "Worlds of Wonder: Sensation and the Victorian Scientific Performance" *Isis* Vol. 101 No. 4 (2010): 806-816.

Chapter Two

The Responsibilities of a Scientist

"Discovery of a truth in the heavens varies in little, except the subject, from the discovery of a crime on earth," explained a 1909 review of Percival Lowell's latest popular-audience book, *Mars as the Abode of Life* (1908).[128] In this book, Lowell described how being an astronomer was very much like being a sort of detective. To many of Lowell's professional colleagues, however, his investigations were, in fact, much more like the crimes themselves. By 1907, Martian canals had become one of the hottest topics to ever hit the world of public science.[129] And it had hit hard, often to the chagrin of more conservative scientists.

According to British astronomer E. Vincent Heward (1830-1914), Mars possessed a "significance in the public eye which places it first in importance among the planets.[130] This assessment appeared in a 1907 article originally published in England's *Fortnightly Review* and reprinted soon after in the widely-known American weekly magazine, published from 1844-1941, *The Living Age* (also known as *Littel's Living Age*).[131] In this

[128] "Detective Work in Astronomy," *Current Literature*, Vol. XLVI, No. 4 (1909): 441.
[129] Historians and philosophers of science define public and popular science in many ways. Several great general discussions of the meaning and parameters of public science exist in the scholarship. A few of these are Roger Cooter and Steven Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science*, Vol. 32 (1994): 237-267; Jane Gregory and Steven Miller, *Science in Public* (New York: Plenum, 1998); James A Secord, "Knowledge in Transit," *Isis*, Vol. 95(4)(2004): 654-673; Aileen Fyfe and Bernard Lightman, *Science in the Marketplace* (Chicago: University of Chicago Press, 2007); Bernadette Bersuade-Vincent, "A Historical Perspective on Science and Its 'Others'," *Isis*, Vol. 100(2)(2009):359-68. Admittedly, public science is a loaded term with many nuances and variations in meaning. For the purposes of this discussion, I define works of public science by their intended readership. I use the term public science to mean scientific materials and publications that the author intends to be read by or otherwise consumed by a general audience rather than specialists within the given discipline.
[130] E. Vincent Heward, "Mars: Is it a Habitable World?," *The Living Age*, September 1907, 741.
[131] Ibid.

article, Hewerd summarized observations and theories concerning Mars, both past and present, while urging readers to exercise caution before accepting the existence of artificial canals on the planet's surface. According to Hewerd, although Lowell's "pre-eminence as an authority on Martian observation none will gainsay," he and those who agreed with his Mars ideas had done nothing more than let themselves get carried away on a flight of fancy.[132] Hewerd wondered,

> What have we really seen in gazing at Mars with the telescope? A vast number of thread-like lines which are thought to be on the planet's surface. All the rest is simply inference drawn from data which cannot in all cases be tested.[133]

It was time the world got its collective feet back down to Earth, Hewerd felt, for sound evidence supporting canal theory was nonexistent.

Hewerd was by no means alone in his exasperation with the Martian canal craze and, increasingly, he was also not alone in his attempt to intervene in the public dialogue. Along with continued and increasing criticism from Lick Observatory, several prominent scientists spoke out against Lowell in 1907 and 1908. In doing so, they also increasingly employed public and popular media channels to reach a general audience. This was, of course, the same audience that was reading Lowell's books and articles. This outreach campaign of sorts was largely based on the perceived responsibilities of a scientist when communicating with the public. From the perspective of his critics, Lowell had summarily neglected these perceived duties in favor of sensationalism.

Some surprising voices emerged. William H. Pickering (1859-1938) aided Lowell in building his observatory. Pickering was there with advice and resources when

---

[132] Ibid., 743-44.
[133] Ibid., 745.

the ideas first flowed and plans for the observatory emerged in the winter of 1894. He was with Lowell the first time he set foot on Mars Hill. He worked at Flagstaff for the first two years (1894-1896). But, by 1904, Pickering was disillusioned by canals and worked to discredit Lowell's theories through articles in popular science magazines. William Pickering's older brother, Edward C. Pickering (1846-1919), director of Harvard College Observatory (HCO), harbored a similar antipathy towards canal theory and worked to block Lowell's access to the Associated Press. Big names like physicist Arthur Stanley Eddington (1882-1944) and naturalist Alfred Russel Wallace (1823-1913) lent their notoriety and influence to the cause of discrediting Martian canals.

The popularity of Lowell, his ideas, and the persona that he created for himself as the "Roosevelt of Astronomy" prompted several prominent scientific figures to launch a public science intervention against him and his canal-building Martians. In doing so, critics often met Lowell on his own home turf: the pages of popular magazines and newspapers. However, as in Hewerd's article, Lowell's critics frequently recognized his overall skill and tenacity as an observational astronomer. When they separated the canals from the whole of Lowell's work, they could not be deny that he and his staff had amassed some of the best data on Mars up to that point.

The conflict between Lowell and his detractors was not one of the demarcation of science from metaphysics, pseudoscience, or non-science. These sorts of issues, along with similar biases surrounding Lowell's education and credentials, did play a role in the criticism of Martian canals. But the primary issue at hand was that of science communication and the responsibilities of the scientist when conveying information to the general public. The increasing criticism of Lowell and his theories and the intensifying rivalry between Lowell and Lick Observatories demonstrated a clash over who should have access to popular audiences and the duties that scientists owed to those audiences.

Counting the Stars

The mounting animosity between Lowell and Lick Observatories, which began when Lowell Observatory opened in 1894, began to boil over in 1907. In April 1907, less than a month before the Lowell Expedition to the Andes set sail, Lowell capitalized on the publicity of the pending expedition to make a claim for scientific authority at the expense of his most prominent rivals. Lowell published an article in the popular New York magazine *The Outlook.* In this article, Lowell claimed to provide quantifiable evidence that his 24-inch Clark refractor rendered better observational results than Lick's 36-inch.[134] Despite its smaller size, Lowell argued that the main telescope at his observatory revealed more stars in a specific area of the night sky than did the one at Lick.[135] The reason: better atmosphere.

Lowell wrote this article for a general reader, whom he addressed openly as the "layman."[136] Given the audience and the nature of the claim, Lowell's goal in writing the article was clear. He wanted to convince the general reader that his theories concerning Mars held more weight than those of his critics. The primary target was, of course, Lick Observatory and its second director William Wallace Campbell (1862-1938). However,

[134] Lowell Expedition to the Andes set sail May 11, 1907.
[135] Percival Lowell, "Is Mars Inhabited?," *The Outlook,* April 1907.
[136] Ibid., 844.

Lowell also took the US Naval Observatory, with canal critic Simon Newcomb as its director, to task for inferior seeing. In addition to the direct criticism both these institutions had offered Lowell in the past, they were also some of the better-known observatories within the public sphere. As Lowell put it, to accomplish an understanding of the conflicting information the average reader faced, "It is vital…to learn how the sites of observatories whose names are familiar to him compare with regard to what they will show."[137]

Lowell made a bold and confrontational claim that, although his main telescope was smaller than those of Lick or the Naval Observatory, it performed better overall because of the clear and steady atmosphere at Flagstaff. He also made an attempt to quantify this distinction. In his article for *The Outlook*, Lowell cited three similar star charts produced at Lowell, Lick, and the Naval Observatory, respectively. In the same area of the night sky, Lowell Observatory charted 172 stars while astronomers at Lick Observatory only saw 162. The Naval Observatory, located in a part of Washington DC nicknamed "Foggy Bottom," charted a measly 61 stars. Alongside these figures, Lowell also cited the sizes of the telescopes used: 24 inches, 36 inches, and 26 inches, respectively. According to Lowell, "details are unmistakable in good air which wholly escape detection in a poor one."[138] Or,

> In other words, so much purer was the air at Flagstaff than at Mount Hamilton or Washington that more stars were visible with a 24-inch glass there than with a 36-inch one at the Lick, and nearly three times as many as could be detected with 26-inches at the Naval Observatory.[139]

---

[137] Ibid., 845.
[138] Ibid.
[139] Ibid.

Lowell used these figures to support a powerful argument, but he did not explain the figures' origins nor the context behind them. He did, however offer the numbers to the reader to speak "impersonally" in favor of the superior credibility of observations at Flagstaff when compared to those of his most prominent critics.[140]

Also in Lowell's April 1907 article was an attempt to discredit his detractors, this time on the basis of specialization. To make a point about the importance of subdisciplines, Lowell compared astronomy to other professions that the reader would be more likely to encounter in everyday affairs: medicine and law.[141] Lowell noted, for example, "One would hardly consult an aurist for an attack of typhoid fever."[142] By that same common-sense reasoning, "a man whose occupation is celestial mechanics is not on that account an authority on planetary observation."[143] Lowell discussed examples from unnamed astronomers (reminiscent of Campbell and Newcomb), none of which lived up to Lowell's criteria for specialization in solar system astronomy nor for a thorough knowledge of Mars.[144] Finally, Lowell summarized,

> That life now habits Mars is the only rational deduction from the observations in our possession; the only one which is warranted by the facts.[145]

If Lowell's claims in *The Outlook* were to be believed, canal critics possessed inferior equipment, had less experience than he did, and, if they denied the existence of life on Mars, were down-right irrational.

---

[140] Ibid.
[141] Ibid., 844.
[142] Ibid.
[143] Ibid.
[144] Ibid., 845.
[145] Ibid., 848.

William Wallace Campbell, director of Lick Observatory, did not publish a response for over a year, but when he did he published in the same popular magazine, *The Outlook,* and focused on refuting Lowell's claim of superior visibility. He paid little attention to the issue of specialization, largely a qualitative matter, and focused on the numbers and their meaning. He did adopt Lowell's medical metaphor, however, in describing the lack of experience that the original Lick observer possessed in producing star counts.[146] Campbell said nothing of the Naval Observatory. Foggy Bottom fell silent. In all fairness, it could have been a lost cause in a debate about superior seeing conditions.

Campbell provided context for the star charts that Lowell cited in his article. The set of observations Lowell used for Lick's star count were made in 1894 (13 years prior) by Richard Hawley Tucker (1859-1952). Tucker was a talented stellar astronomer but was inexperienced at the type of work involved in producing large-scale star charts. His specialty was determining the positions of individual stars. In this endeavor, he used a small scanning telescope rather than the 36-inch. In fact, Tucker had never used the 36-inch refractor, or any similar instrument, and he never used it again (at least not in professional context).[147] The weather conditions were also not ideal at the time the observations were made, a fact that Tucker cited in his observational records.[148] In short, Campbell argued, Tucker's data was never meant to be a definitive example of the Lick telescope's capabilities and the use of it as such was a distortion of its real power.

---

[146] W.W. Campbell, "The Lick Observatory," *The Outlook*, October 1908.
[147] Ibid.
[148] Ibid., 255.

As Campbell explained in his response to Lowell, Lick staff astronomers remapped a portion of the original charts. In doing so, they documented significantly more stars not only than Tucker's 1894 tally but also than those seen at Lowell the previous year. This level of proof was enough for Campbell and he stopped the experiment without completing the rest of the original region. He explained, dismissively, "there are endless ways in which the telescope and the observers' time can be put to better use."[149]

Campbell also responded to Lowell's claims for superior seeing in the pages of *Popular Astronomy*. According to Campbell, Lowell's original boast of being able to document more stars in the night sky than Lick Observatory was not of any special concern to Lick. Initially, they did not fret over the contention. In fact, as Campbell noted, Lowell had begun making these comparisons as early as 1905.[150] In recent months, however, Lowell had started publishing his star chart assessments in public media. According to Campbell, the issue took on a new import since "Mr. Lowell has made it the basis of public claims, in several magazines."[151]

Campbell and the staff at Lick Observatory did not feel the need to respond to Lowell's claims within the scientific community but they did take offense when Lowell began to publish them in popular periodicals. To professional astronomers, the power of the Lick 36-inch "spoke for itself indisputably" through seventeen years of pioneering discoveries.[152] During this time, as Campbell trumpeted, the Lick telescope aided in the

---

[149] Ibid., 256

[150] W.W. Campbell, "Comparative Power of the 36-inch Refractor of the Lick Observatory," *Popular Astronomy* Vol, XVI, No. 9 (1908). In William W. Payne & H.C. Wilson (eds.), *Popular Astronomy Volume XVI* (Northfield, MN: Goodsell Observatory, 1908): 560-562, 560.

[151] Ibid., 561

[152] Ibid., 560.

identification of thousands of double star systems and made possible the observation of countless faint objects in the night sky.[153] What prompted Campbell to answer Lowell was that, although the article had not "misled experienced astronomers into believing that it is true" the misinformation therein had led to the sad reality that "no doubt thousands of general readers have been misled."[154]

The response to Campbell's refutation came not from Lowell himself, but from staff astronomer Vesto M. Slipher (1875-1969). Although he generally avoided involvement in the various controversies surrounding Lowell and his Mars theories, Slipher was keen at this point to defend his own credibility as well as that of the institution at which he would end up spending over fifty years of his life. Slipher spent his entire career at Lowell Observatory. He first began work at Flagstaff in 1901 (under what was supposed to be a temporary appointment) and remained there until his retirement in 1954. He received a promotion to assistant director in 1915, and another when he became acting director after Lowell's death in November 1916.[155]

Slipher described his distaste with Campbell's 1908 articles in *The Outlook* and *Popular Astronomy* in his correspondence with Lowell. The crux of the matter seemed to

---

[153] Ibid.
[154] Ibid., 561.
[155] Slipher's early work at Flagstaff was in planetary spectroscopy. After he completed a spectrographic series for the major planets, he moved away from planetary observations to stellar and galactic spectroscopy. He became most famous for his pioneering work in the radial velocity of spiral nebulae, as well as the red shift effect this velocity caused in the spectral readings. These discoveries provided the foundation for later work, primarily by Edwin Hubble (1889-1953) at Mount Wilson Observatory, in establishing a functional relationship between radial velocity and distance of extragalactic objects. This and similar experimental and theoretical extrapolations from Slipher's initial discovery led to the theory of the expansion of the universe and the Big Bang in the 1920s and 30s. For more on the evolution of these ideas, see Marcia Bartusiak, *The Day We Found the Universe*, (New York: Vintage Books, 2010).

be the topic of reputation and the sway which Campbell held in influencing outside opinion. According to Slipher, regarding Campbell comments,

> It is the discrediting influence of such criticism that does the harm. We have stood enough of such in recent years although it has generally come from those with little influence and scarcely capable of an opinion.[156]

Slipher was not only fed up with the criticism that Lowell Observatory regularly received, but it also seemed as though Campbell, with his experience and reputation, wielded more weight than many other critics. Slipher believed that it was time that he and Lowell do something about Campbell. He wrote to Lowell that "the time had come when it seems to me we might now make a stand and have it out. Both in print and direct with Professor Campbell."[157]

A victory against Campbell and Lick Observatory, according to Slipher, could offer benefits beyond the scope of this particular debate over the comparative power of their telescopes. If Lowell and his supporters could undermine Campbell, Slipher explained, they would achieve a significant boost to their public reputation. According to Slipher, if he and Lowell could demonstrate to the public "the weakness of the criticism offered by the Director of the Lick Observatory" then it would call into doubt all of the negative press they had received.[158] They could silence Campbell while "at the same time be putting doubts in the readers minds as to the fairness of all the criticism that has been unfavorable to us."[159] If this were the case, the criticism might abate and "we may in this way obtain fair treatment in the future."[160]

---

[156] Vesto M. Slipher to Percival Lowell, October 13, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[157] Ibid.
[158] Ibid.
[159] Ibid.
[160] Ibid.

Slipher mailed his letter in response to Campbell on November 4, 1908. He told the editors of *The Outlook* that Campbell had "omitted some facts vital to the case" and that he would like to set the record straight.[161] One of the editors "HJH" responded to Slipher very quickly, just five days later, and requested significant edits. Not least of these requested edits was to reduce the word count by about half. According to the magazine, the initial two thousand words would "occupy more space in our pages than we feel ought to be devoted to this subject just now."[162] It was, after all, the third piece of writing the magazine published on the topic of two observatories arguing about how many stars they could see. The editor, given the popular readership of the magazine, suggested that Slipher first cut the more technical sections. These "would not be so interesting to the readers of *The Outlook* as the more popular statement of your case."[163]

Slipher's argument was slightly different than Lowell's original claims. Slipher argued that the greater size of the Lick 36-inch should yield more power than it was demonstrating in reality. Tucker's 1894 observations fell far short of what should have been expected from the massive instrument. But, the numbers Campbell cited in the new chart were still less than what they should be seeing at Lick. With the difference in light-gathering and magnification capabilities between the two lenses, Slipher argued, Lick Observatory should be able to see twice as many stars as Lowell. But the superior atmosphere at Flagstaff greatly narrowed that gap.[164] According to Slipher,

> Hence the discrepancy remains, and the new Lick observations only testify for, rather than against, the reasonableness of Professor Lowell's conclusion that it is

[161] Vesto M. Slipher to Editor of *The Outlook*, November 4, 1908, *Vesto M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[162] "HJH" (Editor of *The Outlook*) to Vesto M. Slipher, November 9, 1908, *Vesto M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[163] Ibid.
[164] V.M. Slipher, "Air and Large Telescopes", *The Outlook*, December 1908, 867.

> due to a more transparent air at Flagstaff, an assumption which is further borne out by spectroscopic observations."[165]

Therefore, according to Slipher, even given the greater number of stars that Campbell cited in his revised observations, Lick still underperformed. The atmosphere at Lowell made up for the smaller lens. Furthermore, in response to Campbell's assertion that he had better things to do than complete the entire area of the original star chart, Slipher noted "the reason given for not completing it [the experiment] seems scientifically inadequate."[166]

On the same day that Slipher sent his letter to *The Outlook* to be published, he sent a copy to Lowell to review. Though Slipher was angry about Campbell's assertions and accusations, he believed that he had addressed the issue "fairly and strongly and coolly." [167] A few weeks earlier, he had been ready to issue a direct public challenge to Campbell. In mid-October, Slipher wrote to Lowell suggesting that the observatory offer to execute a simultaneous test with Lick, to be carried out on the same night and in the same part of the sky. In this way, they could see once and for all whose telescope was better. According to Slipher, "If he [Campbell] declines this proposal he practically admits he has no case."[168] But Lowell did not trust Campbell,

> As to your idea of writing to Campbell to propose a simultaneous test I think nothing would be gained by it as he would only term it as showing how interested we were in the matter and he would give such good excuse for not trying it that you would lose rather than gain in the result.[169]

---

[165] Ibid., 869.
[166] Ibid.
[167] Vesto M. Slipher to Percival Lowell, November 4, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[168] Vesto M. Slipher to Percival Lowell, October 13, 1908.
[169] Percival Lowell to Vesto Melvin Slipher October 19, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

What Campbell lacked in atmospheric conditions, Lowell believed, he made up for in cleverness and resourceful diplomacy.

Though interested in the practical aspects of the observational comparisons, it seemed that Slipher's primary reason for entering into the debate was to guard his emergent scientific reputation from the damage someone like Campbell could inflict. Slipher was only thirty-three in 1908 and was still working towards his doctorate (he received it the following year from Indiana University). On February 6, 1909, Slipher wrote to Campbell, describing how he had participated in the debate in *The Outlook* despite the fact that "I deplore controversy much more than the case may suggest."[170] He went against his peaceful predisposition because he saw the need to defend his reputation. As Slipher believed, "when discredit falls on Lowell's work it falls on mine, too."[171] He wrote to Lowell the following year, reflecting on the incident, and described how he was concerned about what the readers of the magazine might have thought. To Slipher, "It is it seems to me not so much what he [Campbell] says as what the reader is led to infer that is most objectionable."[172]

Brothers in Arms

William H. Pickering was largely responsible for transforming Lowell Observatory from concept to reality. In the first years of building and operations,

---

[170] Vesto M. Slipher to W.W. Campbell, Feb 6, 1909, *Vesto M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[171] Ibid.
[172] Vesto M. Slipher to Percival Lowell, March 16, 1910, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

Pickering provided Lowell with a great deal of technical assistance, equipment, connections, and insight.[173] He was Lowell's right hand man. Or, perhaps, Lowell was his. But after working at Flagstaff from 1894-96, he became intolerant of Lowell's extraterrestrial speculations and returned to HCO. In 1904, Pickering published "An Explanation of the Martian and Lunar Canals" in *Popular Astronomy*. He became, because of his prior involvement with Lowell Observatory, one of the most potent critics of Lowell's Martian theories.[174]

In this article, Pickering presented two arguments to explain the canal phenomena. Firstly, the larger "canals" did exist but they were natural planetary features rather than artificial waterways. The smaller canals, however, were merely optical illusions. According to Pickering, the Maunder experiment (1903) and similar researches had more than adequately demonstrated that "many of the finer Martian canals are probably nonexistent."[175] The eye and mind wanted to make sense of random patterns. "There is a curious tendency," thought Pickering, "of the human eye to see such dark points united by faint narrow lines."[176] As Pickering elaborated in another popular article

[173] David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin*, (Cambridge, MA: Harvard University Press, 2001) gives full credit to W.H. Pickering for the idea of carrying out an atmospheric survey to select the observatory location. K. Maria D. Lane, *Geographies of Mars: Seeing and Knowing the Red Planet*, (Chicago: University of Chicago Press, 2011) credits Pickering with setting the bar for the astronomer-adventurer archetype through his 1892 expedition to Peru. See also Lane's chapter "Astronomers at Altitude: Mountain Geography and the Cultivation of Scientific Legitimacy" in Denis E. Cosgrove and Veronica Della Dora (eds.), *High Places: Cultural Geographies of Mountains and Ice*, (London: I.B Tauris, 2008).
[174] William H. Pickering, "An Explanation of the Martian and Lunar Canals" *Popular Astronomy*, Vol. 12(7) (1904).
[175] Ibid., 3.
[176] Ibid.

on the topic four years later, the only thing known for certain about life on Mars, of course, was that "if we were transported there ourselves, we would instantly die."[177]

In January 1908, William Pickering elaborated on the argument for natural causation in *Harper's*, suggesting that the lines could be caused by a combination of steam and natural vegetation patterns. There was no reason to doubt the existence of vegetable life on Mars, only Lowell's advanced civilization of engineers. The constraints for higher-order life, Pickering argued, were much narrower than those of life in general. Pickering suggested a hypothesis that he claimed, based on his correspondence, was "generally preferred by those astronomers interested in Mars."[178] In Pickering's theory, the lines on the surface of Mars were in fact cracks formed by volcanic activity. Water vapor would escape from these cracks and sustain plants that grew along their edges. This vegetation, likely a sort of bush or small tree, was what was visible through the telescope. Like Lowell, Pickering argued that it was the vegetation along the edges of the channels that was visible to observers on Earth. However, unlike Lowell, Pickering argued that the circumstances surrounding the appearance of this border vegetation were natural.

"What the public generally does not understand," Pickering explained, "is that while the drawings may look thoroughly artificial, and may be most carefully made, yet that planet itself, *if sufficiently well seen,* might not look artificial at all."[179] The lines on the surface of Mars, in reality, were not as straight and uniform as they appeared in some

[177] William H. Pickering, "Different Explanations for the Canals of Mars," *Harper's Monthly Magazine*, January 1908, 29-34: 34.
[178] Ibid., 33.
[179] Ibid., 31.

books and magazines. Their uniform appearance, furthermore, was "by no means generally accepted by astronomers."[180] Like in his 1904 article in *Popular Astronomy*, Pickering repeated that the Maunder theory of optical illusion could explain the preponderance of smaller canals.

Pickering came to the defense of professional astronomers who criticized Lowell and his supporters. They were not as narrow-minded as Lowell sometimes suggested. Their skepticism of canals was due to a lack of reliable evidence not "a sort of jealousy of the other planets, such as Professor Lowell has suggested."[181] Astronomers had no desire that "intelligence should be confined to our Earth."[182] In general, professional astronomers were just as captivated by the possibility of life on other planets as anyone else. Pickering suggested that if evidence of life on another planet were brought forth, professional astronomers, just as everyone else, would welcome it "not only with pleasure, but with wild enthusiasm."[183] The problem, as many others suggested before and after Pickering, was that Lowell offered no such evidence.[184]

In the late-nineteenth and early-twentieth century, during the time of the canal debate, Harvard College Observatory (HCO) acted as a distributor of news concerning astronomy and related fields. An astronomer or observatory with a new discovery or an important announcement first sent that information via telegraph to HCO.[185] Then, HCO distributed the news to the Associated Press and to observatories, universities, and other institutions that subscribed to their telegraph service. In this way, HCO was a

---

[180] Ibid.
[181] Ibid., 34.
[182] Ibid.
[183] Ibid.
[184] Ibid.
[185] See William Graves Hoyt, *Lowell and Mars* (Tucson: University of Arizona Press, 1976), 290.

clearinghouse for information and, as a result, possessed a great deal of power in deciding what news made it to the press and how.[186]

William Pickering's older brother Edward C. Pickering (1846-1919) wielded this power against Lowell and his theories concerning Mars and other planets. The elder Pickering was director of Harvard College Observatory from 1877 to 1919. As such, he refused to circulate Lowell's telegrams from the 1907 opposition and the Lowell Expedition to the Andes.[187] In discussing with the *New York Times* his refusal to distribute news from Lowell Observatory, Pickering did not veil his distaste for Lowell's theories. When asked why HCO did not offer any of its own research on Mars and Martian canals, Pickering answered,

> Our work is confined exclusively to the stars, where we obtain results that are of permanent value. We do not consider it worth while to abandon our investigation in this line to go hunting for evidences of habitation on Mars.[188]

The evidence for habitation, of course, was still absent, according to the elder Pickering (as well as the younger). Furthermore, while Lowell and his followers could have been convinced by the so-called evidence that they cited for Martian inhabitation, "the great majority of astronomers are skeptical so far as the subject is concerned, and moreover regard it as a waste of energy."[189]

A few months before this disavowal of all things Martian, in February 1907, Lowell and Pickering had it out over the HCO telegraph service. Lowell called Pickering

---

[186] For an example that sending telegraphs from Lowell to HCO for distribution was a customary procedure before 1907 see Edward C. Pickering to Percival Lowell, April 11, 1905, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Pickering let Lowell know that his recent telegraph had been received and "sent out as usual." It was also relayed to the Associate Press.
[187] See Hoyt, *Lowell and Mars*.
[188] "Special to the New York Times," *New York Times* (New York, NY) July 7, 1907.
[189] Ibid.

to complain of the cost of the telegrams that he received from HCO. The total cost for 1906 was about $50, which would translate to over $1200 in modern currency. During that year, Lowell Observatory received thirty-six telegrams from the HCO news distribution service at an average of $1.36 apiece. Both Pickering and Lowell agreed that this was an unusually large number, especially given that the fee to send a telegraph message from Massachusetts to Arizona was not insignificant. By February 14, the day they spoke about it and Pickering subsequently wrote to Lowell to elaborate, there had been no telegrams for the year 1908.[190]

The HCO telegraph service was tiered into higher and lower classes. Higher classes of subscription received more telegrams than the lower classes. Lowell Observatory was registered in Class A, which meant they received everything that HCO issued out.[191] Pickering suggested that if Lowell were overly concerned about the cost, he should change his class. Pickering suggested,

> If you desire to make your expense lower than that of Class A, I should suggest that you take Class D. This will insure all original announcements being sent, but the subsequent positions from other observers and the final ephemerides would be omitted.[192]

With a class D subscription, Lowell would have received nine rather than thirty-six telegraphs, lowering the cost to a more reasonable $12.[193] With Lowell's background as a wealthy and well-connected member of Bostonian society, this suggestion was no doubt very insulting.[194] To make the matter even more impersonal, Pickering enclosed a form

---

[190] Edward C. Pickering to Percival Lowell, February 14, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[191] Ibid.
[192] Ibid.
[193] Ibid.
[194] See David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin*.

with which Lowell could alter his enrollment. He told Lowell, "If you wish any change in your classification it can readily be effected by filling out and returning the blank attached to the circular."[195] The treatment of Lowell Observatory as any other subscriber furthered the insult.

By January 1909, Lowell had begun to distribute news from Lowell Observatory directly from Flagstaff without using HCO as an intermediary. Lowell wrote to Pickering,

> I have your note offering to distribute by mail bulletin the announcements from the Lowell Observatory… and in reply I beg to say that such distribution on this side of the Atlantic is to be done directly from this observatory.[196]

The relationship between Lowell and HCO remained strained. Pickering and HCO were put in a very tenuous position when Lowell's brother, Abbot Lawrence Lowell (1856-1943) became President of Harvard University in 1909. One year apart in age and very close, A. Lawrence Lowell later wrote a glowing biography of his brother.[197]

In 1910, Edward Pickering wrote to Percival Lowell requesting that the Solar Conference, which Pickering was partly in charge of organizing and which would be meeting at the Carnegie Solar Observatory at Mount Wilson, California, be able to stop over at Flagstaff for a visit. Quite in opposition to his 1907 statement to the *New York Times* that astronomers saw Lowell's work as a "waste of energy," Pickering now praised Lowell's work and his reputation in professional circles. Pickering mused,

> I believe that astronomers feel as I do a great admiration for your persistence and skill in developing the study of planetary detail…[198]

---

[195] Edward C. Pickering to Percival Lowell, February 14, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[196] Percival Lowell to Edward C. Pickering, January 21, 1909, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[197] See A. Lawrence Lowell, *Biography of Percival Lowell* (New York: MacMillan, 1935).
[198] Edward C Pickering to Percival Lowell, May 28, 1910, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

Lowell agreed to host the Solar Conference at Flagstaff, noting that he was “happy to have them and will see that arrangements are made for their reception.”[199] Pickering’s change in outlook about Lowell and his work, at this point, was quite remarkable.

Alfred Russell Wallace’s Challenge to the Educated World

In December 1907 well-known British naturalist Alfred Russell Wallace, then 84 years old, published *Is Mars Habitable?* Wallace intended this book to discredit Lowell and his claims for life on Mars. William Graves Hoyt, in *Lowell and Mars* (1974), describes it as a “direct assault” on Lowell’s Martian theories.[200] Wallace, not mincing words, described it in very similar terms himself. Because of the speculative nature of the Martian canal theory, Wallace pronounced,

> This volume is therefore in the nature of a challenge, not so much to astronomers as to the educated world at large, to investigate the evidence for so portentous a conclusion [that of an advanced civilization on Mars].[201]

As Wallace explained, *Is Mars Habitable?* began as a review article of Lowell’s most recent and, as it would turn out, most popular book *Mars and Its Canals* (1906). But Wallace must have found it difficult to limit his criticism to just a few paragraphs and wound up expanding it into a 110-page book. *Is Mars Habitable?* presented several modes of argument against the existence of canals and their irrigators. These consisted of both Wallace’s’ own views and those borrowed from other canal critics, especially William H. Pickering.

---

[199] Percival Lowell to Edward C. Pickering, June 2, 1910, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[200] Hoyt, 214.
[201] Alfred Russell Wallace, *Is Mars Habitable? A Critical Examination of Professor Lowell’s Book ‘Mars and Its Canals,’ with an Alternative Explanation* (London: MacMillan, 1907), 9.

Like Pickering, Wallace combined Maunder's 1903 optical illusion theory (for smaller canals) with natural explanations (for the larger). He accepted that the larger canal lines were real and represented natural features of the Martian surface.[202] Schiaparelli and Lowell were not the only people to have seen lines on the surface of Mars. Other more disinterested observers documented the linear markings, therefore, "the objection of unreality seems no longer valid."[203]

In support of the claim for natural origins, Wallace proposed that Mars had experienced a much different geological history than Earth. There was no reason to assume that its surface features would have anything in common with terrestrial ones. As a result, Mars might therefore present geological formations unlike those humans had yet observed.[204] Anything was possible.

Anything except canals, of course. To Wallace, the theory of a global canal system on Mars was "wholly erroneous and rationally inconceivable."[205] He presented several reasons why canals made no sense. First, for the canals to be perfectly linear, as Lowell claimed, the surface of Mars would have to be perfectly flat. Each of the canals supposedly ran for thousands of miles, yet exhibited no deviation in their straight paths. There were no bends or curves like the waterways of Earth as they traverse uneven topography.[206] How could Mars be smooth and perfectly spherical with no mountains, hills, valleys, canyons, etc.?

---

[202] See Pickering "An Explanation of the Martian and Lunar Canals" (1904) and "Different Explanations for the Canals of Mars" (1908)
[203] Wallace, 78.
[204] Ibid.,78-80.
[205] Ibid., 32.
[206] Ibid., 19-20.

The basic planetary conditions of Mars, as Wallace explained, also rendered planet-wide canals very unlikely. If Lowell were correct in his assumption that the canals ran through thousands of miles of desert, the water would simply evaporate too quickly to be of any practical use to their builders. This would be especially true on Mars with its low gravity and low atmospheric pressure, the combined effect of which quickened evaporation and made the water's ability to move along the canals very unlikely.[207] The low pressure meant that water turned to vapor more quickly than on Earth and the decreased gravity meant that there was not enough force to pull the water from the poles to the equator. There could not be enough water in the poles to compensate for such effects. That was, of course, if the polar caps were made of water at all, which many astronomers doubted in the first place.

The average temperature of Mars was also a notable point of disputation between Lowell and Wallace. In discussing the climate of Mars, Wallace cited an article Lowell published in July 1907 called "A General Method for Evaluating the Surface-Temperature of the Planets; with Special Reference to the Temperature of Mars." In this article, Lowell claimed that Mars, despite receiving less sunlight and having a significantly thinner atmosphere than Earth, nonetheless experienced a somewhat pleasant average temperature of 48° F.[208] Wallace found this figure, which was "similar to Southern England," to border on the absurd.[209] According to Wallace, "such a contention of course required to be dealt with."[210]

---

[207] Ibid., 20-24.
[208] Percival Lowell, "A General Method for Evaluating the Surface-Temperature of the Planets; with Special Reference to the Temperature of Mars," *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, Vol. 14, No. 79: 161-176, 176.
[209] Wallace, v.
[210] Ibid., v-vi.

The average temperature of Mars is somewhat of a misleading figure because the temperature on the planet varies widely from day to night, from season to season, and between the poles and the equator. Because of the thin atmosphere, the planet experiences extremes in temperature from under -200° F under its coldest conditions up to 70° F or more at its warmest. But even considering this large range, Lowell's figure of 48° F, and the related figures he used to derive it, were far different than the estimates of his contemporaries. The most recent calculation at the time Wallace was writing came from eminent astronomer and mathematician Forest Ray Moulton (1872-1952).[211] Moulton's calculations suggested -80° F, a difference of 128° F compared to Lowell's estimate.

This was not the only unusually high figure that Lowell cited in his July 1907 article on the surface temperature of planets. According to Wallace, Lowell's work was crammed with "figures of doubtful accuracy."[212] Another example was in Lowell's estimate for the Earth's albedo. The albedo of a planet is its reflectivity - the amount of sunlight its atmosphere reflects back into space. Earth's albedo was an important figure in determining, by comparison, the likely albedo for Mars. Lowell's value was suspiciously high at 75%, a percentage he described as "probably a minimal value".[213] This meant that, according to Lowell, the Earth reflected, at a minimum, about two thirds of the light it received from the sun. Other estimates available in 1907 reckoned somewhere between 50-60% for the Earth's albedo (the modern mean value is about

[211] Ibid., 68. Moulton was co-author of the Chamberlin-Moulton Planetesimal Hypothesis (1905) and at the time, he was also the associate editor of the *Transactions of the American Mathematical Society*.
[212] Wallace, v.
[213] Lowell, "A General Method," 168.

30%).[214] With a very high estimate for Earth's albedo, Lowell was free to assume that the albedo of Mars was also higher than his colleagues would suggest. Because the atmosphere of a planet is what reflects the sunlight, a higher albedo meant a denser atmosphere. The denser atmosphere allowed for a higher surface temperature. In this way, the figures Lowell used, even if they were far different than accepted values, leant very well to the determination of a habitable climate on Mars.

Did Lowell see what he wanted to see and calculate what he wanted to calculate? Perhaps. Like many before and after him, Wallace criticized Lowell for his lack of objectivity and scientific rigor. Lowell attempted to provide objective proof for canals through his photographs of Mars. But, as Lorrain Daston and Peter Galison discuss in *Objectivity* (2010), this attempt was not successful because of the inability to reproduce the photographs in print. [215]

But logical leaps and unusually high estimates for planetary data did not make Lowell dangerous to professional science. Many of Lowell's critics did not perceive him as an overall bad scientist, all things considered. Even Wallace complimented Lowell on his technical skill and dedication to the hard work of planetary observation.[216] Wallace also noted Lowell's talent and insight in "seeking out so admirable a position as regards altitude and climate, and in establishing there a first-class observatory."[217]

What was most threatening about Lowell, to Wallace and many others, was the visibility and popularity of his theories, writings, and public persona. As Wallace

---

[214] Wallace, 51.
[215] For more on issues of Lowell and objectivity see Lorrain J. Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2010).
[216] Wallace, 14-15.
[217] Ibid., 99.

described, once word of Martian canals got out, it "at once seized upon the public imagination and was spread by the newspapers and magazines over the whole civilised world."[218] This popularity was what prompted Wallace to target "the educated world at large."[219] Lowell's books, articles, lectures, etc. had served to shift attention to the topic of Mars, as Wallace grimaced, "from comparative obscurity into a position of the very first rank both in astronomical and popular interest."[220] *Mars and Its Canals* (1906), Lowell's most recent book and the one Wallace had initially reviewed, would be reprinted several times over the following few years. And the problem, in Wallace's opinion, was getting far out of hand.

William J.S. Lockyer (1868-1936), astronomer and son of the co-discoverer of helium Norman Lockyer (1836-1920), wrote a review for Wallace's *Is Mars Habitable?* This review was published in the February 1908 issue of *Nature*, the journal which Norman Lockyer founded and served as editor. Though the younger Lockyer would "unhesitatingly recommend" Wallace's book, he also believed "the last word on this difficult question has not been said yet."[221] Lowell attempted to have this last word the following month in *Nature*. In March 1908, Lowell wrote a letter to the editor,

> Inasmuch as Dr. Wallace has sent me his book through his publisher…I suppose it is incumbent on me to acknowledge it, since he clearly expects some sort of reply.[222]

---

[218] Ibid., 6.
[219] Ibid., 9.
[220] Ibid., 99.
[221] William J.S. Lockyer, "Review of Is Mars Inhabitable? A Critical Examination of Prof. Lowell's Book, 'Mars and Its Canals,' with an Alternative Explanation by Dr. Alfred Russell Wallace, *Nature*, February 13, 1908. In *Nature: A Weekly Illustrated Journal of Science*: *Volume LXXVII Nov 1907-Apr. 1908* (London: MacMillan & Co., 1908), 337-339: 339.
[222] Ibid.

This reply, as it were, was blatant. To Lowell, reading Wallace's book strengthened his resolve in the belief of life on Mars because Wallace had to resort to "misstatements of fact" to be able to "make out even a seeming case upon the other side."[223] In general, Lowell, somewhat ironically, warned against the improper execution of science,

> Misstatements cannot be too carefully avoided in science, especially when a man, however eminent in one branch, is wandering into another not his own…Indeed, if criticism were confined, as common-sense counsels, to those versed in the phenomenon, we should hear very little about the inhabitability of Mars.[224]

Conclusion: The Rules of Engagement

Accusations of irresponsible communication shadowed Lowell from the beginning, but became more abundant over time. In the summer of 1894, shortly after Lowell Observatory saw first light, Edward S. Holden (1846-1914), the first director of Lick Observatory, voiced his misgivings about Lowell's public claims of life on Mars. Holden published a disparaging article about Lowell's announcements in both the *Publications of the Astronomical Society of the Pacific* (June 9) and the *Los Angeles Times* (July 22).[225] In this latter article, headlined "Men of Mars," Holden cited a paper that Lowell had recently read at the Boston Scientific Society regarding the opening of his observatory. [226] This speech had been transcribed in a popular Boston-based magazine, *Commonwealth*.[227] Quoting Lowell's speech as transcribed in *Commonwealth*, Holden believed many passages to be "very misleading and

---

[223] Ibid.
[224] Percival Lowell, "The Habitability of Mars," *Nature* March 19, 1908. In *Nature: A Weekly Illustrated Journal of Science*: *Volume LXXVII Nov 1907-Apr. 1908* (London: MacMillan & Co., 1908), 461.
[225] Holden was the founder and first president (1889-1891) of the *Astronomical Society of the Pacific*.
[226] Edward S. Holden, "Men of Mars," *Los Angeles Times* (Los Angeles, CA), July 22, 1894.
[227] See *Commonwealth* (Boston, MA), May 26, 1894.

unfortunate."[228] According to Holden, it was "the duty of all instructed observers to be scrupulously exact in announcing results for a popular audience."[229] Furthermore, scientists must also be "extremely cautious not to mislead; and especially to avoid over-statement" when conveying ideas and research to the public.[230] Lowell, by Holden's estimation, had "not always observed these obvious rules."[231]

Like his predecessor, the misinformation of the public was of immediate concern to Campbell, the second director of Lick Observatory, in 1907-1909. At stake in the growing rivalry between Lowell and Lick, as demonstrated in the *Outlook* debate and beyond, were issues of credibility, reputation, and certainly a fair amount of ego. Campbell wrote to Slipher in November 1909 about Lowell's claim of superior observations. "I think it entirely uncalled for," Campbell complained, "that Mr. Lowell should have endeavored to boost his work at our expense." [232] But, perhaps more fundamentally, the two observatories were at odds about who was able and qualified to communicate science to the public and how that communication should be carried out. To Campbell, it was a "duty" to address the issue of misinformation.[233] Campbell feared, "as Mr. Lowell has published this claim in several magazines, there is no doubt that hundreds of thousands of general readers have been misled."[234] This, Campbell felt, was a hostile act, made more hostile because of its medium and audience.

---

[228] Edward S. Holden, "The Lowell Observatory, in Arizona," *Publications of the Astronomical Society of the Pacific* Vol. 6 (36) (1894): 160-169, 160.
[229] Ibid, 165.
[230] Ibid, 160.
[231] Ibid, 161.
[232] W.W. Campbell to Vesto M. Slipher, November 22, 1909, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[233] Campbell, "The Lick Observatory," 255.
[234] Ibid.

Lowell had not challenged Campbell within the confines of established science, he had undermined him to the general population, a readership that Campbell felt only saw things in black and white and was not interested in context or subtleties like "approximately" or "nearly."[235] Of Lowell, Campbell believed

> Expressed in military language, he in this took the offensive attitude; and this claim was repeated in so many places, with variations, that his attitude became offensive in the every-day sense…he was building up his popular superstructure at our expense.[236]

It was not necessarily what Lowell said, or even how he said it. The primary issue for Campbell was where Lowell made his legitimacy claims and to whom.

Arthur Stanley Eddington issued a statement to the press about Lowell's 1907 *Nature* article regarding the Lowell Expedition to the Andes and the photographs it produced. Eddington claimed English astronomers, in general, were united in their rejection of Lowell's Martian canal theories.[237] As he explained to the *New York Times*, Eddington also believed, like W.H. Pickering, that the lines existed but that they were "not artificial at all." Merely because the lines existed, even if they were shown in photographs, did not mean "a direct sequitur that the planet is at present the abode of constructive life." [238] According to Eddington, any consideration of life on Mars, past or present, was "mere speculation."[239]

Scientists like Eddington, Holden, Campbell, Hewerd, Wallace, the Pickering brothers, and many others believed that public science carried with it clear rules,

---

[235] W.W. Campbell to Vesto M. Slipher, November 22, 1909. *Vesto M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[236] Ibid.
[237] Percival Lowell, "Mars in 1907: Observations at the Lowell Observatory," *Nature* Vol. 76(1974) (1907): 446.
[238] "Is Not Convinced of Life on Mars" *New York Times* (New York, NY), August 31, 1907.
[239] Ibid.

obligations, and responsibilities. Communicating with the public meant taking on a duty to avoid sensationalism or misstatement.

It is perhaps not surprising that the efforts of canal critics to turn the tide of public opinion after-the-fact were not entirely successful. By 1907, the Martian canals held a grip on the fascination of the American public. When reporting E. C. Pickering's refusal to distribute Lowell's telegrams from the 1907 Martian opposition, the *New York Times* accused E.C. Pickering of "indifference to popular astronomy." [240] After this conflict between Lowell and HCO had escalated further, in 1909, the *Times* similarly granted Lowell its "heartiest sympathy in his controversy with that ancient institution, Harvard University." [241] When Lowell subsequently usurped power from HCO in matters concerning planetary astronomy, the *New York Times* article noted it was "as it should be." Taking on the responsibility of speaking for the American public in general, the *Times* added

> The people of this country support Prof. Lowell in his Martian campaign.[242]

The newspaper's pages were no more sympathetic to William Pickering. In an article "Pickering vs. Lowell" the *New York Times* put forth that, in his articles arguing for the natural origins of the "canals," W.H. Pickering had failed to "make a single reasonable point against Prof. Percival Lowell's Martian theories," [243] Instead, Pickering had been thoroughly routed by his "astute rival."[244] For Eddington, the *Times* accused him, essentially, of a lack of expertise. According to a September 1907 article "Strengthen

[240] "Special to the New York Times" *New York Times* (New York, NY), July 7, 1907.
[241] "Flagstaff vs. Harvard" *New York Times,* (New York, NY) Nov 9, 1909.
[242] Ibid.
[243] "Pickering vs. Lowell" *New York Times,* (New York, NY), Dec 22, 1907.
[244] Ibid.

Mars Theories," Eddington, in criticizing Lowell, had employed "arm chair philosophy" while Lowell practiced "telescopic observation and deduction." [245] By that same measure, all critics of Lowell and his theories, according to the article, had "been met and shown to be scientifically untenable."[246]

Lowell had become the public hero of the Martian story, often at the expense of his critics, for reasons outside of the reach of established professional science. Public audiences saw him in a much different light than his colleagues within the disciplines of astronomy and astrophysics. This public appeal became the basis of Lowell's power, even as professional astronomers tried to reclaim the ability to create and distribute knowledge and public opinion. As Hoyt describes, thousands of non-astronomers read Lowell's books, articles, or listened to his lectures. Additionally,

> Thousands more absorbed the major points of his theory at second hand, often in oversimplified and not always accurate form, from reports, reviews, and commentaries in a press that was already familiar with the lurid techniques of what came to be known as 'yellow journalism.'[247]

Even when professional astronomers entered the public dialogue, they had much less to offer than Lowell to either the press or the general reader. Lowell gave the public a new and interesting world to daydream about. His critics often offered much less tantalizing prizes: academic honors, deductive objectivity, and conservative interpretations of data. These things rarely make for good headlines. Nor do they make for interesting reading.

In a similar instance of this disconnect between professional science and the public, Katherine Pandora, in her article "Knowledge Held in Common," discusses the

---

[245] "Strengthen Mars Theories: Prof. Lowell Received Additional Photographs Which Confirm Canal Belief" *New York Times*, (New York, NY), September 6, 1907.
[246] Ibid.
[247] Hoyt, 87.

example of early-twentieth-century horticulturist Luther Burbank (1849-1926). Lowell and Burbank were contemporaries and, like Lowell, Burbank was a public hero who graced the pages of newspapers, magazines, and popular books. But, also like Lowell, Burbank was an outcast and target of criticism from his professional counterparts.[248] According to Pandora, "academic scientists increasingly dismissed Burbank as a glorified gardener."[249] But the public saw Burbank as a legitimate, even ideal, source of scientific knowledge and identity.[250]

As Lowell, Burbank, and similar public figures show, audiences do not necessarily fall into line with the decrees of professional science concerning what is legitimate science and what is not. [251] Even when Martian canal critics like Wallace, Campbell, Holden, Eddington, the Pickerings, and others appealed directly to the public, meeting Lowell on his own terms, the audience was initially unreceptive to their arguments. As Bernadette Bensuade-Vincent describes in her article "A Historical Perspective on Science and Its Others," popular science is defined more by what it is not rather than what it is. It is a "transient and contingent notion, characteristic of the nineteenth- and twentieth-century science that saw scientific practices gradually confined into academic spaces and thus configured the 'public' as a passive spectators or users of its products."[252] Lowell, Burbank, and similar public figures appealed directly to general

[248] Katherine Pandora, "Knowledge Held in Common: Tales of Luther Burbank and Science in the American Vernacular," *Isis*, Vol. 92(3) (2001): 484-516, 484-5.
[249] Ibid., 486.
[250] Ibid., 485.
[251] For more on the issue of demarcation in science, and astronomy, see Norris S. Hetherington, *Science and Objectivity: Episodes in the History of Astronomy* (Iowa State University Press: Ames, 1988) and Michael D. Gordin, *The Pseudo-Science Wars: Immanuel Velikovsky and the Birth of the Modern Fringe* (Chicago: University of Chicago Press, 2012).
[252] Bernadette Bensuade-Vincent, "A Historical Perspective on Science and Its Others," 367.

readers, empowering them in the process of creating knowledge in common while professional science had defined itself by its distance from the mundane and the popular. For those determined to put the canal theory to rest, things would get worse before they got better.

Chapter Three

Communicating with Mars

"Strange things are happening" announced a 1907 article from the *Daily Press* in Newport News, Virginia. For several nights, workers at the local telegraph station had been receiving odd signals that they could not explain nor trace. The overnight crew, already with the bad luck to get the late shift, found their misfortunes multiplied as, every night, they were "awakened with a start…frightened and vaguely anxious" by the mysterious messages. The article described the scene,

Midnight. Tap, tap, tap! Tap, tap, tap! Tap, tap, tap!

The telegraph operators were baffled. Through a little detective work, they had established seemingly without doubt that "from no earthly station has such a message been sent at such a time." So, they waited, "in the oppressive silence of the deserted night," as the eerie dispatch repeated predictably yet puzzlingly and with no way to silence it without cutting off all communication and potentially losing their jobs.[253]

"Some one [sic] is telegraphing," the article clarified, "but not from this world."[254] The messages must have been coming from "somewhere beyond."[255] A likely explanation, and in fact the only one offered in the article, was that the messages were coming from Mars.

Like a populated Mars full of canals, it was not an unusual belief in the late-nineteenth and early twentieth-century that Mars and Earth could communicate by

---

[253] "A Mysterious Call," *Daily Press* (Newport News, VA), August 10, 1907.
[254] Ibid.
[255] Ibid.

telegraph, telephone, light signals, mirrors, monoliths, or even telepathy. These two topics, canals and communication, were intimately interrelated and experienced a mutual interchange of ideas. Both, of course, were dependent upon the belief in life on Mars. But each discussion, as they appeared in scientific as well as public discourses, possessed distinctive elements that separated the two into different and divergent conversations.

Historical analyses often neglect the discrete nature of the two issues, that of canals and Martian communication. Typically, discussions of the topic of communication focus on purported light signals that some, at the time, believed to be attempts from Mars to contact the Earth. These discussions ignore other elements of the discourse on interplanetary communication which included emerging technology (like telegraphs and telephones) as well as elements of spiritualism. For example, Hoyt, as Lowell's biographer, describes the conversation about signaling as "short-lived" and what gave the Mars craze "its early manic taint."[256] William Sheehan, in *Planets and Perception* (1988), characterizes signaling and communication in much the same way. In his estimation, the notion of Martian signals was, in 1892, considered far-fetched even by contemporaries and served merely as "an indicator of the popular mood about Mars before Percival Lowell arrived to stir it up even further."[257] Robert Markley's *Dying Planet: Mars in Science and the Imagination* (2005) does not discuss the signals nor other modes of interplanetary communication devised at the time.[258] K. Maria D. Lane, in her book *Geographies of Mars* (2011), briefly describes many of the key events and

[256] William Graves Hoyt, *Lowell and Mars* (Tucson: University of Arizona Press, 1976), 9.
[257] William Sheehan, *Planets and Perception: Telescopic Views and Interpretations: 1609-1909*, (Tucson: The University of Arizona Press, 1988), 136.
[258] Robert Markley, *Dying Planet: Mars in Science and the Imagination*, (Durham, NC: Duke University Press, 2005). This book does, however, discuss many themes that translated from popular science into literature during this era.

players in the debate over Martian signals and touches on ideas of wireless telegraphy as another means to communicate with Mars. In doing so, she features Lowell's negative reaction to the emergence of such ideas despite his role in engendering them. As Lane describes, Lowell's "insistence that Mars hosted intelligent life clearly contributed to the popular belief that they [flashes of light on Mars] could be signals."[259] While it is true that Lowell provided a great deal of the popular basis for the notion of an inhabited Mars, the idea of Martian signals predated Lowell's entrance into the field of astronomy and persisted throughout the Mars craze without, and even despite, him. He was, in fact, a minor figure in the controversy.

The topic of Martian communication is seen, in many cases, as an offshoot of canal theory or as a secondary or less important element in the canal craze that began with the opposition of 1877. The two conversations share a lot of common themes. They both contained elements involving legitimacy claims based on elevation and atmosphere, the burden of proof and responsibilities of science, and the importance of popular media to convey ideas. However, the idea of interplanetary communication, as a separate element of popular astronomy at the turn of the twentieth century, also had its own origins, themes, and participants. The conversations about different methods for contacting Mars revealed a strong faith in technology that informed a sense of futurism and a belief in the power of science to reveal hidden truths, a belief shared by contemporary fringe sciences.

[259] K. Maria D. Lane, *Geographies of Mars: Seeing and Knowing the Red Planet* (Chicago: University of Chicago Press, 2010), 199.

Signals in Space

During the 1890 opposition, observers at Lick noticed luminous projections seeming to originate from either the surface or atmosphere of Mars. Lick astronomers saw the light effect on the night of July 5th, 1890 after a visitor first pointed it out during public observation night. [260] The projections occurred at the terminator, the arced line that moves across a planet dividing day and night. Astronomers at Lick published their observations of "the interesting phenomenon" in *The Publications of the Astronomical Society of the Pacific* (ASP) a few months later.[261] The "bright spots" along the edge of the Martian nightfall looked much like the ones previously documented on the moon during waxing and waning phases. [262] Though not enough information was yet available to understand the Martian projections, the article pointed out that the ones on the moon were caused by mountains and craters. It was likely, by analogy, that the Martian projections were also caused by light and shadow playing upon large topographical features.

Because the report was published in a professional journal, the mystery of these bright flashes seemed to remain mostly contained within academic circles for several months. In October 1890, Camille Flammarion (1842-1925) prepared a general account of observations and issues concerning Mars, focusing particularly on the research of that

---

[260] E.S. Holden, J.M. Schaeberle, J.E. Keeler, and W.W. Campbell, "White Spots on the Terminator of Mars," *Publications of the Astronomical Society of the Pacific*, Vol. 2, No. 10 (1890): 248-249, 249.
[261] Camille Flammarion, *La Planète Mars et ses Conditions D'Habitabilité*, (Paris: Guathier-Villars, 1892), 247.
[262] Ibid., 248.

year's opposition.[263] Flammarion published this summary, "New Discoveries on the Planet Mars," in popular Boston-based magazine *The Arena* in February 1891. It seemed even Flammarion, a professional astronomer and Martian expert, had not heard about the Lick observations yet. Though Flammarion made note of "extraordinary meteorological and climatological events" recently observed, he did not mention projections, flashes, or bright spots at the terminator.[264] He did, however, discuss the canal lines in some depth, but with marked uncertainty as to their origin and purpose. He was certain that "there is an immense network of straight lines, more or less deep-colored" but that, if they were canals, astronomers did not yet know the details of what they contained or how they worked.[265]

The opposition of 1892 brought more publicity to the terminator projections and their potential as interplanetary light signals. But that year's opposition, in general, was not a constructive period for observations in the US or Europe. The 1892 opposition, peaking in August, was extremely favorable in terms of distance between Earth and Mars. The planets came within about 35 million miles of one another, the nearest that oppositions occur.[266] Because of the fifteen-year opposition cycle, Mars had not been that close since 1877 when Schiaparelli produced his first set of canal maps. However, Mars was positioned very low in the night sky in the northern hemisphere. This made for limited viewing at observatories in Europe and North America, both because of

---

[263] Camille Flammarion, "New Discoveries on the Planet Mars," *The Arena*, No. XV (1891), [1].
[264] Ibid.
[265] Ibid., [2].
[266] Flammarion measured about 56 million kilometers, or 34.8 million miles. Oppositions range from about 60 million miles to about 35 million.

obstructions along the ecliptic (trees, hills, buildings, etc.) and the limited duration that the planet remained above the horizon.

Despite observational challenges in the northern skies, in September 1892, an anonymous article appeared in *Nature* discussing the appearance of the projections during that year's opposition. The author was able to see them on several nights in June and July. They were "undoubtedly luminous phenomena" that "presented themselves with such clearness that it is hardly possible to consider them as the result of any illusion."[267] The author, however, did not wish to speculate on the origins or purpose of the light projections. In fact, the author was hesitant to report such observations until he learned that "Lick astronomers have also observed the luminous projections on the edge of the disc."[268] It seemed that the anonymous observer did not want to go out on a limb in recording such seemingly strange features, even though the letter was unsigned, until he found a reputable precedent.

Edward S. Holden (1846-1914), first director of Lick Observatory, summarized the 1892 observations in New York's *Forum* magazine, noting that recent popular news of Mars had been of two kinds. The first kind of news, like the *Nature* article, informed readers about the "details of observation." The second type, however, had discussed "whether the planet was inhabited by beings like ourselves." Even more speculative and sensational, in Holden's view, the dialogue concerning Mars also included "whether such beings were not actually engaged in making signals to astronomers on the earth." [269] Holden did not dismiss the topic of conversation as inane or divergent. In fact, he

---

[267] "Observations of the Planet Mars," *Nature*, Vol. 46, No. 1194 (1892): 482-83, 483
[268] Ibid.
[269] Edward S. Holden, "What We Really Know About Mars," *Forum*, November 1892: 359-368, 359.

believed that the question of life on other planets was one of the most important mysteries in astronomy. However, he did believe that more research was needed before any informed speculation could be made about such life and its earthly intentions. The first step, in Holden's view, was to determine, by observation and analysis, whether Mars and the other planets of the solar system were physically habitable.

But not everyone shared such cautious views of life on other planets, especially American electrical engineer Arthur Vaughan Abbott (1854-1906). This was a time, in the late-nineteenth and early-twentieth centuries, when technology seemed to be unlocking all the mysteries of nature.[270] In October 1892, soon after the opposition, Vaughan expressed his views on the plausibility of contact with Mars in the inexpensive and widely-circulated magazine *Frank Leslie's Popular Monthly*. To Abbot, interplanetary communication was not as far-fetched or sensational as it may have sounded to scrupulous researchers like Holden. The exchange of messages need not even be restricted to neighboring planets. Mars, in Abbott's view, would merely be the first step. He imagined that, in the near future, with improvements in electrical communication, "we shall be able to read the undulations of the ether, and send on its delicate waves, over the boundless ocean of space, from planet to planet and from star to star, intelligible messages."[271] This interstellar communication could also extend, over time, outside the galaxy and "to the very confines of the great ocean of ether."[272] There

[270] Technological confidence is a well-established aspect of nineteenth-century science and technology studies. For an example of such faith in technology to advance scientific knowledge, as it relates to astronomy, see Patrick McCray, *Giant Telescopes: Astronomical Ambition and the Promise of Technology*, (Cambridge, MA: Harvard University Press, 2004).
[271] Arthur Vaughn Abbott, "Our Neighbor Mars," *Frank Leslie's Popular Monthly*, Vol. XXXIV, No. 4 (1892): 28-34, 28.
[272] Ibid.

was no reason humans could not communicate with Martians, but also not reason to stop at Mars.

The 1894 opposition, with Mars much more visible in the northern hemisphere, saw a flurry of popular discussion about Martian communication. Other observatories in the US and Europe began documenting the bright projections first seen by the thirty-six-inch refractor at Lick in 1890. The "signals," as some proposed them to be, became the topic of many news and popular science articles. However, the signals themselves became less significant in the dialogue than the more general concept of communication between Earth and Mars. One particular issue that arose was that of how to answer the messages.

Once again, perhaps in anticipation of the mounting interest in Martian signaling that came with the approaching opposition period, observers at Lick addressed the issue of the initial projections first reported at Mount Hamilton. Campbell took on the task this time, in March 1894. Though the projections had garnered popular interest, Campbell explained, "they do not seem to have received further attention from astronomers interested in Martian problems." [273] It was a reasonable and unexciting assumption, Campbell believed, that Mars had mountains and that some of them would be large enough to be glimpsed by a powerful telescope. It was also very likely that the flashes of light seen at the terminator were "due to mountain chains lying *across* the terminator of the planet, possibly covered with snow in some cases, and in others not necessarily

[273] W.W. Campbell, "An Explanation of the Bright Projections on the Terminator of Mars," *Publications of the Astronomical Society of the Pacific*, Vol. 6, No. 35 (1894): 109.

so."[274] Though this was the most probable hypothesis, Campbell urged caution and continued observations before establishing certainty. Accordingly,

> It will not be possible to establish any theory until the projections have been accurately observed at several oppositions, or possibly through one or more of the 15-year cycles. The mountain theory is offered here as a working hypothesis.[275]

Campbell's recommendations for conceptual restraint and the need for significant further research, however, were not accessible to the public in the same way that newspapers and popular magazines were. His article was printed in the ASP *Publications*. The ASP was founded to bring professional and amateur astronomers together and to coordinate public education. However, the *Publications* were still primarily directed toward professional circles and thus held little appeal to the general reader.

It seemed that the caution that Holden, Campbell, and the Lick staff would have liked to impart did not reflect the reality of the general discourse. By 1894, Lick scientists and the popular media were talking about two different things. In the news, people were very rarely discussing the nature of the flashing projections anymore and were much more concerned about the possibility and means of contacting Mars. "When the electric telegraph was invented," mused a June 1894 article in the *Los Angeles Times*, "people thought that we had reached the limits of the wonderful in the line of communicating with persons at a distance."[276] But communication technology had only broadened and improved since then thanks to "the wonders that have been accomplished in the line of scientific invention." Though it may sound absurd to talk to Martians at that moment, prior generations could not have imagined talking to people in other cities.

---

[274] Ibid.
[275] Ibid.
[276] "Wonders of Science," *Los Angeles Times* (Los Angeles, CA), June 14, 1894.

Given such rapid changes, “it would be rash to assert that anything is absolutely impossible…It is the impossible that happens nowadays.”[277]

Two months later, Professor Ezekiel Wiggins (1839-1910) of Ottawa entered onto the scene and offered new and distinctive dimensions to the story of Martian signals. His occupation, before and after becoming an expert on Martians, was that of weather prophet.[278] He also dabbled in astronomy, claiming astronomical causation for many weather events. In August 1894, Wiggins lectured in Ontario on the topic of Martian communication and, according to the Associated Press and the *Los Angeles Times*, he spoke “learnedly on unknown things.”[279] Wiggins cited recent confirmations, made the previous month, of the Martian projections made by Stéphane Javelle (1864-1917) of Nice Observatory (est. 1878). Wiggins deduced that projections of light were certainly some form of signal that the Martians were directing toward Earth.

Wiggins believed that the signals were tied to a distant shared ancestry between humans and Martians. In his August lecture on the topic, as the AP release quoted, Wiggins professed to have “the best scientific evidence to prove that man is a native of Mars and lived there millions of years before he was transplanted to the earth.”[280] The Martians, through light signals, knew of these common origins and were trying to contact their lost relatives (humans). Wiggins explained, “The Martians regard us as their lost brethren and have been searching for us for thousands of years.”[281] Back on Mars,

---

[277] Ibid.

[278] A weather prophet was a person who studied meteorological and atmospheric sciences, but with a special focus on causality and prediction.

[279] “Among the Stars: Prof. Wiggins Discourses Learnedly on Unknown Things,” *Los Angeles Times* (Los Angeles, CA), August 5, 1894.

[280] Ibid.

[281] Ibid.

observers were noticing some changes on Earth that made them optimistic that they would at last make contact: electric lights. Fortunately for the heartbroken yet determined Martian signalers, according to Wiggins, "We [earthlings] will be able to converse with them by signals before another century passes."[282]

The US and Canada were not the only participants in the enthusiasm and anticipation of the idea of communicating with Mars. As Wiggins noted, European observers had also documented the flashing projections coming from Mars (Nice Observatory, for example). In August 1894, a European correspondent for the *New York Times* reported that, due to the sightings of bright lights on Mars, "circumstances are exceptionally favorable to the hypothesis that Martians are trying to signal to us."[283] There existed alternate theories to explain the phenomena, of course, but "scientists appear actually to regard these as less probable than the first explanation [that of signals]." Such diverse and unappealing conjectures included, as the correspondent described, auroras or "forest fires on a gigantic scale."[284] Messages were the most likely interpretation, and by far the most exciting. As the article explained,

> The mere suggestion of such a thing sends a thrill of fascinated expectancy through the whole academic system of Europe, and men of weight are already reviving the old schemes and propounding new ones, by which an effort at sending back an answering signal through space may be made.[285]

The idea of communicating with Mars travelled through scientific circles and popular media across North America and Europe. There seemed a very real sense that Martians

---

[282] Ibid.
[283] "Shining Specks on Mars" *New York Times* (New York, NY), August 5, 1894. "By Commercial Cable from Our Own Correspondent"
[284] Ibid.
[285] Ibid.

not only existed but were, in real time, reaching out across interplanetary space to communicate with humans. Possibly, with the help of recent communication technology, we could answer them.

Electrical engineer William H. Preece (1834-1913) of Wales discussed similar possibilities for wireless communication with Mars, in the forms of both telegraphy and telephony, in a paper he presented at the Society of Arts in London in 1894. The *Los Angeles Times* reported on Preece's presentation, in which he described his recent studies relating to "signaling through space."[286] Preece, a pioneer in the field of telegraphy, spoke of recent experiments in which he was able to transmit wireless signals from an island to the mainland at distances of up to five kilometers using water as a conduit. If water could act as a medium, then why not space, he wondered? Telephoning Mars was another option. As the *LA Times* quoted him,

> If any of the planets be populated with beings like ourselves, having the gift of language and the knowledge to adapt the great forces of nature to their wants…it would be possible for us to hold commune by telephone with the people of Mars.[287]

By 1894, Preece believed, Mars may have already been trying to speak to humans over the phone lines. Preece pointed out that "strange, mysterious sounds are heard on all long telephone lines…especially in the calm stillness of the night."[288] These background noises could have been garbled interplanetary messages.

Some people were not convinced of the impending contact with Mars. In August 1894, an article appeared in the *Los Angeles Times* that argued strongly against the idea

[286] "Telephoning to Mars," *Los Angeles Times* (Los Angeles, CA), May 6, 1894.
[287] Ibid.
[288] Ibid.

of setting up communication with Martians. In fact, it took those who proposed it to task for bringing astronomy "into contempt" and for "imposing on a gullible public."[289] This was especially true, the article noted, of Professor Wiggins. His accounts of interplanetary brotherhood were "absolute twaddle."[290] The anonymous author also implicated Flammarion in engendering such scandal and nonsense, but his crimes against astronomy were of lesser severity than Wiggins because "still he is a scientist."[291] The article ended with a general caution about popular science,

> Astronomy is an interesting science, and it is a good thing to popularize it, as is being done nowadays, but at the same time it is well to draw the line between fact and fiction.[292]

Percival Lowell, who some would have argued was the weaver other Martian fictions, did not advocate for the existence of Martian signals. In fact, he argued against them and presented alternate theories for the bright spots and flashing projections on Mars. December 1900 saw another reemergence of Martian flashes in the news. This time, according to Lowell, the resurgence in signaling theories resulted from a misunderstanding of one of Lowell Observatory's telegrams. In late 1901, Lowell published a paper in the *Proceedings of the American Philosophical Society* called "Explanation of the Supposed Signals from Mars," with a special mention of the sightings made the previous December.[293] It was reprinted in *Popular Astronomy* shortly

---

[289] "The Truth and Fiction of Astronomy," *Los Angeles Times* (Los Angeles, CA), August 8, 1894.
[290] Ibid.
[291] Ibid.
[292] Ibid.
[293] Percival Lowell, "Explanation of the Supposed Signals from Mars of December 7, and 8, 1900," *Popular Astronomy*, Vol. 10: 185-194, 185.

after appearing in the *Proceedings*.[294] In this paper, Lowell sought to clear up misunderstandings and dispel the myths circulating about Martian projections.

During the Martian opposition in the winter of 1900-01, Lowell explained, the "vividness of headline made up for meagerness of news"[295] Lowell staff astronomer Andrew E. Douglass (1867-1962) sent out a telegram announcing the appearance of one of the terminator projections, but "journalistic ingenuity," according to Lowell, transformed the announcement into one of a signal from Mars.[296] Lowell took the opportunity of the false attribution to express his interpretation of the signal issue. Over the course of the 1894 opposition, the observatory's first, Flagstaff recorded over four hundred of the Martian projections. But the opposition of 1900 only presented two. This drastic difference in frequency was revealing, in Lowell's opinion. Terminator projections on the moon, confirmed visually to be caused by mountains, were common sights. But though there had been increasing numbers of cases of Martian projections over the past few years, they still occurred with "some rarity" on Mars.[297] This was especially true when compared to their lunar counterparts. If caused by permanent features, they should occur more regularly, Lowell thought. Furthermore, Lowell did not believe that Mars had mountains because they would have interfered with the linear structure of the canals. Therefore, Lowell deduced that the bright flashes were caused by clouds.

---

[294] Ibid.
[295] Ibid.
[296] Ibid.
[297] Ibid.

Irish astronomer Sir Robert Stawell Ball (1840-1913) was another prominent critic of Martian signals. In March 1901, Ball published an article in London's *Pall Mall Magazine* discussing the impossibility of communication with Mars.[298] This article was reprinted in US magazine *Eclectic Magazine of Foreign Literature.*[299] In June 1901, Ball published another article on the same topic for New York's *The Independent*. Ball was an admirer of Lowell's, noting his "consummate skill and assiduity" in extending research on Martian canals.[300] Though Ball supported the idea of artificial canals and the existence of intelligent life on Mars, he thought signaling back and forth with Martians to be an impossible dream. It was "beyond the power of human resources." He also noted the "utter futility of human endeavor to make any demonstrations on a sufficiently large scale to be perceptible to the inhabitants of Mars." [301]

In November 1901, Ball gave a lecture about Martian signals in Philadelphia and argued much the same premises. The *New York Times* reported on the lecture noting Ball's authority on the subject given his possession of "more honorary degrees and titles of fellowship and membership in learned and astronomical societies than would fill the remainder of this column."[302] According to Ball's Philadelphia lecture, though "everything known points to a race of very intelligent and enterprising people" on Mars, Ball "spoiled a great many pleasant fancies respecting the interchange of messages

[298] Sir Robert S. Ball, "Signalling [sic] to Mars," *The Pall Mall Magazine*, Vol. 23, No. 95 (1901): 76-83.
[299] Reprinted in *Eclectic Magazine of Foreign Literature*, Vol 136, No. 6: 770-778. June 1901.
[300] Sir Robert S. Ball, "Signaling to Mars," *The Independent…Devoted to the Consideration of Politics, Social and Economic Tendencies, History, Literature, and the Arts*, Vol. 53, No. 2740 (1901): 1315-16, 1315. Also see "Signaling Mars Impossible: Sir Robert S. Ball in The Independent" *New York Times* (New York, NY), June 23, 1901. This news article contains excerpts from the paper.
[301] Sir Robert S. Ball, "Signaling to Mars," *The Independent*, 1315.
[302] "No Message from Mars," *New York Times* (New York, NY), November 14, 1901.

between the earth and Mars."[303] He offered an example to illuminate the difficulties of reaching Mars,

> If Lake Superior could be filled with petroleum and set on fire, the resulting blaze might be discerned as a speck of light, but not sufficiently prominent to suggest that anything unusual was in progress.[304]

Messaging Mars was just not feasible. This was not, by Ball's account, because the Martians were not there but because they were simply too far away to see our signals.

In late May 1903, Lowell responded to a telegram from the *New York Herald* asking him for information on more of the supposed signals seen on Mars two days prior. "There is no reason," explained Lowell, "to suppose that is was of the nature of a signal."[305] Lowell repeated his theory that the flashes of light were reflected sunlight bouncing off clouds. "It could not have been an illuminated mountain peak," explained Lowell, because of its quick disappearance.[306] It was, instead a cloud, "travelling slowly northward and dissipating as it went."[307] Vesto Slipher first saw the flashes of light on May 26. He and Lowell observed it that night for thirty-five minutes. It vanished as the planet rotated. The next night Slipher and Lowell looked for it again but could not find it. It's short duration "conclusively proved" that it could not have been caused by a permanent feature like a mountain.[308] The *Herald* reported Lowell's conclusions faithfully but noted that Lowell's explanation "will be a disappointment to those who fondly believe that Mars' supposed inhabitants are in the habit of signaling to us."[309]

---

[303] Ibid.
[304] Ibid.
[305] Percival Lowell to *New York Herald* and *New York World*, May 28, 1903, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[306] Ibid.
[307] Ibid.
[308] Ibid.
[309] "An Immense Light on Mars," *New York Herald* (New York, NY), May 30, 1903.

It may have been true that even lakes of fire were too small to get the attention of observers millions of miles away. It may have been reasonable to guess that the flashes of light seen at the terminator of Mars were the result of light playing on mountains or clouds. But there was still the issue of electronic communication. If, in Lowell's absence, the idea of communicating with Mars needed an advocate capable of making waves in the popular discourse, inventor Nikola Tesla (1856-1943) was the man for the job.

Tesla, according to Tesla, was the first person to receive a message from Mars. It happened atop a mountain peak in Colorado. He described the incident, its significance, and how to go about responding in a February 1901 article for *Collier's Weekly*. The idea of communicating with life on other planets was a very old one, Tesla explained, but it had never been anything more than a "poet's dream."[310] With expanding scientific knowledge and recent technological achievements, the idea had grown, however, "to such a degree that it seems as if it were destined to be the dominating idea of the century that has just begun."[311] But not everyone believed it were possible to communicate with Mars or other planets; some "scoff at the very thought" and still others insist that "it is beyond human power and ingenuity."[312] Tesla believed, however, that it was possible and that he already knew how to go about turning the dream into reality. He would "soon convert the disbelievers."[313]

---

[310] Nikola Tesla, "Talking with the Planets," *Collier's Weekly Journal of Current Events*, Vol. 26, No. 19 (1901): 4-5, 4.
[311] Ibid.
[312] Ibid.
[313] Ibid., 5.

In 1899, Tesla went to the Rocky Mountains to perform electrical experiments relating to wireless energy. In the rarefied air of a summit near Pike's Peak, Colorado "electrical effects and changes were more readily and distinctly perceived."[314] In this way, Tesla's Colorado experiments fit into the model of high elevation as being a benefit to science and an enhancement of scientific credibility. The effects of the remoteness and high altitude were remarkable, as Tesla described. He was able to produce electrical sparks over one hundred feet long and charges up to 110,000 horsepower.[315] The result of these general research achievements, their influence soon to be "before the world" and "felt everywhere," was that wireless messages "over sea or land, to an immense distance" were soon to be available.[316] The massive amounts of power Tesla was able to create in Colorado and their potential for wireless communication meant that making contact with Mars, to Tesla, was a very distinct possibility.

Electric light signals would not work. To produce a light effect of a magnitude visible to Mars would require far too much energy. However, as Tesla described,

> But with the novel means, proposed by myself, I can readily demonstrate that, with an expenditure not exceeding two thousand horse-power, signals can be transmitted to a planet such as Mars with as much exactness and certitude as we now send messages by wire from New York to Philadelphia.[317]

This novel idea, which shows up in much of Tesla's electrical research, was the use of the earth as an electrical conductor. "At the present stage of progress," as Tesla described, "there would be no insurmountable obstacle in constructing a machine capable of

---

[314] Ibid., 4
[315] Ibid.
[316] Ibid., 4-5.
[317] Ibid., 5.

conveying a message to Mars."[318] Once the machine was finished, there would also be no significant obstacle "in recording signals transmitted to us by the inhabitants of that planet" as long as they were also "skilled electricians."[319]

Tesla believed that Martians were, in fact, skilled electricians because he believed he already intercepted messages from them. The messages that he picked up in Colorado were "possibly of incalculable consequences to mankind," though he did not understand their origins at first.[320] He was alone in his laboratory at night when the mysterious vibrations came. At first, these "disturbances" were unexplainable and frightening.[321] They were too precise and regular to be caused by natural electromagnetic interference, like from the sun or atmospheric changes. After some thought, Tesla came to realize that they were actually "intelligently controlled signals" and that he "had been the first to hear the greeting of one planet to another."[322] But what about responding? This, by Tesla's estimation would be difficult but not impossible. He "already found a way of doing it."[323]

Tesla's assertions caused some backlash. His *Collier's* article "Talking with the Planets" was reprinted in the New York magazine *Current Literature* alongside another article "Nonsense About Mars." In the latter article, the editors of *Current Literature* described Tesla's claims as having insufficient evidence: at least, that anyone besides Tesla had seen. It was not the premise that they found unbelievable. "The possibility of life on Mars is not denied," explained the article, "nor is it believed impossible that that

---

[318] Ibid.
[319] Ibid., 5.
[320] Ibid.
[321] Ibid.
[322] Ibid.
[323] Ibid.

life may have attained intelligence akin to human, and that eventually communication may be established."[324] What was without basis was Tesla's claim that he had already received a signal and could ready a machine to make reply. *Scientific American* was equally skeptical of Tesla's latest news about Mars in a January article, appearing before Tesla's complete description of the events in *Collier's*. Though it was not impossible to communicate with Mars through telegraphy, an article entitled "That Message from Mars" asserted that "it will certainly need something more than mere observations of some unexplained electrical impulses on a Colorado mountain" to serve as proof of such possibilities.[325]

The Independent was not as diplomatic about Tesla's announcements regarding Martian messages. Also in January, when news about Tesla's supposed interplanetary communication began to surface, the magazine began its article "Tesla and Mars" with the simple allegation that. "Mr. Nikola Tesla talks too much." Though a gifted experimenter, "he is too fond of publicity." Additionally, the great things that he envisions making and producing, "they do not much materialize." Many people, by 1901, had come to see him as a "newspaper sensation" and the idea that he was in contact with Mars was "not worth considering." [326]

---

[324] "Nonsense about Mars," *Current Literature*, Vol. XXX, No. 3 (1901): 257. The reprinting of Tesla's article appeared on 359-360.
[325] "That Message from Mars," *Scientific American*, Vol. LXXXIV, No. 3 (1901): 34.
[326] "Tesla and Mars" *The Independent…Devoted to the Consideration of Politics, Social and Economic Tendencies, History, Literature, and the Arts*, Vol. 53, No. 2720 (1901): 171.

Spiritualism and Thought Projection

Some astronomers tired of the conversation about the projections on Mars altogether. In January 1901, the same time Tesla began recounting his Colorado research, Flammarion described his frustration with the topic in Paris newspaper *Le Temps*. On January 19, the *San Francisco Call* quoted excerpts from the article. According to Flammarion, the announcement of luminous projections on Mars "has been made nearly every two years for the last fifteen years, and each time the false interpretations made of them have been refuted."[327] Flammarion offered mountains or clouds as equally plausible causes, not deciding between Lowell's and Lick's interpretations.[328] But every opposition year, despite repeated explanations, it started over again because "the public memory is short" and "not everyone reads astronomical works even of the most popular kind."[329]

Though Flammarion did not believe the projections on Mars to be signals, he did believe communication with Mars to be possible through thought projection and spiritual mediums. Flammarion was a prolific author, varying in subjects from astronomy textbooks, science fiction, to spiritualism. An 1892 article in the *New York Times* satirizing the debate over life on Mars described Flammarion as "almost as fond of

---

[327] "No Signals Sent from Ruddy Mars," *San Francisco Call*, Vol. 87, No. 50, 6.
[328] Flammarion wrote to the ASP in 1894 showing tentative support for the mountain hypothesis. See Camille Flammarion "Extract from a Letter from M. Flammarion Relative to the Eclipse Comet of 1893, and to Bright Projections on the Terminator of Mars," *Publications of the Astronomical Society of the Pacific*, Vol. 6, No. 38 (1894): 289.
[329] "No Signal from Ruddy Mars," 6.

getting into print as he is the science of astronomy."[330] He was also almost as fond of psychical research and spiritualism as he was of the science of astronomy.

Like many people in the nineteenth and early-twentieth centuries, Flammarion thought psychical research to be a legitimate science, just as real as physics or astronomy.[331] As Flammarion noted, "we live in the center of an invisible world" that connected multiple forms of energy, some known and some unknown.[332] In his opinion, psychical theories were subject to the same scientific methods and rigors as all other topics and must be investigated "freely, in full liberty of conscience."[333] Thought waves were no different than electromagnetism, light, sound, telegraphy, or photography.[334] These phenomena were all unknown or unexplained at one point. According to Flammarion, "if blind credulity is deplorable, systematic incredulity and skepticism are no less opposed to the onward march of progress."[335] There must be a balance between skepticism and open-mindedness, and psychical research helped to bridge that gap.

Flammarion believed that human, and perhaps extraterrestrial, thought waves could travel through space. In 1891, he wrote in popular Boston magazine *The Arena*,

> The human soul would seem to be a spiritual substance, endowed with psychical force, capable of acting outside bodily limits. This force, like all others, may be transmissible into the form of electricity or heat, or may be capable of bringing

---

[330] "The Folks on Mars," *New York Times* (New York, NY), August 7, 1892.
[331] There are many books about spiritualism and the Society for Psychical Research. A few that deal with the themes of scientific methodology are Roy Wallis, *On the Margins of Science: The Social Construction of Rejected Knowledge*, (Keele, UK: University of Keele Press, 1979); Renée Haynes, *The Society for Psychical Research 1882-1982: A History*, (London: Macdonald, 1982); John J. Cerullo, *The Secularization of the Soul: Psychical Research in Modern Britain*, (Philadelphia: Institute for the Study of Human Issues, 1982); Jeffrey J. Kripal, *Authors of the Impossible: The Paranormal and the Sacred*, (Chicago: Chicago University Press, 2011).
[332] Camille Flammarion, *Death and Its Mystery: At the Moment of Death*, trans. by Latrobe Carroll (New York: The Century Co., 1922), 10. French edition published 1921. This is the second part of a three-part series,
[333] Ibid., 3
[334] Ibid., 37.
[335] Ibid., 296.

> into activity certain latent energies while it yet remains intimately united with our mental being.[336]

Intelligence, or thought, to Flammarion was the third ingredient in the recipe of the cosmos - added to matter and force to create reality as we understand it. Astral projection and the transmission of thought waves were just examples of the physical properties of intelligence. Other examples included "magnetism, hypnotism, suggestion, telepathy."[337] Thoughts moved in vibrations, Flammarion posited, and the transmission of thought worked much the same way as a telegraph. Thoughts travelled through the ether "through a series of vibrations as yet unknown to us" and reassembled when they came into contact with another brain.[338] There did not seem to be any limit to the distance that disembodied thought could travel. Therefore, according to Flammarion,

> It requires but one step more for the admission that psychical communications may be established between an inhabitant of Mars and an inhabitant of the earth.[339]

That additional step was the assumption that Martians were capable of sending and receiving the same psychical transmissions as humans. This ability could not only be possible, but innate for Martians. As Flammarion described, if human hearing could extend beyond simple sound waves into other types of energy "we should hear those voices from space, this ethereal music" and "all of the unknown forces with which we are here concerned would seem natural."[340] Perhaps Martians evolved with a more extensive sense of hearing and were capable of discerning thought waves.

---

[336] Camille Flammarion, "The Unknown: Part II," *The Arena*, No. XX (1891): 160. Translated by G.H.A. Meyer and J. Henry Wiggin from Flammarion's manuscript for publication in the magazine.
[337] Ibid., 166.
[338] Ibid., 168.
[339] Ibid., 168-9.
[340] Flammarion, *Death and Its Mystery*, 10.

This idea of communication through thought projection, or what Flammarion called “psychical transmissions by ether waves,” repeated in much of Flammarion’s writing.[341] It was not limited to his works on spiritualism, of which there were many, but also appeared in his popular astronomy texts. Flammarion’s 1904 book *Astronomy for Amateurs* asked, “Where is the mind that is not attracted to these enigmas?” [342] In this case, he was referring to the science of astronomy. The two fields, astronomy and psychical research, however, were very intimately related in Flammarion’s view. Flammarion asked his readers,

> Innumerable worlds! We dream of them. Who can say that their unknown inhabitants do not think of us in their turn, and that Space may not be traversed by waves of thought, as it is by the vibrations of light and universal gravitation?[343]

Mars, according to Flammarion’s account in this popular text, was a “very living world” with a population that was older and likely more advanced than humans. Their gravity was low and their air thin, so the beings were likely “more delicate, more ethereal” and the climate milder and more “congenial” than Earth. [344]

To those who wondered if humans should ever be able to speak to these wise ethereal entities, Flammarion reassured, “There is no despair of entering some day into communication with these unknown beings.”[345] To do so was “no more audacious and no less scientific that the invention of spectral analysis, X-rays, or wireless telegraphy.”[346] Flammarion was not the only person to suggest thought communication. In 1892, when

---

[341] Ibid., 242.
[342] Camille Flammarion, *Astronomy for Amateurs*, trans. by Frances A. Welby (New York: D Appleton and Company, 1904), 2. The French edition was titled *Astronomy for Women*, 1903.
[343] Ibid., 24.
[344] Ibid., 141.
[345] Ibid., 142.
[346] Ibid.

discussing the likelihood of reaching mars through telegraph, Arthur Vaughan Abbott noted thought projection as another means by which communication with Mars could be accomplished. "It is now suspected that each brain is the seat or centre of thought waves," Abbott described, "which some invention of the future may seize and perpetuate, even as the phonograph records the sound waves of speech."[347] Abbott shared the same view that thought waves were discrete entities or forces and that technology could, as some point, develop in such a way that would allow people to harness them.

In his article "Mars and the Paranormal," literary scholar Robert Crossley investigates the connection between astronomy and astral projection in the work of Flammarion and some of his contemporaries. Crossley notes the example of *Urania* (1889), one of Flammarion's science fiction stories. In addition to being fiction, however, Urania contains distinct elements of both autobiography and popular science. In *Urania*, Flammarion took a telepathic trip to Mars, but he claimed special scientific authority, as a Mars expert, for the descriptions of what he found there.[348] Also in this work, Flammarion articulated the connection he saw between the sciences of the mind and of the universe, noting that "astronomy and psychology are indissolubly connected"[349]

In another instance of telepathic Mars travel, a Swiss psychic, who went by the name Hélène Smith, reported her mental travels to Mars in astonishing detail.[350] This

---

[347] Arthur Vaughn Abbott, "Our Neighbor Mars," 28.
[348] Robert Crossley, "Mars and the Paranormal," *Science Fiction Studies*, Vol. 35, No. 3 (2008): 466-484, 470.
[349] Camille Flammarion, *Urania*, trans. Mary J. Serrano (New York: Cassell, 1890), 161. Quoted Crossley, 471.
[350] Carl Jung later used Hélène Smith as a case study in multiple personalities and wrote a preface to a later edition of *From India to the Planet Mars*. Jung met Flournoy as a student.

account, however, was not framed as a fictional story but was a case study for the phenomena of thought projection and seances from the gaze of a psychologist, Theodore Flournoy (1854-1920). Flournoy's book, *From India to the Planet Mars* (1899) was, according to Crossley, "the most celebrated instance of the intersection between Mars and the paranormal" during this period.[351] The story began when Flournoy, a psychical researcher as well as a psychology professor at the University of Geneva, attended a séance with the young woman whom he gave the alias Mlle. Smith. He was intrigued by her purported abilities and continued to investigate them.

Mlle. Smith honed her talents during the time Flournoy knew her and, with practice, developed the ability to travel to India, and then to Mars, from the comfort of her sitting room. While visiting the latter, through psychic trance, she noted the makeup of the world, the character of its inhabitants, and became fluent in the Martian language – both written and verbal. In the beginning of his description of Mlle. Smith's travels to Mars, what he called her Martian Cycle, Flournoy quoted one of Flammarion's most popular astronomical works, *The Planet Mars* (1892). According to the quotation,

> We dare to hope that the day will come when scientific methods yet unknown to us will give us direct evidences of the existence of the inhabitants of other worlds, and at the same time, also, will put us in communication with our brothers in space.[352]

Flournoy came to the conclusion that Smith's astral travels and spirit-channeling had psychological rather than paranormal causes (he called it a form of somnambulism). But this context was not always repeated in the discussion of the Smith story. According to

---

[351] Crossley, "Mars and the Paranormal," 468.
[352] Camille Flammarion, *La Planète Mars et Ses Conditions D'habitabilité*, (Paris, 1892), 3. Quoted Flournoy, 140.

the *New York Times*, Flournoy was called upon by supporters of psychic theory in "long extracts" which "robbed of their context, would go far toward establishing the actuality of spiritualism."[353] Flournoy's theories were not as salacious as the story itself: a young woman (Flournoy described her as quite beautiful) who could travel through space and, on occasion, call upon the spirit of Marie Antoinette as well.[354]

The use of psychic power to contact Mars was a recurring theme in the conversation about Martian communication. In 1909, during another period in which the topic of signals was all the rage, another medium who called herself Princess D'Antuni claimed to have the ability to contact Mars. D'Antuni told the *Los Angeles Times* that various schemes for signaling Mars with light or mirrors were "of no practical use."[355] Wireless telegraphy was a possibility. But spiritual methods were, in her opinion, "the best and safest option." Without the use of psychics, Martian communication would lag and its possibilities remain unachieved. Not only this, but "until spiritualism is recognized as a science many problems which baffle mankind will remain unsolved."[356]

Flammarion was also a séance enthusiast and would have agreed with D'Antuni's sentiment about the legitimacy of psychic research. In 1897, he reported to *The Arena* of a séance that he had recently attended with Italian medium Eusapia Palladino (1854-1918). Flammarion had wanted to write about the experience sooner but was held up by "the astronomical labors which constantly absorb my time."[357] The session he attended,

---

[353] "Mlle. Smith, Medium," *New York Times* (New York, NY) August 18, 1900.
[354] Ibid.
[355] "Spirits May Talk to Mars," *Los Angeles Times* (Los Angeles, CA) May 6, 1909. Advertised as a "Direct wire to the Times" and as an "Exclusive Dispatch"
[356] Ibid.
[357] Camille Flammarion, "A Séance with Eusapia Paladino: Psychic Forces," *The Arena*, Vol XVIII, No. 97 (1897): 730.

he made certain to point out, was carried out under the “strictest test conditions.” Flammarion would have known, given that “during the past thirty years or thereabouts, I have studied nearly all the mediums whose manifestations have made the greatest noise in the world.”[358] Flammarion, however, was not the only astronomer, nor even the only Mars expert involved in the case of this particular medium. By the time Flammarion called on her, she had already been submitted to the scrutiny of other scientists. One of those researchers was Giovanni Schiaparelli, who had initially written to Flammarion to inform him about Palladino’s case.[359]

It was not unusual for astronomers to be involved in psychical research. In 1923, after many years of experience, Flammarion would become the president of the International Society for Psychical Research.[360] Simon Newcomb of the US Naval Observatory was the first president of the American chapter of the Society for Psychical Research when it opened in New York in 1885.[361] Lowell was also involved in psychical research for a relatively brief period before beginning his career in astronomy.

In 1894, while planning his observatory, Lowell published *Occult Japan*, in which he investigated mesmerism and possession in Japanese culture and Shinto religious practices. Lowell biographer David Strauss discusses this “brief foray into psychical research” as a precursor to Lowell’s style of doing science. [362] Lowell approached his

---

[358] Ibid.
[359] Ibid., 732.
[360] Crossley, “Mars and the Paranormal,” 467.
[361] Newcomb supported the notion that psychical topics required scientific investigation, but was not a believer in any of the psychical phenomena that the SPR investigated. See Albert E. Moyer, *A Scientist’s Voice in American Culture: Simon Newcomb and the Rhetoric of Scientific Method*, (Berkeley: University of California Press, 1992), Chapter X.
[362] David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin*, (Cambridge, MA: Harvard University Press, 2001), 133.

study of trances, Strauss argues, in much the same way he approached his study of Mars. Lowell's interview practices were questionable. He met with his interviewees as a group, not individually, and did not spend much time with them.[363] He also held some very Western-centric views about the importance and meaning of the trance rituals that he studied, so much so that other nineteenth-century upper-class white men were put off by the racist subtexts. As Strauss described, psychical researchers who read Lowell's work were "disturbed by Lowell's insistence on using his investigations of occult practices to confirm Japan's ranking as a civilization below that of Western countries."[364] Mainstream scientists and researchers did not agree with Lowell's views or approaches. They also had significant "doubts about the validity of his results."[365]

But this did not stop Lowell, just as it would later prove no barrier to his Martian theories. In writing *Occult Japan* for a popular audience, he stepped around rather than into the discourses of professional anthropology, history, or psychical research. He also conducted his research in such a way that he sought to prove existing theories, Strauss points out, rather than develop theories from the information gathered.[366] He would follow this pattern again when it came to his quest to prove the existence of life on Mars.

Flammarion and Lowell were close friends and colleagues and they corresponded regularly. Upon returning to Massachusetts from his occult research in Japan, in the winter of 1893, Lowell received Flammarion's *The Planet Mars* (1892) as a Christmas gift.[367] It was a huge influence on his decision to build an observatory, that following

[363] Ibid., 150.
[364] Ibid., 134.
[365] Ibid., 133.
[366] Ibid., 150.
[367] Sheehan, *Planets and Perception*, 167.

Spring, to study Mars. Lowell sometimes addressed his letters to Flammarion as "My friend and colleague" and sometimes as "My dear Martian." Over the years, Flammarion was one of the first people to whom Lowell wrote when he experienced a breakthrough of some kind. One instance occurred in February 1908 when Lowell wrote to Flammarion to announce that Slipher had been successful in capturing a spectral reading of water vapor on Mars.[368] Lowell saw Flammarion as an ally and a kindred spirit. In 1907, Lowell sent Flammarion copies of the photographs that Lampland made of Mars. Lowell celebrated in the new evidence, noting that the markings on the planet were "well linear" and that "even the skeptics could not misunderstand."[369] Flammarion was certainly no skeptic. In rare instances, Lowell expressed so much faith in Flammarion's dedication to canal theory that he asked Flammarion to reassure him. He confided in his friend, asking him to "tell me that it is not me who makes the lines on Mars, that it's the Martians."[370]

Mirrors and Balloons

In the years between 1890 and 1908, reports of flashes and projections on the surface of Mars appeared sporadically in the news. Each opposition year differed in its enthusiasm for contacting Martians. Much like the discussion of canals, the topic of Martian signaling experienced ebbs and flows in publicity. During the years of 1908-09,

---

[368] Percival Lowell to Camille Flammarion, February 25, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Translated from French by author.
[369] Percival Lowell to Camille Flammarion, August 28, 1907, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Translated from French by author.
[370] Percival Lowell to Camille Flammarion, January 30, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Translated from French by author.

a peak year for such coverage, Martian communication was a prominent element of the public discourse.

The idea to use mirrors to signal Mars was not new in 1909, but William H. Pickering gave the suggestion new life leading up to that year's opposition.[371] This happened despite Pickering's own misgivings on the worthiness of such an endeavor. Pickering did not think the method of constructing mirrors to use as interplanetary communication to be without merit, but that it was prohibitively expensive and potentially a waste of time. He described his preliminary plan to *Popular Mechan*ics. It involved, along with motors and encasements, the making of 2500 mirrors to span a quarter of a mile.[372] This, along with labor costs and the necessary land, would cost, Pickering estimated, about ten million dollars. As the *Popular Mechanics* article described, Pickering was "among those who seriously doubt that there are any living beings on Mars."[373] What he believed was that, if anyone were to go through with an attempt to contact Mars, "his scheme of sending messages is the one practical way."[374] "The question of the number of mirrors necessary for sending this flash," Pickering explained, "is a simple matter of astronomical calculation which any astronomer can figure out in five minutes." But Pickering did not believe anyone would put up that kind of money to flash Mars.

But some did take Pickering's proposal seriously. The nuance of his argument was lost in its repetition. The *Los Angeles Times* reported, "communication with

---

[371] Robert Crossley, *Imagining Mars: A Literary History*, (Middleton, CT: Wesleyan University Press, 2011), 101.
[372] "The Scheme to Signal Mars," *Popular Mechanics*, Vol. 12, No. 1 (1909): 10.
[373] Ibid.
[374] Ibid.

Martians will be made possible…by adopting his [Pickering's] method of flashing messages."[375] If the money could be found, according to "Harvard University's celebrated astronomer," the mysteries of Mars would soon become "an open book."[376]

When Pickering assumed that no one would be willing to spend ten million dollars on something that was very large and potentially of no real use, he did not count on potential funders in Texas. Two newspapers in Fort Worth, Texas, *The Star* and *The Telegram*, reached out to Pickering via telegram and offered to join forces to raise the necessary funds for Pickering's mirror machine if he were to build it in Texas.[377] Pickering told the *New York Times* that he would go through with the construction but "would advise those who made the offer to wait until additional and more conclusive evidence as to the inhabitation of Mars had been secured…before spending so large a sum." As he noted in an article from two days earlier, "It would be much better to spend such a sum on an observatory."[378]

Leading up the 1909 opposition, David Peck Todd of Amherst, director of the Lowell Expedition to the Andes (1907), made plans to retrieve signals from Mars in a hot air balloon. He scheduled the intrepid experiment for September, but began planning during the spring and summer. On May 1, 1909 the *New York Times* announced,

> Prof. David Todd of Amherst does not believe it absurd to plan for communication with other worlds, and in an attempt to get signals from Mars will ascend in a balloon to a height greater than usually reached."[379]

[375] "We May Talk to Mars, Says Prof. Pickering," *Los Angeles Times* (Los Angeles, CA), April 19, 1909.
[376] Ibid.
[377] "Offer Money to Signal Mars," *New York Times* (New York, NY), April 27, 1909.
[378] "Pickering's Idea for Signaling Mars" *New York Times* (New York, NY), April 25, 1909.
[379] "Signals Mars from a Balloon," *New York Times* (New York, NY), May 1, 1909.

According to the article, Todd had enlisted the help of leading balloonist (or aeronaut) Leo Stevens (1877-1944) to operate the balloon while Todd attempted to make contact with Mars. Todd explained to the press that his plan sought to right a terrible wrong. Humans had terrible manners,

> If life really exists on Mars, they have been trying for years to get into conversation with us, and perhaps wonder what manner of stupid things we are not to respond.[380]

To be sure, Todd did not want to get carried away with what he could accomplish on a single balloon trip. "We cannot presume," Todd explained, "to send messages to Mars on this coming trip, but will only try to receive."[381] That would, however, be an important first step.

Todd and Stevens planned to go up five miles into the air, a very high altitude for the time. But what was the purpose of this ascension? Would five miles really make a difference when picking up transmissions from a planet at least thirty-five million miles away? Todd believed that reaching a higher altitude would allow him and his partner to escape the ether interference on earth's surface and get a clearer, less adulterated signal. There would be no background interference at that height. "I have thought that we may feel their presence if we could get high enough up,"[382] Todd explained to the press, "away from the noises and the ether waves that surround us, up in the rarefied regions of our atmosphere with nothing to disturb the communication."[383] In this way, Todd, already a believer in the notion of atmosphere as authority through is involvement in the

---

[380] Ibid.
[381] Ibid.
[382] Ibid.
[383] Ibid.

Lowell Expedition to the Andes (1907), offered yet another claim that high elevation served as a valuable aid in scientific research.

Todd had given a lot of thought to how he was going to be able to accomplish such a dangerous and potentially life-threatening experiment. To escape the perils of high altitude, Todd and Stevens would be "shut into a metal box made of aluminum" and have a pump regulating the air pressure and flow of gases.[384] This device would be very similar, in fact, to a makeshift hyperbaric chamber that Todd constructed during the Andes expedition to help with elevation sickness.[385] In the balloon basket would also be a standard wireless receiver, but they had not quite worked out how they would ground the device in order to establish a connection. Perhaps a "thousand-foot wire hanging from the car" would suffice.[386] In the end, they would do whatever was "practicable" at the time.[387]

Many people, in addition to Leo Stevens, wanted to help Todd with his project. The Aero Club of New England offered up the use of their newest balloon for Todd to use in his Mars experiment.[388] Charles Jasper Glidden (1857-1927), a skilled telegrapher and the first person to drive around the world in a car, also offered his services to the cause – perhaps to run the telegraph equipment or perhaps to drive the ground-wire car.[389]

---

384 Ibid.
385 "Something Like Human Intelligence on Mars," *New York Times* (New York, NY), October 27, 1907. In this article, Todd speaks to the NYT about the expedition and describes the device that he constructed for elevation sickness.
386 "Signals Mars from a Balloon"
387 Ibid.
388 "Offer Balloon to Todd," *New York Times* (New York, NY), May 7, 1909.
389 Ibid. Perhaps this would have been the first instance of "ground control."

Conclusion: Signals and Seances

Beginning in the late nineteenth century and continuing into the twentieth, there existed significant public and scientific discourse about contacting and communicating with Mars. The debate began appearing in newspapers and scientific magazines after Schiaparelli's maps in 1877 but before the founding of Lowell Observatory. Unlike the canals, the origins of the Martian communication controversy can be traced back to Lick Observatory and the projections that Lick astronomers saw at the terminator of Mars in 1890. While these observations began the conversation about contacting Mars, over time the topic took on new elements. This was especially true when light signals stopped being the focus of discussion and new modes of communication were introduced: especially telegraphy and thought projection.

The signals from Mars are a lesser-known element of the Martian furor, and a part in which Percival Lowell played a very small role. The idea of signaling back and forth between planets, or contacting Martians by other means, was related to the canal controversy but not a consequence of it. The two discourses shared common themes of scientific legitimacy through elevation and atmosphere, criticism over lack of evidence, and the importance of popular publications to perpetuate ideas not accepted by mainstream science. Subjects of public science communication and media coverage emerged as equally important in the topic of interplanetary contact as it did in the discussion of canals. The different ideas for contacting Mars were subject to sensationalism in the press, but also dependent upon public interest to remain viable.

But Martian communication was also a separate issue with separate themes, interests, events, and people involved. Supporters of contacting Mars, like Flammarion, Todd, Tesla, and others, justified their beliefs and expertise in several different ways than did those involved in the canal controversy. This was especially true in their perpetuation of the promise of technology. One of the main participants in the Martian signaling controversy, Nikola Tesla, was in fact very annoyed by the continued discussion of communication methods. This was especially true of the mirror method, which he found to be completely impossible. After all, he had already solved the problem early on during his experiments in Colorado. That solution was a very large wireless transmitter which, by 1909, he had still not gotten around to building. That year, Tesla wrote a letter to the editor of the New York Times rehashing the issue. In a testament to the power of technology, Tesla noted, "Civilized existence rests on the development of the mechanical arts."[390] It was these mechanical arts that provided him with proof, he believed, in life on other planets. The so-called canals did no such thing. According to Tesla, "The straightness of the canals, which has been held out as a convincing indication to this effect [life on Mars], is not at all such."[391] Instead, he based his "faith" on the "feeble planetary disturbances which I discovered in the Summer of 1899."[392] He could, he believed, eventually "make the whole earth loudly repeat a word spoken in the telephone."[393]

---

[390] Nikola Tesla, "How to Signal Mars," *New York Times* (New York, NY), May 23, 1909.
[391] Ibid.
[392] Ibid.
[393] Ibid.

Chapter Four

Elevation Showdown

"Learned professors on the planet Mars, after careful scrutiny of Earth, have just decided that the Earth cannot contain intelligent creatures."[394] This satirical announcement was published in *The Oregonian* in February 1908. Some of the reasons for the nonexistence of life on Earth, according to Martian researchers, were the crippling effects of Earth's gravity and the overabundance of wind, tides, and violent storms. Also among the reasons that Earth proved an inhospitable environment was its over-dense atmosphere. It had far too much water vapor. To the Martians, water only existed "in solid state and is fit only for medicinal purposes."[395] At the levels the earth's atmosphere held, it would surely suffocate any living thing.

In 1908-09, the existence of water vapor on Mars became the topic of a high-altitude scientific debate between Lowell and Lick Observatories. Lowell and his staff argued that spectroscopic analysis proved the presence of water vapor in the Martian atmosphere. Lick Observatory maintained that the spectral data instead showed that there was none. By the end of 1909, each observatory had gone to great lengths, or in this case heights, to prove its interpretation as the correct one. For Lowell, the nonexistence of water vapor in the Martian spectrum would have been a terrible blow to his theories of an inhabited Mars. Lick, on the other hand, very much wanted to be the ones to strike that blow and to rein in the Mars craze.

[394] "Is Earth Inhabited?" *The Oregonian* (Portland, OR) Feb 2, 1908
[395] Ibid.

More was at stake than having the most accurate spectral reading of Mars. The competition over Martian spectra was the climax to a battle for the power to create popular science. Lowell's heavy public involvement had changed the parameters of the canal debate to be one that was fought outside the confines of academic and professional science. Though critics of life on Mars had more reasoned arguments and clearer evidence, the consensus of professional astronomers failed to put an end to the popular discourse. Attempts to publish counter-arguments against Lowell and his theories, even in popular magazines, had fallen on deaf ears as the American public continued to eat up news of Martians. Professional astronomers, in attempt to wrest power away from Flammarion, Lowell, and other popular scientists who supported life on Mars, decided to meet them on their own terms. This was especially true of Campbell and Lick Observatory. To appeal to the standards that Lowell had set for the debate over life on Mars – rugged environments, adventure, publicity – Campbell planned for a mountain expedition. In the years 1908 and 1909, the existence or nonexistence of water vapor in the Mars spectrum became an issue of direct competition between Lowell and Lick Observatories, already at odds with each other for several years, which escalated into a sort of high-elevation showdown for control over popular astronomy.

Recording the Martian Spectrum

The first decades of planetary spectroscopy left a lot of room for interpretation and error on the part of the observer. Before 1895, observations were made visually rather than photographically. This was an important difference. Early astronomical spectroscopes attached to the eyepiece of the telescope, allowing the observer to look through the spectroscope's eyepiece rather than the telescope's. Inside the spectroscope was a diffraction grating that separated the light that came through the telescope's objective into a spectrum with distinctive and recognizable lines. These lines, used to identify elements based on their patterns, are often referred to as either Fraunhoffer lines, for the absorption spectrum, or Kirchhoff lines for the emission spectrum. Because there were not yet means by which to record the spectra mechanically, astronomers looked through the spectroscopes and rendered the line patterns by hand. In other words, they had to draw the spectra of the objects that they were seeing in real-time.

To further complicate the process, recording the spectrum of the Martian atmosphere, or that of any planet, meant that observers needed to record two sets of spectral data. They needed the spectrum of Mars, of course. They also needed a way to remove the effects of the earth's atmosphere on that spectrum. The path of light coming from Mars to a telescope on the surface of Earth travelled through Earth's upper spheres and, therefore, showed the contents of the terrestrial atmosphere as well as that of Mars. When looking at the spectrum of Mars, spectroscopists were really looking at the spectrum of both Earth and Mars.

The spectrum of the moon, because it has no atmosphere, served as a valuable tool for separating the two. The lunar spectrum captured from Earth's surface revealed only the contents of the Earth's atmosphere, through which the moonlight also must pass. But there was no lunar atmosphere to pass through. It therefore could be subtracted from the Martian spectrum as a fair representation of the terrestrial effect. This process required that the spectrum of each, Mars and the Moon, be taken when the two were in similar positions in the night sky and as close as possible to the same time. Atmospheric conditions change over the course of an observation period, sometimes slightly but sometimes quite drastically.

Though this was a very valuable trick to eliminate the effect of Earth's atmosphere, it meant that astronomers had to draw two spectra by hand in quick sucession and then compare the two drawings, subtracting one from the other. At times, drawing was too slow of a process and all the observer could do was, according to spectroscopy pioneer Vesto Slipher (1875-1969) of Lowell Observatory, "compare the mental image of the spectrum of the one with the spectrum of the other."[396] The entire process of visual planetary spectroscopy relied on a great deal on the eyesight, measuring ability, drawing skills, and interpretation of the practitioner.

Because of these inherent complications, it became of supreme importance to take these lunar and planetary readings under conditions that minimized the contents of Earth's atmosphere. Having lesser amounts of terrestrial contents, especially water vapor, made it easier to compare Mars and the moon and offered more precise measurements. Planetary spectroscopy was easiest and most effective in places with dry, thin air. As a result, atmospheric conditions of the observation site immediately became an important factor in obtaining the best results. Lowell must have been elated by this development. The issues of atmosphere and elevation entered into the debate over the contents of the Martian atmosphere more heavily than at any other point in the discourse

[396] V.M Slipher, "The Spectrum of Mars," *Astrophysical Journal,* 28 (1908), 398.

about life on Mars. Environmental conditions at the observation site became a major source of legitimacy for the spectra those observations produced.[397]

Lick Observatory atop Mount Hamilton near San Jose, CA produced the first photographs of the Mars spectrum 1894-5. [398] These and Lick's subsequent photographic series, taken by Director Campbell and staff astronomer James E. Keeler (1857-1900) over the next two years, came to be generally accepted as the standard for the professional community. Several prior visual spectra of Mars, made at Lick and elsewhere without the aid of photographic plates, indicated small amounts of oxygen and water vapor. There was no question within professional astronomy that having photographs to compare rather than the drawings or memories of astronomers was a much more reliable method. Therefore, these prior visual results were largely dismissed. The new Lick photographic series indicated no difference between the Martian and lunar spectrum, meaning no atmosphere at all. [399] But, of course, it was still difficult to be sure. Even with the addition of photographic technology, analyzing the spectrum of Mars still required the laborious process of eliminating terrestrial elements through comparison with the moon.

The photographic process also still relied on securing readings with the lowest amount of terrestrial interference. Dry, thin air was still important. Later, Campbell would outline the necessary conditions for a clear Martian spectrum,

---

[397] For more on elevation and other environmental conditions as scientific legitimacy see K. Maria D. Lane, "Astronomers at Altitude: Mountain Geography and the Cultivation of Scientific Legitimacy" in Denis E. Cosgrove and Veronica Della Dora (eds.), *High Places: Cultural Geographies of Mountains and Ice*, (London: I.B Tauris, 2008).
[398] W.W. Campbell, "Concerning an Atmosphere on Mars," *Publications of the Astronomical Society of the Pacific*, Vol. 6, No. 38 (1894): 273-283.
[399] Ibid. See also Edward S. Holden, "The Latest News of Mars," *The North American Review*, Vol 160, No. 462 (1895): 636-638.

> To hope for success, the observations should be made from a high-altitude station, at times when the overlying air strata carry a minimum of water vapor, and when the planet is as near the zenith as practicable; observing the lunar spectrum, under identical conditions, for comparison.[400]

There existed a lot of variables to account for and a multitude of interpretations. Additionally, of course, the technology of adding photographic plates to astronomical spectroscopes and processing the plates to produce very fine and very precise spectral lines was in its infancy.

In 1904-1905, Slipher, using photographic techniques, obtained negative results for water vapor on Mars. Like Campbell and Keeler at Lick, Slipher's first attempts at spectral photography produced photographs of the Mars spectrum that showed water vapor to be absent in the Martian atmosphere. But he complained of the data he used, calling it "difficult, uncertain, and discordant."[401] He made it clear that, though he now reported a lack of water vapor, "the conclusion should not be drawn that it does not exist."[402] Slipher believed that water vapor existed on Mars and was not ready to dismiss the earlier visual accounts as without merit. He was determined to prove spectroscopically that the Martian atmosphere contained water. As Hoyt describes his dedication to Martian water vapor, Slipher "was willing to concede only technological defeat, and this only temporarily"[403]

From 1905-1908, Slipher tinkered with spectrographic equipment, photographic plates, and chemical baths in order to improve the sensitivity and accuracy of spectral

---

[400] W.W. Campbell and Sebastian Albrecht "On the Spectrum of Mars as Photographed with High Dispersion" *Science*, Vol 31, No. 808 (1910): 990-992, 991.
[401] V.M. Slipher, "An Attempt to Apply Velocity-Shift to Detecting Atmospheric Lines in the Spectrum of Mars," *Lowell Observatory Bulletin*, 17 (1905) in *Bulletins of the Lowell Observatory*, Vol. 1 (Flagstaff, AZ: Lowell Observatory, 1911), 118.
[402] Ibid.
[403] William Graves Hoyt, *Lowell and Mars* (Tucson: University of Arizona Press, 1976), 139.

photographs. The lines for water vapor show up in the yellow region of the spectrum. So Slipher began using yellow tinting on the glass plates he used to process the photographs that the spectroscope's camera produced. He also found a mixture of chemicals that made the black spectral lines sharper in the image. Because of these techniques, worked out through trial and error, Slipher was able to capture clearer lines in the Martian spectrum in the region where water vapor presents itself. He was even able to capture a line in the water vapor region that did not show up at all in the Lick spectrum. He called this line the little *a* band.

These accomplishments and improvements in technique were even more impressive given that Slipher was mostly self-taught in spectral research. In December of 1901, his first year at Flagstaff, Slipher asked Lowell's permission to go visit Lick and learn from Campbell and the rest of the staff. The spectrograph at Lowell Observatory was modeled after the one at Lick and the staff had significantly more hands-on experience in operating it.

Lowell, because of the criticism that Lick had directed to him and his theories since he began his career in astronomy, did not like the idea of asking Lick for help. In reply to Slipher's request, Lowell made it known that Slipher should only go to Lick after he had "learnt [sic] all about the spectroscope and can give as much as you take."[404] He did not want the request to seem as though Slipher needed Lick's help, giving them power and perhaps the ability to publicize the exchange in a way that enhanced their research claims. Lick Observatory, after all, produced the spectral analysis of Mars (with

[404] Percival Lowell to Vesto M. Slipher, Dec. 18, 1901. *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Also quoted Hoyt 132.

no water vapor) that Slipher and Lowell were attempting to refute. After Slipher had taught himself how to use specialized astrophysical and photographic equipment, Lowell would then reconsider and be "very glad" for Slipher to visit Mount Hamilton.[405] A couple of weeks later, elaborating on the issue, Lowell noted his pleasure at Slipher's following his recommendations,

> I am glad the postponing of your desired trip to the Lick commends itself to you. You are quite right in supposing that everybody encounters the same snags; the only difference being the clever ones contrive to get over them themselves whereas the stupid ones have to have recourse to others.[406]

For several years, Slipher and Campbell did keep up a hearty correspondence about technical issues having to do with spectroscopic research. As late as December 28, 1906 Campbell wrote to Slipher to give advice on the best place to take some spectrograph prisms for repair.[407] The relationship became less amiable and more formal surrounding the *Outlook* articles of 1907-08.[408] But after that episode, their professional relationship rebounded and they kept up correspondence long after the water vapor showdown, after Slipher took over the directorship of Lowell Observatory.

In February 1908, Slipher got the results that he had been wanting. He produced spectrographs that he believed showed a relatively small but measurable amount of water vapor in the Martian atmosphere. Thereafter, Lowell wasted no time getting news of the discovery to the reading public, this time circumventing Edward Pickering and HCO altogether. At the time Slipher rendered the spectrographs, Lowell was in Boston.

---

[405] Ibid.

[406] Percival Lowell to Vesto M. Slipher, Jan. 4, 1902, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Also quoted Hoyt 133-4.

[407] William Wallace Campbell to Vesto M. Slipher, Dec. 28, 1906, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

[408] Discussing the relative powers of the telescopes at Lick and Lowell Observatories.

Slipher wrote to Lowell to inform him that he had produced spectra that showed water vapor and sent along negatives for Lowell to inspect. On February 25, 1908 Lowell went straight to the Associated Press, not Harvard, with news of the discovery of water vapor on Mars.[409] Relations between Lowell and HCO had already disintegrated because of disagreements over the ways that HCO distributed news in the field of astronomy.[410] Lowell had fresh new evidence supporting the existence of Martian canals and he wanted to get the information in the hands of the reading public as soon as possible and, no doubt, with as little Pickering involvement as possible.

In April 1908, Slipher sent Campbell prints of the spectra that he produced of other planets but, perhaps wanting to stave off controversy, did not include the Martian one.[411] Campbell replied that he was pleased to receive the spectrographs and data and congratulated Slipher on his "great skill in such matters."[412] But Campbell was eager to see Slipher's Mars spectrographs. Slipher obliged, sending them along to Mount Hamilton that week.

After receiving the prints, Campbell wrote back to Slipher asking for more detail about the atmospheric conditions under which they were taken and the positions of Mars and the moon. He added, "I am awaiting the formal and detailed publication of your observations with much interest."[413] He wrote to Slipher again in September, this time arguing against Slipher's interpretations. First, he explained his belief that all the spectra

[409] "Water Vapor in Mars Atmosphere" *New York Times* (New York, NY) Feb 26, 1908.
[410] See Chapter Two, "Responsibilities of a Scientist"
[411] Vesto M. Slipher to William Wallace Campbell, April 17, 1908, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[412] William Wallace Campbell to Vesto M. Slipher, May 1, 1908. *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[413] William Wallace Campbell to Vesto M. Slipher, May 11, 1908, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

made with the older visual methods, as well as all those that have been made in Europe, to be “absolutely worthless.”[414] The spectra made without the use of photographic equipment contained too much human error and those made in Europe were not made under the proper conditions. The Flagstaff data was good, however, but Slipher did not interpret it correctly. According to Campbell,

> In the regions referred to I can see no evidence in your photographs of Mars and the Moon that any lines or bands are stronger in Mars’ spectrum than in the Moon’s, in fact the exposures on these copies happen to be such that any excess of strength appears to be in the Moon’s spectrum.[415]

In this way, Campbell argued not against the quality of Slipher’s spectra, but his reading of them.

Despite Campbell’s acceptance of the Flagstaff prints as good and legitimate representations, he placed more faith on his own interpretations, and those of his staff, of the water vapor bands contained therein. Though Campbell believed there to be no water vapor on Mars, the issue was also partly a matter of pride and a refusal to be outdone by Lowell. From the time Lowell entered the scene in American astronomy, Lick Observatory acted as his archrival and harshest critic.[416] Lick was in an ideal position, both literally and figuratively, to compete with Lowell and his claims of superior observational conditions. Campbell, already incensed by the controversy of Lowell’s claim that his telescope outperformed Lick’s, did not concede the existence of water vapor on Mars despite his general acceptance of Slipher’s work as technically sound.

---

[414] William Wallace Campbell to Vesto M. Slipher, September 4, 1908, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[415] Ibid.
[416] Hoyt, 89-90.

Besides having one of the largest telescopes in the world, the 36-inch inch, Lick Observatory also had a viable claim to outstanding atmospheric and climatic conditions. In 1888, Lick was the first permanent mountaintop observatory in the world, situated at about 4,200 feet above sea level. Because of the mild climate of the region, Lick boasted at least 200 clear nights a year (a conservative estimate made by Holden, its first director, upon its founding).[417]

Over a decade before Lowell, the Lick Trust, tasked with planning the observatory, also carried out an atmospheric and meteorological survey to find an ideal location. It did not traverse as extensive an area as Lowell's, but the duration of testing was longer. Astronomer Sherburne Wesley Burnham (1838-1921), famous for his work with double star systems, tested seeing conditions on Mount Hamilton from August through October 1879. Burnham described his work as a "series of astronomical observations for the purpose of determining the atmospheric conditions."[418] Burnham classified the seeing on Mt. Hamilton into three categories- cloudy and foggy, medium, and first class. During his study, he counted 42 first class nights, 7 medium, and 11 cloudy and foggy.[419] Burnham was particularly impressed with the consistency of good seeing. At the future location of Lick, favorable conditions lasted through the night instead of only coming in sporadic intervals. Additionally, during his time on Mount Hamilton, Burnham claimed to have discovered several new double stars and, to him, that

---

[417] Edward S. Holden, *Hand-book of the Lick Observatory of the University of California* (San Francisco: The Bancroft Company, 1888), 91. Later estimates tended to be higher.
[418] Sherburne Wesley Burnham, *Report to the Trustees of the James Lick Trust of Observations Made on Mt. Hamilton with Reference to the Location of Lick Observatory* (Chicago: Knight & Leonard Printers, 1880), 1.
[419] Ibid, 6.

was the best demonstration of the "wonderful purity and steadiness of the air."[420] In the end, Burnham enthusiastically recommended the site he tested based on the dryness, steadiness, and clearness of the atmosphere and what could be accomplished in such a setting.

In December 1908, writing about his Mars spectra in professional publication, *Astrophysical Journal*, Slipher called attention to the issue of atmosphere very clearly. But a great deal of the discrepancies between his spectra and those of Campbell and Keeler could be explained, in Slipher's opinion, by improved technology in the intervening time between their observations. However, he added, one must not forget that, at Flagstaff, "the air is very dry and the conditions are peculiarly favorable to the delicate study of the spectrum of *Mars* for atmospheric absorption, particularly that due to water-vapor."[421] Like Lowell, Slipher pointed to quality seeing conditions as a claim for superior observational ability,

> The elevation of this observatory, 7250 feet…gives it advantages for planetary spectroscopy not enjoyed by any other similarly equipped observatory.[422]

The following month, Slipher's evidence and interpretations of the Martian atmosphere began receiving support in professional circles and in more popular magazines. Samuel Alfred Mitchell (1874-1960), professor of astronomy at Columbia University, agreed with Slipher's determination of water vapor in the Martian spectrum and believed it to be of monumental significance. In *Scientific American*, Mitchell wrote that the discovery of water vapor on Mars was "one of the most important additions to

---

420 Ibid, 12.
421 V. M. Slipher, "The Spectrum of Mars," *Astrophysical Journal* 26 (1908): 397-405, 398.
422 Ibid.

astronomical knowledge that has been attained in recent years"[423] Mitchell also recognized that the area where the spectrum was recorded needed to be as free from earth's own water vapor, as "high and as dry," as possible.[424] Flagstaff, as Mitchell described, fulfilled these requirements, of course. But, according to Mitchell, Lick Observatory was "another ideal location for such research."[425]

But if both locations were ideal, who could actually claim the best seeing conditions and, thusly, the definitive Martian spectrum? Lick staff astronomer Robert Grant Aitken (1864-1951) weighed in on this general issue a few years later,

> Lowell praises the atmospheric conditions at Flagstaff in the highest terms, and he sees the canals: it is admitted by astronomers generally that the seeing on Mount Hamilton is good, and we do not see the canals.[426]

The same could be said of Martian water vapor. Aitken, in this 1910 article, agreed with the results of his institution in that there existed no measurable amount of water vapor on Mars. Even if it did exist in the relatively small amounts that Lowell and Slipher claimed, Aitken found it "difficult to understand how so small an amount of water can keep a geometrical canal system on Mars in active operation."[427] Nevertheless, the differences between Lick's and Lowell's interpretations, in Aitken's opinion, were not due to superior seeing at Flagstaff because Flagstaff did not possess superior seeing.

---

[423] S.A. Mitchell, "Water Vapor on Mars," *Scientific American*, Vol. 98, No. 12 (1908): 201-204, 201.
[424] Ibid, 202.
[425] Ibid.
[426] R.G. Aitken, "A Review of the Recent Observations of Mars" *Publications of the Astronomical Society of the Pacific*, Vol. 22, No. 131 (1910): 78-87, 82.
[427] Ibid, 87.

Reading Between the Lines

In addition to the continued argument of superior atmosphere and seeing conditions, Lowell offered up quantifiable confirmation for his and Slipher's claim of water vapor in the Martian spectrum. A new ally, Frank Very (1852-1927), and Very's invention, a spectral band-comparator, provided this new source of numerical backing. [428] In 1897, Very retired from the directorship of Brown University's Ladd Observatory (1891), in Providence, Rhode Island, to pursue independent research. By 1908, part of this research consisted of working on a device for quantifying and standardizing the measuring of bands in a light spectrum. Very claimed the machine he invented could do just that and Lowell, seeing the opportunity to strengthen his position in the water vapor debate, sent Slipher's spectra to Very to be analyzed. Lowell was gnawing at the bit to have quantifiable evidence that supported the existence of life on Mars. [429] This was especially true after photographs, both from Flagstaff and the Andes Expedition, proved to be difficult to reproduce in print.

Very was vague about how the comparator worked, but it was apparently an intense operation which he described to Slipher as "complex," "sufficiently difficult," and "a whole chain of processes … astronomical, photographic, mechanical, physical, physiological, and psychological."[430] It must have been quite the undertaking to measure spectral data in this era. Nevertheless, Very persevered through the ordeal and confirmed

---

[428] Frank W. Very, "The Presence of Water Vapor in the Atmosphere of Mars Demonstrated by Quantitative Measurements," *Science*, Vol. 29, No. 735 (1909): 191-93, 191.
[429] Vesto M. Slipher to Percival Lowell, Nov. 19, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. See also Hoyt, 143.
[430] Frank Very to Vesto M. Slipher, Jan. 16, 1909, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

the presence of water vapor in the Flagstaff samples in a January 1909 article published in *Science*.[431] According to Very, there was not a lot of water in the Mars atmosphere, reflecting the presence of "a mild but desert climate, as Professor Lowell has all along maintained."[432] The amount of difference between Mars and the moon, according to Very's calculations, corresponded to a 22% increase in the specific spectral lines indicative of water vapor.[433] This meant the Martian atmosphere, according to Very's comparator, contained about 22% of the total water vapor present in the atmosphere at Flagstaff, Arizona on the night(s) the data was recorded. This was not a lot, 22% of a dry climate on Earth, but it was there.

Campbell, like Very, also had prints of Slipher's 1908 Mars spectra. He wrote to Slipher, after reexamining the data Slipher had sent him, that "there are some matters in Very's measurements which I find difficulty in explaining."[434] Campbell also wrote to *Science* expressing his skepticism for Very's measurements and questioning the efficacy of the device that Very had made himself to take those measurements. This might have been a fair assessment, given that no one but Very had ever used his device nor had a clear understanding, despite some photos he published in *Science*, of how it worked.

However, Campbell also argued, less fairly, that too much was being made over the difference between Slipher's rendering of the Mars spectrum and that of the Lick staff in 1895.[435] The improvements that Slipher made to the photographic process, especially

---

[431] Frank W. Very, "The Presence of Water Vapor in the Atmosphere of Mars."
[432] Ibid, 193.
[433] Ibid. See also telegraph from Percival Lowell to Vesto Melvin Slipher, Dec. 8, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[434] William Wallace Campbell to Vesto Melvin Slipher, Oct. 4, 1909. *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[435] W.W. Campbell, "Note on the Spectrum of Mars" *Science*, Vol. 29, No. 743 (1909): 500. Letter dated February 6, 1909.

in the use of yellow tint, had allowed more of the spectrum to appear on the plate. But, according to Campbell, the rest of the spectrum was remarkably similar to the Lick series. He failed to point out that it was exactly in the region that was clearer and had an additional line, the little *a* band, that the presence of water vapor could be determined. Slipher based his entire assessment on precisely the small part that was different from Lick's.

But there were problems along the way, for Very and Slipher, in measuring the water vapor bands. In January 1909, Very wrote to Slipher, in a ten-page letter, to discuss a discrepancy with the plates. One of the plates showed little to no difference between Mars and the moon in respect to water vapor. Very asked Slipher if such an error could have been due to clouds or mistakes in preparing the filters or processing the plates.[436] Slipher wrote back to Very that the problem must surely be due to an error in exposure.[437] These types of "mistakes" were omitted from the discussion of the plates and dismissed as technical errors rather than anomalies to consider.

Perhaps the more troublesome aspect of Very's *Science* article, from Campbell's perspective, was his citing the earliest Lick experiments, using the highly problematic visual method, out of their proper context. In the hand-drawn renderings of the Martian spectrum, made by Campbell and other Lick astronomers, Campbell had thought he saw slight amounts of water vapor. In 1894, Campbell claimed that the Martian atmosphere could contain water vapor, as long as the amount was no more than one-quarter that

---

[436] Frank Very to Vesto M. Slipher, January 16, 1909, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[437] Vesto M. Slipher to Frank Very, January 22, 1909, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

contained in the terrestrial atmosphere. [438] This number appealed to Very and cited his 22% as falling within the range Campbell prescribed. In this way, Very cited Campbell's earlier obsolete experiments, as well as similar ones for prior astronomers, to support the Slipher-Lowell-Very position. Very did not take into account that Campbell had since revised his conclusions.

According to Campbell, "in those days we had not the means of photographing it [the spectrum]."[439] His observations since 1894, made "under vastly improved conditions," had convinced him that neither water vapor nor oxygen were present on Mars.[440] According to Campbell,

> I think Professor Very's article…though written with the kindliest feelings for all …is certain to convey a wrong impression as to the observations made by Huggins, Vogel and others in the sixties and seventies and by myself in 1894-5.[441]

According to Campbell, Very's article cherry-picked citations that would support his own views. He made a comparison between results made photographically and those made visually, without fully explaining the difference between the two methods.

Lowell continued to take advantage of Very's data to quantify his argument in favor of Martian water vapor. According to Very, however, Slipher was the true victor in the confrontation. Very wrote to Slipher, "It all depended on your splendid spectrograms."[442] On September 1, 1910, Lowell told the Associated Press that Very had just measured another of Slipher's spectra and that the new one yielded "more striking proof of the presence of both water vapor and of oxygen in the atmosphere of Mars than

[438] See W.W. Campbell, "Concerning an Atmosphere on Mars," (1894)
[439] W.W. Campbell, "Note on the Spectrum of Mars," 500.
[440] Ibid.
[441] Ibid.
[442] Frank Very to Vesto M. Slipher, February 15, 1910, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

the previous plates."[443] The news was reported the next day in the *Los Angeles Times* as "more striking proof of the presence of both water vapor and of oxygen in the atmosphere of Mars than the previous plates."[444]

The Conflict Peaks

Campbell decided to break the stalemate over Martian water vapor by planning an expedition to Mount Whitney for the 1909 opposition of Mars. This expedition served two primary purposes. The first was to secure new data. Slipher claimed that Lick's results were out of date and therefore not able to contend with his own. He also claimed the advantages of dry air and elevation. A mountains expedition would answer both these challenges. Lick would have a new data set produced with improved equipment and methods and this data would come from the highest point possible in the United States: Mount Whitney, in the Sierra Nevadas, at 14,500 feet above sea level, almost twice the elevation of Lowell Observatory. Presumably, the air would be even thinner and contain less terrestrial water vapor than at any site where a Martian spectrum had been secured up to that point. In a debate where atmosphere and elevation proved important factors in establishing authority, the increased elevation enhanced Campbell and Lick's legitimacy claims.[445]

The second reason was, as we saw with the Lowell Expedition to the Andes in 1907, expeditions meant publicity. They were big news, made for entertaining narratives,

[443] "Measures Water Vapor" *Los Angeles Times* (Los Angeles, CA) Sep 2, 1910.
[444] Ibid.
[445] See Lane, "Astronomers at Altitude"

and were good opportunities to court general audiences. As Maria Lane describes, “challenging treks through rugged and difficult wilderness in search of perfect, remote, sublime sites of science” were something that appealed to American audiences.[446] Campbell wanted to sway popular opinion in favor of his interpretation of the Martian atmosphere as well as winning the scientific consensus. That is, that it was devoid of water or contained such trace amounts as to not show up in tests. If he could convince the public that Mars had no water, then perhaps he could put an end to all the discussion over life on Mars and the Martian canals.

In light of the news of Campbell’s forthcoming expedition, Slipher wrote to Lowell to suggest a counter-maneuver against Campbell and Lick. Lowell Observatory could also get spectral readings at higher elevations. He asked Lowell,

> What do you think of attempting spectrographic observations of Mars next opposition from a station on the [San Francisco] Peaks? As Campbell is going up Mt. Whitney for the same purpose it would be a case of self defense [sic] for us to make mountain observations here.[447]

Slipher went on to describe the relative value of the undertaking,

> The work would have to be done under rather unfavorable conditions owing to the expedition nature of the undertaking, but it might be well worth the effort.[448]

He might have lived to regret this positive assessment of the value and the tolerability of the working conditions when Lowell, agreeing that the new station was a good idea, put him in charge of the project.

---

[446] Lane, “Astronomers at Altitude,” 141-2.
[447] Vesto M. Slipher to Percival Lowell, Dec. 29, 1908, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[448] Ibid.

The building of the new observational station was front-page news for Lowell Observatory. Slipher, Lowell and the observatory staff built the base on nearby Doyle Peak at an elevation of about 11,500 feet (for good measure, Lowell rounded up to 13,000).[449] They equipped it with a twelve-inch refractor. On November 23 the *New York Times* reported Lowell sought "a clearer atmosphere…for the study of Mars" and that "Prof. V.M. Slipher will have charge of the task of erecting the big telescope."[450] With the proximity to the main observatory, the station could be used not just for one expedition, but continuously (when weather permitted). In 1928, the Doyle Peak station was still in operation and even had a road leading to it when Slipher, then director of the observatory, ordered a series of improvements for the old building.[451]

Despite the general excitement, it seemed, at least at first, that the observational results from the mountain station were underwhelming. In October 1909, Slipher wrote to Lowell that he had observed in the San Francisco Peaks the previous weekend. Saturday, Slipher reported, was a "very good day" but "clouds and haze made Sunday's work a failure."[452] Slipher told Lowell that he would probably go back up to the station soon, if the moisture content of the air remained low and it hadn't begun to snow yet. But Slipher was less than thrilled by the results he obtained there. If anything, it seemed to underscore the ideal conditions of his previous experiments. According to Slipher,

---

449 See Kevin Schindler, *Images of America: Lowell Observatory* (Arcadia Publishing, 2016), 103. For the overestimate of the elevation see "For a Better View of Mars" *New York Times* (New York, NY) Nov 24, 1909.

450 "For a Better View of Mars" *New York Times* (New York, NY) Nov 24, 1909.

451 Rose Houk, *From the Hill: The Story of Lowell Observatory* (Flagstaff: Lowell Observatory, 2000), 19.

452 Vesto M. Slipher to Percival Lowell, Oct. 13, 1909, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

> These tests have convinced more than ever before of the extremely favorable conditions under which the Mars spectrograms were got…I was surprised to find so much evidence of water on the mountains.[453]

It seemed clear that Slipher was unwavering in his belief that he had produced the best possible spectral recording for the atmosphere of Mars and that spectrum contained water vapor. But whether it was truly worth the effort or not, it seemed that both Lick and Lowell Observatories would have high-elevation data by the end of 1909.

The Mount Whitney expedition ran into some snags as well. It stormed for most of the journey, making travel difficult and allowing for only two nights of good observational conditions. Fortunately, however, the Smithsonian Institution sent up a preliminary party with local craftsmen to build a small shelter for the observers, so they were protected from the elements at least part of the time.[454] The second party to make the climb, to carry out observations and record data, consisted of Campbell himself, his assistant Sebastian Albrecht (1876-1957), chief of the San Francisco Weather Bureau, Alexander McAdie (1863-1943), and director of Smithsonian Astrophysical Observatory, Charles Greeley Abbot (1872-1973).[455] While on Mount Whitney, the expedition party used a 16-inch reflector fitted with a spectroscope and protected by a canvas dome. They set up a base camp at 10,300 feet and acclimated to the conditions for two days before continuing on to the summit to secure spectral readings.

Upon the Mount Whitney expedition's return on September 8, 1909, Campbell released a statement to the press boasting that they had secured data from "a higher

---

[453] Ibid.
[454] "Mount Whitney Expedition" *Annals of the Astrophysical Observatory of the Smithsonian Institution*, vol. III (Smithsonian Institution: Washington D.C., 1913).
[455] Lick's Crocker Fund provided the rest of the funding for the expedition.

elevation than that which observations ever were made before."[456] It would take a few days, Campbell reported on September 8, to develop all the negatives from the expedition. But he was clearly already excited that they were "now in a position to issue the strongest statement that ever has been issued as to the existence of water vapor on Mars."[457]

"They are all wrong" was the statement that Campbell issued a week later, on September 15, 1909. [458] It was, indeed, a strong one. Campbell and his expedition party's results and their interpretations of the results showed no water vapor and, therefore, Slipher and others who argued for its existence were, according to Campbell, mistaken in either their execution or in their interpretation of the data. Either no water vapor existed on Mars or it existed in such small quantities as to not be detectable by contemporary spectroscopic methods.[459] Campbell's statement to the Associated Press was later reprinted in whole in the October 1909 edition of *Science*.[460]

The results of Lick's expedition to Mount Whitney resonated within the professional community as thorough and definitive. As Lane describes in "Astronomers at Altitude," it was "widely considered the final word on the subject" with this audience.[461] Astronomers and other scientists also saw Lick's data as being strong proof against life on Mars and the issue was settled for a great many people working within the field. The high altitude, thin air, and clear atmospheric conditions offered a "locus of

---

[456] "Hope to Show Life May Exist on Mars" *New York Times* (New York, NY) Sep. 9, 1909.
[457] Ibid. See also *Science* article reporting the same press release "Water Vapor in the Atmosphere of the Planet Mars" *Science*, Vol. 30, No. 771 (1909): 474-475.
[458] "New Tests Indicate No Life on Mars" *New York Times* (New York, NY), Sep 16, 1909.
[459] "What of Interest Happened in a Day Up and Down the Great Pacific" *Los Angeles Times* (Los Angeles, CA), Sep 15, 1909.
[460] W.W. Campbell, "Water Vapor in the Atmosphere of the Planet Mars," 474-5.
[461] Lane, Astronomers at Altitude," 127.

legitimacy" to the expedition's claims that struck a strong blow against theories of Martian inhabitation, and especially canal theories.[462] If there were not water vapor on Mars, how could there be immense networks of waterways?

This, however, was not the case with popular audiences. From the beginning, it seemed the Mount Whitney expedition met with misrepresentations and misunderstandings in the press. News articles noted the key advantages of the expedition, including elevation and that "the atmosphere was clear, and Mars was so near the horizon that very sharp negatives were procured."[463] The *Los Angeles Times* noted the problems of planetary spectroscopy in general,

> The observer of Mars must look up through the earth's atmosphere; and the great quantity of water vapor in our atmosphere, if the observer is near sea level or at ordinary altitudes, blots out the effect of any Martian vapor, making a solution of the problem impossible.[464]

But while the general features of the expedition were presented clearly and explained fairly well, Campbell's position against the existence of water vapor was less clear. Headlines concerning the expedition included "Hope to Show Life May Exist on Mars" (Sep 9, 1909), "Mars Holds Secret Well" (Sep 15, 1909) and "Water on Mars: Prof. Campbell's Observations Do Not Disprove Its Possibility" (Nov 20, 1909).[465] Proving the existence of Martian life or finding a "secret well" on Mars were both far from what

---

[462] Ibid.
[463] "Hope to Show Life May Exist on Mars: Lick Observatory Astronomers Go to Mountain Top to Examine Planet's Spectrum," *New York Times* (New York, NY), Sep. 9, 1909.
[464] "Mars Holds Secret Well: Astronomers Find no Hint of Life on Planet" *Los Angeles Times* (Los Angeles, CA), Sep. 15, 1909. Under section "What of Interest Happened in a Day Up and Down the Great Pacific Coast"
[465] Ibid. See footnotes 44 and 45 and "Water on Mars: Prof. Campbell's Observations Do Not Disproves Its Possibility," *New York Times* (New York, NY), Nov. 20, 1909.

Campbell intended to do on the expedition. If anything, he wanted to disprove these notions.

In early October, Campbell wrote to Slipher explaining how his telegraph to Harvard College was misinterpreted by the press to say, "a little water vapor." [466] In fact, the text of the telegraph had referred to "little *a* water vapor bands," referring to specific lines in the spectrum that indicated for water vapor.[467] Campbell did not know the exact source of the error, but determined that it had surely happened "east of San Jose,"[468] meaning that the information in the telegram that left the observatory was correct, but was misunderstood by someone who read it. The press, while generally taking an interest in the expedition, seemed not to be eager to take Campbell's side on the interpretations of the data from the expedition. He wanted to rob Mars of its water, and consequently of its life.

As certain as Slipher was of his evidence that water vapor was present on Mars, Campbell and the astronomers at Lick were equally certain that they had produced the best photographs of the Martian spectrum and that it did not contain water vapor. In June 1910, Campbell and fellow expedition member Sebastian Albrecht published another paper about the Mount Whitney expedition in *Science*. They reiterated the conclusion that "the quantity of any water vapor then existing in the equatorial atmosphere of Mars was too small to be detected."[469] Again, the Lick astronomers did not make strong statements about the nonexistence of water vapor, but rather cautious ones about the

---

[466] William Wallace Campbell to Vesto M. Slipher, Oct. 4, 1909. *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[467] Ibid.
[468] Ibid.
[469] Campbell, "On the Spectrum of Mars as Photographed with High Dispersion," 992.

spectroscopic results they have collected so far. The article also cited more spectral readings performed at Lick with the 36-inch in January and February, the latter being under extremely steady and dry conditions.[470] The results were the same – no water vapor appeared in the spectra. According to Lick Observatory, when it came to water vapor, there was no measurable difference between the spectral lines of Mars and those of the moon.

As the two observatories had it out, perhaps weary of the conflict, Slipher maintained hope that a consensus could be reached and that the data could be brought into agreement. Slipher wrote to Campbell on September 29, 1909, a few weeks after the Mount Whitney expedition returned, and asked him to "favor" him with "as many of your plates as you may care to."[471] Slipher was cordial, letting Campbell know, "Anything you send will be appreciated." Slipher also expressed that he believed that perhaps that two spectrographs did not differ as much as it would seem.

> As our observations are photographic they should agree and I believe they can be brought into agreement. Today I see no other way of interpreting my plates and naturally I was very much surprised to hear that you had got a different result. But at this point I shall postpone further discussion until I hear from you and I hope, receive a specimen of your spectrograms."

Campbell responded to Slipher that he had not yet made copies of the Mount Whitney spectra, but remained mute on the possibility that the two sets could be made to agree.[472]

It would be some time before Slipher was able to see the Mount Whitney spectra, but when he did, he was impressed by them. In early September 1910, nearly a year

---

[470] Ibid.
[471] Vesto M. Slipher to William Wallace Campbell, Sep. 29, 1909, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[472] William Wallace Campbell to Vesto M. Slipher, Oct. 4, 1909, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.

later, Slipher wrote to Frank Very that he had recently had the opportunity to see the spectrographs at a meeting of the Solar Union at Mount Wilson Observatory (MWO) (1904). It is important to note that Slipher was not a member of the Solar Union, but an invited guest.[473] The Solar Union, founded by George Ellery Hale (), director of MWO, was dominated by its parent institution and Lick Observatory. The Union's primary purpose was to compile and share data on the radial velocities of stars. But, according to the research plan, all the data was to come from either MWO or Lick. The Lick would observe brighter stars with a magnitude of 5.5 or greater and MWO would cover the fainter ones with less than 5.5 magnitude.[474] This was an example of the close relationship between Lick and MWO as well as the dominance in the field of those who had the biggest telescopes.

Slipher had some general criticisms of Campbell's prints, but overall he admitted "they were good" and very similar to his own.[475] In some respects, like the simultaneous capture of the lunar and Martian spectra, he found them "an improvement perhaps."[476] Slipher did not have any of his spectra with him to compare side-by-side, but was "of the opinion that our air was quite as dry here on Jan. 15, 1908 as it was on Mt. Whitney when he [Campbell] made his observations."[477] On the best nights at Flagstaff, Slipher believed, it was even drier.

---

[473] William Wallace Campbell to Vesto M. Slipher, June 6, 1911, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[474] Ibid.
[475] Vesto M. Slipher to Frank Very, Sep. 5, 1910, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[476] Ibid.
[477] Ibid.

Slipher reiterated his belief that his and Campbell's data must be fundamentally similar, if not the same, and only differed in interpretation. He told Very, "I believe that if the two series of spectrograms could be directly compared and examined that there would be less divergence of view held concerning them."[478] Slipher first believed that the difference between his and Campbell's research was that of the quality of data. By the time Slipher photographed the Martian spectrum in early 1908, Campbell's 1895 spectra were already outdated and made with inferior photographic plates. They were also, according to Slipher, not made in the best atmospheric conditions. With the new and improved spectrographs from the Mount Whitney expedition, Slipher now thought that the fundamental difference between Lick's and Lowell's views was that of the analysis of the spectral bands.

The issue of water vapor on Mars was the last time Slipher entered the canal debate. After saying his peace, he seemed eager to put the issue of water vapor to rest and find common ground with Campbell and Lick Observatory. According to Hoyt, "In the future, Slipher was content to leave the polemics to Lowell whose mastery of the art by now was widely acknowledged."[479]

Conclusion: Toward Quantification

To Lowell, Slipher, and Very, the results of the spectral band-comparator seemed to provide sufficient evidence for the existence of water vapor in the Martian atmosphere.

---

478 Ibid.
479 Hoyt, 145.

Very wrote to Slipher in February 1910, "it does seem to me that neither you nor I have any reason to feel dissatisfied."[480] Furthermore, "Campbell has fired his shot, and it has gone wide of the mark. The thing has now been threshed out to the bitter end."[481]

But by April, fresh criticism about the Martian spectrum surfaced, this time from Charles Greeley Abbot, director of Smithsonian Astrophysical Observatory and member of the 1909 Mount Whitney expedition party. Abbot wrote to Lowell and the observatory staff to amend some statements made in Lowell Observatory Bulletin Number 43 about poor weather during the Mount Whitney observations. According to the Bulletin, this poor weather rendered the data useless.[482] Abbot maintained that, in fact, the Mount Whitney spectrographic series was conclusive and made under excellent conditions.

In response to Abbot's request to amend the statement about poor conditions on Mount Whitney, Very suggested to Slipher that in order to defend against the "new attack" they should "do what we can to back him [Lowell] up."[483] To Very, who had read Abbot's letter, Abbot's correspondence on the matter was demanding and "in a somewhat high and mighty manner."[484] Lowell was in Europe at the time, but Very and Slipher could be in a "position to possibly furnish some ammunition for a repulse of this new attack."[485] This meant playing "the part of Aaron and Hur in supporting the hands

---

[480] Frank Very to Vesto M. Slipher, Feb. 15, 1910, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[481] Frank Very to Vesto M. Slipher, Feb. 15, 1910, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[482] Frank Very, "Water Vapor on Mars: Reply to Campbell's Criticism," *Lowell Observatory Bulletin*, 43 (1910) in *Bulletins of the Lowell Observatory*, Vol. 1 (Flagstaff, AZ: Lowell Observatory, 1911), 43 239-240
[483] Frank Very to Vesto M. Slipher, Apr. 9, 1910, *V.M Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[484] Ibid.
[485] Ibid.

of Moses."[486] Very ended this seventeen-page letter, primarily a rant about the inferior Mount Whitney spectra, to Slipher with "Abbot has his war-paint on – so look out!" Apparently getting nowhere with his request for Lowell to recant, Abbot wrote a letter to *Science* instead, outlining his argument in favor of the Lick data.[487]

Very's dispute against Abbot was that there was no way to tell the true state of terrestrial water vapor during the expedition. There had been storms during part of the trip, but not on the days the spectra were secured. But even if the relative humidity was low on those nights, as Abbot and the rest of the expedition party argued, the upper atmosphere could have been very humid. According to Very, "we have no knowledge of the condition of the air-column above the mountain, except what may be surmised from the general seasonal and regional conditions."[488] Furthermore, "it is quite true that the upper air is affected by the great general movements of the atmosphere." In an area that had experience a great deal of rain, "it is probably pretty safe to assume that the entire air column is replete with moisture to an unusual degree."[489] The observer's line of sight passed through this area of the atmosphere as well. So, there was no way of knowing just how dry the conditions were during the expedition. Very concluded, "The spectrograms prove nothing."[490] Both Flagstaff and Mount Whitney were generally out of the path of

[486] Ibid. This story can be found in Exodus 17:12. Israel's army met with success on the battlefield when Moses, looking on, held his hands up. When Moses put his hands down, the fortunes of the battle shifted toward the enemy. When Moses became too tired to hold his hands up any longer, Aaron and Hur held them.
[487] C.G. Abbot, "Water Vapor on Mars," *Science* Vol. 31, No. 808 (1910): 987-988.
[488] Frank Very to Vesto M. Slipher, April 9, 1910, *V.M. Slipher Papers*, Lowell Observatory Archives, Lowell Observatory.
[489] Ibid
[490] Ibid

large storm systems, unlike the "New England climate so trying to humanity."[491] But the expedition was still under question.

A great deal of controversy arose over the existence of water vapor in the Martian spectrum in the years 1908-1910. Astronomers wrote numerous letters and articles, made biblical allegories describing their struggles, and climbed both actual and metaphorical mountains to outdo each other. But there was much more at stake in this controversy than just producing the best spectral photograph. It was the climax of on ongoing struggle between two different institutions, Lick and Lowell Observatories, over the definition, responsibilities, and meaning of science.

[491] Ibid.

Chapter Five

A Farewell to Mars

"For those who prefer the cold precision of fact to the warm, nebulous glow of fancy," The *Los Angeles Times* announced in January 1910, "there will be no canals on Mars now or for all time to come."[492] This assertion was, of course, a bit of an overstatement. There were some, like Lowell and Schiaparelli, who still maintained at this point, and for years to come, that life on Mars existed. But by the end of 1909 and the beginning of 1910, Martian inhabitation had been largely rejected by scientists, the press, and American readers. This disavowal, or likely sometimes simply disinterest, was a radical change from earlier in 1909 when newspapers were in the business of analyzing the different methods available for contacting Martians.

What happened in the course of a few months to dispel a theory that enjoyed immense popular support for decades? There is no single explanation for why canals fell out of favor in the winter of 1909. But two powerful forces of change played a big role in exacting such a relatively rapid transformation in scientific values. One was technology and new evidence. The other was a change in focus for popular science, including a new persona and a new ideal location. Both transformational influences emanated into the ether of popular opinion from Mount Wilson Solar Observatory (1904), later simplified to Mount Wilson Observatory (MWO), outside of Pasadena, California.

Director of MWO, George Ellery Hale (1868-1938), replaced Lowell as the archetype of the public scientist and thus eclipsed Lowell's popularity with general

---

[492] "Mythical Canals of Mars," *Los Angeles Times* (Los Angeles, CA), Jan 23, 1910.

audiences. Hale defined the role of popular science in similar ways and on similar platforms as Lowell and other Martian life supporters, but also presented some differences in his public persona and professional relationships. Following Lowell and Flammarion's pattern, Hale used popular support and media publicity as a basis of power. But he did not use this power to support his scientific credibility, which he gained through professional channels, but rather to advance his political positions.[493] Hale also frequently employed the argument of elevation and steady atmosphere as a means of authority. But this environmental authority, in Hale's case, was not to stand in for or replace the possession of a giant telescope or of a strong reputation in professional astronomy. Instead, Hale argued, elevation and clear air were valuable additions to his technological superiority and professional training. Hale's identity as a popular scientist followed some of the same patterns as Lowell's "Roosevelt of Astronomy" model, but also refined aspects of the paradigm, resulting in a shift in public perception and a break from popular theories of life on Mars.

Hale, Lick, and Harvard

The first and one of the few direct interactions between Hale and Lowell happened in 1895 when Hale founded *The Astrophysical Journal*. As Hale was wading through submissions for the new journal and trying to keep the project afloat by soliciting subscribers, he came across papers submitted by upstart Percival Lowell. Lowell had built an observatory in Arizona the previous year and now sent in papers about the canals

---

[493] See Kevles, *The Physicists*.

on Mars to be published in Hale's journal. Hale rejected them as being of "dubious value."[494]

The Solar Union of 1910 was not the first time that Hale and Mount Wilson were strongly linked with Lick Observatory, or other sources of criticism for life on Mars. Throughout his career, Hale maintained close connections with the core people and locations that made up the front lines in professional criticism against Martian inhabitation and canal theory. One such connection goes back to when Hale was just fourteen years old. Sherburne Wesley Burnham (1838-1921), an expert on binary star systems, performed the initial atmospheric survey atop Mount Hamilton for the Lick Trust. His tests on the mountain aided in the selection of the site as the future home of the observatory.[495] Although he continued to visit and observe at the Lick on occasion, Chicago was Burnham's permanent home. He worked as a court reporter during the day and lived near a young George Ellery Hale and his family. By coincidence and proximity, Burnham turned out to be one of Hale's earliest mentors.

When teenage Hale was having trouble building his first backyard telescope, he sought help from Burnham. Hale knew from neighborhood gossip that Burnham was an amateur astronomer and thus the most likely person to be able to offer advice.[496] Burnham did just that, by getting Hale in touch with someone who was selling a second-hand 4-inch Clark refractor. Burnham also took young Hale on his first visit to an observatory, the Dearborn Observatory, then located in Douglas Park on the west side of

---

[494] Wright, 116.
[495] See Sherburne Wesley Burnham, *Report to the Trustees of the James Lick Trust of Observations Made on Mt. Hamilton with Reference to the Location of Lick Observatory* (Chicago: Knight & Leonard Printers, 1880).
[496] Wright, 36.

Chicago.[497] Not missing an opportunity to impress Hale with stories of his own astronomical adventures, Burnham told his young companion about his observations at Lick, "contrasting the clarity of the California skies with the murky Chicago heavens."[498] Regaled with tales of adventure, mountain-climbing, and crystal-clear views of the night sky, teenaged Hale learned the value of elevation and a steady atmosphere. Hale and Burnham remained close friends and colleagues until Burnham's death in 1921.

Hale also had a close connection with Harvard. Edward C. Pickering, director of Harvard College Observatory and a very well-connected man, helped Hale receive funding from the Carnegie Institute for the new solar observatory at Mount Wilson. In 1902, when the Carnegie Institute received its initial endowment, Pickering served as the chairman of its Advisory Committee on Astronomy.[499] He wrote to Hale, then the director of University of Chicago's Yerkes Observatory (1897), to invite him to join the committee (which also included Simon Newcomb).[500] Through this advisory board, Hale eventually received the money from Carnegie to begin work at Mount Wilson.

The solar observatory project brought Hale closer to Lick Observatory, both physically and professionally. When Hale received the initial funding from Carnegie Institute, he was not the only person in charge of the project. Hale had two partners. One was Lewis Boss (1846-1912), director of Dudley Observatory in New York. The second was William Wallace Campbell, director of Lick Observatory and, as we have seen, an especially rabid Martian critic.[501] Because of Lick's initial involvement in the project, it

---

[497] Ibid., 38.
[498] Ibid.
[499] Ibid., 162.
[500] Ibid.
[501] Ibid., 164.

was a Lick staff astronomer, William J. Hussey (1862-1926), who did the preliminary survey work for Carnegie's solar observatory. Hussey recommended Wilson's Peak outside of Pasadena as the best site that he had tested.[502] Years later, Hale still gave Hussey full credit for selecting Mount Wilson as the location for the new observatory.[503]

Lick served as an inspiration for Hale's observatory-building efforts, even while he was still living and working in the Midwest. In a manuscript entitled "Some Observatory Problems," Hale described the profound effect that an 1892 visit to the Lick Observatory had on his resolve to build the 40-inch telescope at Yerkes Observatory (1897) on the shores of Lake Geneva, Wisconsin. Yerkes was Hale's first large-scale construction and his first big telescope. Two years after his 1892 visit to Mount Hamilton, by chance the same year Lowell built his observatory in Flagstaff, the grand mountaintop observatory remained on Hale's mind. "Still under the spell of the great 36-inch refractor" is how Hale described himself and his thoughts about the Yerkes project in 1894. [504] Hale recalled the first time he saw the telescope, "dimly seen reaching toward the heavens in a huge dome lit only by the comparison spark of Keeler's spectroscope."[505] This memory of his first encounter with the Lick telescope was very near (perhaps with the exception of his immediate family and closest friends) the limit of George Ellery Hale's capacity for sentimental musing.

---

[502] Ibid. See also W.J. Hussey, "Report on Certain Sites in Arizona and California," *Report of Committee on Southern and Solar Observatories* (Washington, DC: Carnegie Institution, 1903): 71-105.
[503] George Ellery Hale, *Ten Years' Work of a Mountain Observatory*, (Washington, DC: Carnegie Inst., 1915), 6.
[504] George Ellery Hale, "Some Observatory Problems," no date, *George E. Hale Papers*, Caltech Archives, California Institute of Technology, [1]
[505] Ibid.

Like Lowell, Hale knew the value of good and steady atmosphere. Unlike Lowell, he experienced it through trial and error at Yerkes Observatory. As Hale described, "Long periods of unbroken weather, free from rain and with little cloud" made for "tranquility and steadiness of the atmosphere."[506] Lake Geneva, Wisconsin did not have these qualities. It was a good site, for the Great Lakes region, but nothing like the great seeing out West. As Maria Lane describes in "Astronomers at Altitude", Yerkes Observatory had trouble competing with its high-elevation Western counterparts.[507] Yerkes had a huge telescope. The observatory was also well-funded and thrived under the exceptional leadership of Hale. He was, even at the age of twenty-nine in 1897, a dynamo of scientific administration as well research. But, despite "soaring expectations," as Lane explains, Yerkes "never managed to rise above concerns about its location."[508] This lack of location-based credibility, something Lowell capitalized on at every opportunity, undermined the ability of Yerkes to make observational claims. In essence, Yerkes "could not truly challenge the western mountain sites for prestige."[509]

Despite already being the director of a world-class observatory, when Hale got the opportunity to swap Wisconsin for the clear and steady skies of Southern California, he jumped at it. A better-located observatory offered Hale the opportunity to perform his research under better conditions and also enhance his scientific authority. The Yerkes Observatory, according to Hale's "Some Observatory Problems" manuscript, had come

[506] Hale, *Ten Years' Work*, 6.
[507] K. Maria D. Lane, "Astronomers at Altitude: Mountain Geography and the Cultivation of Scientific Literacy" in Denis Cosgrove and Veronica della Dora (eds.) High Places: Cultural Geographies of Mountains, Ice, and Science (New York: I.B. Tauris, 2009).
[508] Ibid., 132.
[509] Ibid.

about through “lucky chance.”[510] The primary 40-inch lens for the great Yerkes telescope was never meant for Hale or Lake Geneva. The Clark firm in Massachusetts built the lens for another buyer. But when that deal fell through from lack of funding, they offered the glass to Hale. Hale scrambled to get the funds for the lens, eventually securing the needed money from Chicago streetcar mogul Charles T. Yerkes (1837-1905).

With the relatively coincidental nature of Yerkes’s beginnings, there was not a clear plan of research in place when observations began. Some of the preparations were haphazard. The lens for Hale’s spectroheliograph, the instrument on which a great deal of his work would be based, was purchased from a pawn shop in St. Louis.[511] “Its [Yerkes’] character was defined by the possibilities of our instruments and resources,” Hale explained, “rather than by the needs of a homogenous and well-ordered plan of research.”[512] Furthermore, Yerkes Observatory was limited to a narrow geographical range. The observatory was part of the University of Chicago and, as such, could not be located too far from its parent institution.[513] This condition was very limiting for Hale, who valued environmental conditions that were not available within a near enough radius of Chicago.

Hale left Yerkes with an even greater appreciation of the era’s growing telescopic capabilities but also of atmospheric necessities. “Every large telescope,” he later wrote, “if efficiently used under good atmospheric conditions, not only adds to our knowledge

---

[510] Hale, “Some Observatory Problems,” [3].
[511] Ibid.
[512] Ibid.
[513] Ibid.

of existing problems but reveals new ones for solution."[514] The stipulation of being used under good conditions was an important one for Hale, especially as he began lobbying Carnegie and its Advisory Committee on Astronomy for the resources to build a new observatory in California. Hale also became convinced that, "all observatories, large or small, should have a well defined [sic] scheme of research."[515] This, Hale implemented at Mount Wilson as well. It's primary focus of research was the sun and stellar evolution in general. Its solar emphasis was especially apparent in its early years, but later expanded to include a variety of subjects as new instruments and new staff members came along.

The sufficient time to plan as well as Hale's years of experience lent their advantages to the new observatory at Mount Wilson. According to Hale, the development of MWO, as compared to Yerkes, "offered a very different condition of affairs."[516] This was not only in regard to preparations and research plans.[517] Perhaps more importantly, Mount Wilson offered the clear and steady atmosphere that Hale had longed for and that would prove invaluable to his solar research. Before selecting the site for the initial construction, Hussey of Lick Observatory had tested the atmosphere in California, Arizona, and Australia. Hale had every confidence in Hussey's abilities; he "knew good seeing when he found it."[518] And at Mount Wilson, he found it in spades.

---

[514] Ibid., [10].
[515] Ibid.
[516] Ibid., [3].
[517] MWO possessed a clear research plan from the start: the study of the sun and of stellar evolution. These topics were of top priority, but of course if the opportunity arose to take photographs of the planets, or other expedient projects, there was no harm in deviating from the program temporarily.
[518] Hale, "Some Observatory Problems," [3].

As Hale described in a similar manuscript, “Building a New Observatory,” the location Hussey recommended in Southern California offered the sought-after conditions of a “site of high altitude, above the denser and more disturbed region of the atmosphere, in a region but little affected by clouds and storms”[519] The observatory on Mount Wilson had many of the technological capabilities of Yerkes from the start, and eventually surpassed it when the 60-inch reflector was completed in 1908. Hale simply brought along some of his instruments from Lake Geneva, including the Snow Solar Telescope, a massive horizontally-mounted instrument designed by Hale shortly before resigning at Yerkes. But in addition to the impressive telescopes and instruments, Mount Wilson also had a clear and steady atmosphere, a high elevation, a little over 5700 feet, and the prestige that came along with those qualities. To Hale, MWO represented “the best attainable instrumental equipment and the most favorable environment.”[520]

Images of Science

Lowell and Hale shared a love of mountains and atmospheric steadiness. They also shared a romanticized notion of science that they incorporated into their scientific identities. But their idealized images were very different. Lowell’s was of a misunderstood prophet, deprived of the appreciation he deserved from old-fashioned scientists and left to the solace of wilderness and the comfort of a tireless passion for truth. In *Mars and Its Canals* (1906), Lowell staged a lone genius, himself, situated

---

[519] George Ellery Hale, “Building a New Observatory,” no date, *George E. Hale Papers*, Caltech Archives, California Institute of Technology, [6].
[520] Ibid., [4].

within a romanticized desert wilderness. The scene was complete with quiet reflection, howling coyotes, and remote snow-covered mesas. [521]

Hale also enjoyed mountains, wilderness, and outdoor activities, especially fly fishing, but did not subscribe to the notion of a lone genius or of the grand discoveries Lowell claimed for himself. Astronomers were sometimes lucky enough to have great adventures, Hale described, but they "spend most of their time in hard and often tedious routine work."[522] The romanticized conception of an astronomer "scanning the heavens throughout the night and occasionally watching a new planet swim into his ken" was simply not true, especially in the new science of astrophysics.[523] The types of investigations carried out by astrophysicists took place just as much in a laboratory setting as it did at a telescope.

The old notions of lone geniuses and telescope vigils were problematic for science communication, Hale complained, and gave the public "a very imperfect idea of present-day facts."[524] In 1915, Hale published an overview of all the work that had been performed at Mount Wilson since it saw first light in 1904. He presented this summary, *Ten Years Work of a Mountain Observatory*, in a booklet, published by Carnegie and meant for visitors and other interested amateurs. It was a sort of popular institutional history. In it, Hale offered a "brief description of some typical methods and results" so that they "may be of service to the visitor and to the general reader."[525]

[521] Cite internal page for reference (don't know this yet). Also see Percival Lowell, *Mars and Its Canals*, (New York: The MacMillan Company, 1906), 7-8.
[522] Hale, "Building a New Observatory," [1].
[523] Ibid., [3].
[524] Ibid.
[525] Hale, *Ten Years' Work*, 4.

Hale's public depiction of science was data-driven, dependent upon technology, and cooperative. In the place of Lowell's lonely coyote, Hale had staffs of scientists and computers in state-of-the-art laboratories and instrument shops toiling away at piles of data. Like Lowell, however, Hale emphasized a heroic sense of hard work and sacrifice. Astronomical work was difficult, painstaking at times. "It is a comparably simple matter," Hale wrote, to demonstrate that a change in temperature created a corresponding change in spectral data. However, even for a large staff of technicians, "to measure the changes for thousands of lines of iron, chromium, nickel, vanadium, and many other elements recognized in celestial objects is a task requiring years of continuous work."[526] Hale warned against the misidentification of so-called discoveries that had taken place at Mount Wilson. Hale noted that,

> In view of certain statements in the public press, it may be remarked here that faint stars photographed for the first time with large telescopes are not regarded by astronomers as discoveries.[527]

He did not want the public to credit discoveries where there were none and, in doing so, perpetuate misunderstandings about how scientific discoveries were made.

Mount Wilson and its talented, experienced director were popular in the press and Hale attracted crowds when he gave public lectures. In January 1909, the *Los Angeles Times* announced a free public lecture by Hale in Los Angeles. The article lauded Hale as "among the world's greatest astronomers."[528] Furthermore, his latest book on solar

---

[526] Ibid., 35.
[527] Ibid., 86.
[528] "Astronomical Lecture: Director of Mount Wilson Will Show Remarkable Views and Tell of Discoveries," *Los Angeles Times*, (Los Angeles, CA) January 28, 1909.

research "attracted the wildest attention."[529] With his solar discoveries, Hale had received so much attention, in fact, that although the lecture was free to the public, tickets were still required for the event to "avoid a crush at the ball."[530]

Beyond frequently being the primary focus of news, Mount Wilson and its observatory were normal features of local culture in Pasadena. News of work at the observatory sometimes made its way into the local columns in the *LA Times* alongside other community happenings and events. Mount Wilson was a part of the identity of the growing city. Hale was a civic leader in Pasadena, especially in his key role in transforming Throop Polytechnic Institute into Caltech. [531]

When talking about the goings-on in Pasadena, Mount Wilson Observatory was often simply a part of the bigger story. Development on the new 78-foot solar observatory tower in 1909 was reported alongside city affairs like new ordinances for Pasadena carriage drivers and proposed sites for new parks.[532] Also in the news alongside construction projects at the observatory were strange parties held by Stanford graduate students in which they tied one another to trees and applauded a seven-month-old baby for riding a burro.[533]

Similarly, plans for the International Solar Union to be held at Mount Wilson Observatory in 1910 found its way into one of the city correspondence sections of the *Los*

---

[529] Ibid. They could have been referring to either of two books Hale published in 1908 reporting on his solar research at Mount Wilson.
[530] Ibid.
[531] When elected to the Board of Trustees of Throop Polytechnic Institute in 1907, Hale enacted many of the changes that led to its transformation into Caltech. Later, Hale was also very much involved, as a board member, in the development of Huntington Library (1919).
[532] "Los Angeles County: Correspondence from Its Cities," *Los Angeles Times*, (Los Angeles, CA), July 19, 1909.
[533] Ibid.

Angeles Times. Hale, "father of the organization," arranged for the meeting to take place at Mount Wilson because of the ideal conditions that the observatory offered. This was true of both "the remarkable equipment of the Mt. Wilson Observatory" as well as the "ideal conditions for observation."[534] The assets of MWO that Hale was very keen to discuss, technological ability as well as quality atmosphere, were not lost on the press nor its readers

A reporter from the *LA Times* spoke to Hale at his Pasadena home and asked about his trip to Europe to plan the solar conference. The reporter then went into detail for several paragraphs about the prestigious lectures, meetings, and events Hale attended while in Europe. Hale's appearances before the Physical Society of France, at Cavendish Laboratory, at the Royal Society, and his attendance at the Darwin Centennial Celebration at Cambridge was simply part of the local news. Oddly enough, the article on Hale's travels came right before another story involving burros: this time a burro chariot race. Included as well was the story of the baseball team at Throop Polytechnic Institute winning a "handsome trophy."[535]

It was clear that Hale and Mount Wilson had become leaders in cutting-edge scientific research and the reading public saw him as such. He was a well-connected scientist and possessed numerous accolades. But the seamless placement of world scientific news, like the Darwin Centennial and meetings of the Royal Society, alongside burro races and baseball revealed Hale as a public figure as well and a participant in community affairs.

[534] "Los Angeles County: Its Cities and Towns, Pasadena, Solar Union Amid Roses," *Los Angeles Times*, (Los Angeles, CA), July 12, 1909.
[535] Ibid.

The *New York Times* also reported on Hale's 1909 trip to Europe to plan a meeting of the 1910 Solar Union. This was the same meeting that Slipher would attend and see the Mount Whitney spectra. The message that Hale was a scientific trailblazer on a global scale remained clear. According to an article titled "Honors for Prof. Hale," the MWO director had recently experienced the "most remarkable series of receptions ever accorded an American scientist abroad."[536] Such hospitality came from, in addition to the events discussed in the *LA Times* article, the Astrocartographical Congress in Paris, University of Rome, and the Italian Physical Society. According to the *New York Times*, they all enthusiastically applauded Hale's solar research as a great contribution to astronomical knowledge.[537]

Less than a week after the reports of Hale's successes abroad, Lowell wrote to V.M. Slipher about all the hullabaloo. He suggested to Slipher that, like Hale and Mount Wilson, Lowell Observatory should start using more photographs in their publications and outreach. "I have come to the conclusion," Lowell announced in his letter to Slipher, "that it will be well to have the visible representation of our work…more known to the world."[538] The photographs, however, did not need to be of excellent quality. It was "the general effect," Lowell assured, that was the "important thing."[539] The topic was on Lowell's mind because of Hale and the publicity he was getting. Lowell grumbled to his assistant, "Hale totes his [photographs] round and makes an impression."[540] At this point, in mid-June, Lowell had no idea how prophetic his remarks about Hale's photos

[536] "Honors for Prof. Hale," *New York Times* (New York, NY), June 13, 1909.
[537] Ibid.
[538] Percival Lowell to Vesto M. Slipher, June 18, 1909, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.
[539] Ibid.
[540] Ibid.

would turn out to be by the end of that year. Hale certainly would make an impression with the photographs he toted after the 1909 Martian opposition. That impression was that life on Mars was an illusion.

Defeating the Martians?

In addition to becoming an increasingly respected and well-known scientist in both professional and popular circles, Hale also produced what Lowell had sought for years: photographic evidence that convinced viewers. Hale participated, often in leadership roles, in the burgeoning technical capabilities of American astronomy in the late-nineteenth and early-twentieth centuries.[541] He had access to the largest telescope lenses and the best equipment. In 1909, he used the Mt. Wilson 60-inch reflector to take photographs of Mars during opposition.

The difference in technology between Mt. Wilson (60-inch lens) and Lowell (24-inch lens) was enough to add a great deal of legitimacy to Hale's photographs and his claims thereof. They were larger and more detailed. But, in addition to the technological superiority of Mt. Wilson, the observatory also held claim to the environmental authority that Lowell had pointed to as his observational asset. The combination of these two forms of justification went far to end the canal debate.

In fact, two people produced compelling evidence against the canals of Mars during the 1909 opposition. It was no surprise that Hale, given his long history of

---

[541] See John Lankford and Ricky L. Slavings, *American Astronomy: Community, Careers, and Power: 1859-1940,* (Chicago: Chicago University Press, 1997) and W. Patrick McCray, *Giant Telescopes: Astronomical Ambition and the Promise of Technology,* (Cambridge, MA: Harvard University Press, 2006).

association with Martian critics, participated in the refutation of life on Mars. The other observer, however, was a much less likely entrant into the ranks of habitation critics: Eugene Antoniadi (1870-1944). Early in his career Antoniadi, worked as assistant to Camille Flammarion. He began his astronomical work in Constantinople (Istanbul), where he was born, and submitted papers to the journal for the French Astronomical Society, which Flammarion edited. In 1893, Antoniadi visited Flammarion at his private observatory near Paris. After the initial visit, he stayed on as Flammarion's assistant until 1902. At the time, Antoniadi was a believer in life on Mars and aided Flammarion in producing canal-laden maps and, it is likely, in some of Flammarion's psychical theories involving Mars.

In 1883, seven years prior to Antoniadi's arrival, Flammarion received a generous donation of a chateau in Juvisy-sur-Orge (about fifteen miles south of Paris) so that he might adapt the home into an observatory and astronomical research center. He equipped the chateau with a dome and a medium-sized refractor, the main lens measuring about 9.4 inches in diameter. At Juvisy, Flammarion and Antoniadi observed Mars and documented canals and other features. Because of the success and wide readership of Flammarion's popular books on Mars and general planetary astronomy, Juvisy became the epicenter for Martian research (before Flagstaff).[542] After Lowell entered into the field of Martian research, he visited Juvisy every other summer.[543]

Antoniadi continued to observe Mars after he left Juvisy in 1902. By 1909, he was the director of the Mars section within the British Astronomical Association (despite

---

[542] Willian Sheehan, *Planets & Perception: Telescopic Views and Interpretations*, 1609-1909, (Tucson: University of Arizona Press, 1988), 169.
[543] Ibid.

being a resident of France). He had become an authority on the planet. Also by 1909, Antoniadi had become skeptical of the existence of Martian canals and general Martian inhabitation. His skepticism, however, became outright refutation that autumn.

During the opposition in the early Fall of 1909, Antoniadi had the opportunity to observe Mars with the third-largest refractor in the world at Meudon Observatory (1879) and he used these observations and the photographs that he produced there to draw a series of maps that seemed to demonstrate that canal lines were features of low resolution.[544] He did this by adjusting the settings of the Meudon refractor and observing on both clear and cloudy nights and then drawing what he saw with the given variables. When conditions were good and the telescope set to a high magnification, the lines faded into shaded areas and smaller more natural features. When either at low magnification or cloudy skies, or both, these features appeared to the eye as distinct lines.

At about the same time Antoniadi was working at Meudon, during the opposition of 1909, Hale harnessed the power of the 60-inch at Mount Wilson to take photographs of the surface of Mars. These photographs inflicted significant and lasting discredit to the theory of Martian canals and of life on Mars in general. People were excited about the opposition and the potential for life on Mars. Hale was a popular public figure and, as Helen Wright describes, he was involved in the canal controversy by virtue of being someone people could ask about it. He "was bombarded with questions from those who wanted to know if the canals were built by human beings."[545] Hale did not believe in the

[544] Meudon Observatory was founded by eminent French astronomer Jules Janssen (1824-1907). The largest lens at Meudon, between Paris and Versailles, was about 33 inches in diameter.
[545] Wright, 257.

canals, but wanted to get to the bottom of the issue and find out for himself what the markings could be.

Like Antoniadi, Hale adjusted the view of Mars through the telescope by adjusting the magnification. He used two different levels. With low magnification, Hale could see the resemblance with Lowell's drawings. But under high magnification, he saw something very different. The straight lines that Schiaparelli, Lowell, Flammarion, and others saw were in fact very irregular, nonlinear, and made up of smaller parts.[546] The canals were, as Hale reasoned, simply a combination of low magnification mixed with a little imagination.[547] His and Antoniadi's methods and interpretations were very similar except that Antoniadi focused on making new maps and Hale on producing photographs.

On December 29, 1909 the British Astronomical Association (BAA) held their annual meeting and Martian canals were the first thing that they discussed. Neither Hale nor Antoniadi were present, but they were both cited for their evidence against canal theory. Lunar specialist Samuel A. Saunder (1852-1912) was the first to present. He led off the meeting by showing the attendees two photographs of Mars taken by Hale at Mount Wilson. Beyond this, however, Saunder extolled the atmospheric assets of Mount Wilson and went into detail about all its environmental and technological advantages. Saunder noted the elevation, showed photographs of the site, and described that "the definition on the summit was really magnificent."[548] But Saunder was not content to

---

[546] Ibid., 257-8.
[547] Ibid., 258. For more on Hale's techniques see Donald E. Osterbrock, *Pauper and Prince: Ritchey, Hale, & Big American Telescopes*, (Tucson: University of Arizona Press, 1993), 110.
[548] "Report on the Meeting of the Association, Held Wednesday, December 29, 1909, at Sion College, Victoria Embankment, E.C." *Journal of the British Astronomical Association*, Vol. 20, Issue 3, 119.

merely tell the rest of the meeting about the exceptional conditions at Mount Wilson. He wanted to give them a demonstration. He showed a picture of a dense fog that had rolled into the Los Angeles area from the ocean. But, as he pointed out, the fog had no effect on observations at Mount Wilson because the observatory was located too high for it to reach.[549] In the end, Saunder returned to Hale's photographs of Mars and reaffirmed that they were taken under the best conditions, with the biggest telescope available, and they did not show canals.

Walter Maunder, who undertook the optical illusion experiments at Greenwich in 1903, was present that day at the BAA and was, not surprisingly, the first to comment on Saunder's presentation. He seemed excited and suggested to the group that "they must all agree that the photographs of Mars which they had just seen were the most wonderful and important of any that had been presented to them so far."[550] In Maunder's opinion, Hale's photographs were "so sharp and distinct" and "the markings came out so clearly" that it was clear that Hale had made "a very great stride."[551] He also made a point to reiterate that "there was no indication of the spidery network covering Mars which Mr. Lowell had acquainted them with."[552]

As it happened, however, Maunder was not finished. He had with him Antoniadi's report to read before the group. Antoniadi, the director of the Mars section, could not come to the 1909 meeting but sent word of his observations earlier that year as

---

[549] Ibid., 120.
[550] "Report on the Meeting of the Association," 122
[551] Ibid., 122.
[552] Ibid., 123.

well as copies of his maps and other drawings.[553] Antoniadi's maps confirmed that, like the Mount Wilson photographs demonstrated, when the supposed canal lines are viewed with high magnification they dissolve into more organic features. According to Maunder, Antoniadi's work might finally "bring them [the BAA] to a most satisfactory conclusion" on the topic of Martian canals.[554] The final declaration Maunder suggested, of course, was that there were none.

Maunder believed that if they could finally put the issue to rest, it would be good for both scientists and nonscientists alike. He urged,

> They [the public] need not occupy their minds with the idea that there were miraculous engineers at work on Mars, and they might sleep quietly in their beds without fear of invasion by Martians after the fashion that Mr. H. G. Wells had so vividly described.[555]

To further support the conclusion of the canal debate, Maunder reminded the group that Antoniadi's research was "supported by the wonderful photographs from Mount Wilson."[556]

Other members of the BAA were not as adamant as Saunder and Maunder, but still agreed that the artificiality of canals seemed to be sufficiently disproved. President of the BAA Henry Park Hollis (1858-1939) called Maunder's proclamations "a little controversial."[557] Hollis agreed that the theory of Martian engineering was unsubstantial and fairly-well refuted, but he was not willing to completely dismiss the existence of linear markings. In a diplomatic tone, he summarized "there are markings on Mars which

---

553 Antoniadi sent a copy of these maps to Lowell and they are available to view in the Lowell Observatory Archives. Antoniadi's artistic talent is remarkable, as is the distinctions he showed in the appearance of features at different levels of clarity and magnification.
554 "Report on the Meeting of the Association," 123.
555 Ibid.
556 Ibid.
557 Ibid

are seen by many persons…some say that they are straight complete lines, others that they are a succession of dots or patches."[558] Though likely not of artificial origin, it could not be assumed that the issue was completely settled. Director of the Jupiter section Rev. Theodore Philips (1868-1942) commented much the same way. To be sure, Philips noted, there existed "no ground whatever for believing the Martian canals as canals."[559] But it might be unfair to reject the observations of the canal theorists outright. Philips believed that even Antoniadi's maps, "the most wonderful they had seen, and quite different from those they had been accustomed to," demonstrated some resemblance to earlier ones containing canal lines.[560] It could still be the case that there were larger linear features on the surface on Mars, but these, everyone who spoke at the meeting agreed, were not canals.

The diplomatic efforts of Hollis and Philips were lost to the press and the public. *The New York Times* described the BAA meeting as concluding definitively and for all that the canals were mere illusions of mind and eye. On December 30, the day after the meeting, a special to the *Times* reported that there was "no doubt" that canal theory had been disproved.[561] This invalidation came about through photographic evidence provided by, the article was certain to point out, Hale and Mount Wilson.[562] These photographs combined with Antoniadi's maps led to the conclusions that canals were

---

[558] Ibid., 124.
[559] Ibid.
[560] Ibid.
[561] "Deny Mars Has Canals: British Association Hears Astronomers' Views Combating the Theory," *New York Times* (New York, NY), December 30, 1909. Special cable to the NYT appearing on the front page.
[562] Ibid.

never real and that they were "explained by the effect on the eye of patterns of dark spots."[563]

In the retelling of the BAA meeting in the press, Maunder also came out as playing a more important role than what he did. In reality, he only delivered Antoniadi's paper. But on January 16, 1910, the *New York Times*, reporting further on the event, described that Maunder had "shattered" the theory of canals on Mars. This article quoted Maunder directly as saying,

> The explanation given by M. Antoniadi, director of the Mars section, is a satisfactory one. It is that the supposed canals are the effect on the eye of congeries of dark spots. There never was any real ground for supposing that we had in the marking of Mars any evidence of artificial action. Had it not been that the idea was a somewhat sensational one, we would never have heard of it, and it the better for science that it is now completely disposed of.[564]

The article also reiterated the role of Hale, Mount Wilson, and its showcase 60-inch telescope. While Antoniadi's drawings were compelling, the photographs Hale made during the 1909 opposition had provided the sure proof to settle the canal debate once and for all.

A week later, on January 23, the *Los Angeles Times* also reported about how Maunder had "disposed of" the theory of canals of Mars.[565] But the *LA Times* emphasized local hero Hale's role more than its counterpart in New York. The article related that, in the end, life on Mars was nothing more than "a delusion spoiled by the Mount Wilson telescope."[566] Furthermore, in no uncertain terms, the paper called canal

---

[563] Ibid.
[564] "Is Mars a Delusion? Greenwich Observatory Man Finds No Martians and No Canals," *New York Times* (New York, NY), January 16, 1910.
[565] "Mythical Canals of Mars" *Los Angeles Times* (Los Angeles, CA), January 23, 1910.
[566] Ibid.

theory "one of the quaintest and most unreasonable of popular superstitions."[567] The *LA Times* article also quoted William Pickering's 1908 article in *Harper's* to offer further explanations for what the so-called canals could be. But nowhere did they mention Lowell's name. He was no longer relevant, no longer the popular hero he once was.

Hale & Schiaparelli: The Canal Debate Comes Full Circle

The astronomer that many credited with producing final evidence against Martian canals, Hale, and the astronomer that effectively began the debate decades before, Schiaparelli, corresponded in the first few months of 1910. Hale was clearly a little hesitant to contact Schiaparelli. He told the Italian astronomer in his first letter, January 1910, "I have delayed in writing you about my work on Mars during the opposition, as I hoped I might be able to obtain further observation."[568] Hale, typically the perfectionist, wanted to present as unassailable a case as possible to Schiaparelli, but the 60-inch had been taken up by other projects in the intervening months. Hale had been "able to devote but little time to Mars."[569] He went ahead, however, and sent the photographs that he took in October. "I am sure that much better ones could be obtained with the 60-inch," Hale wrote, "if special apparatus had been available."[570] He also thought that perhaps greater enlargements would be preferable. But, as it were, Hale outlined the procedures he used for obtaining the photographs including the telescope configuration, the usefulness of red screens on the photographic plates, the exposure time, and all the rest of the details of his observational and photographic techniques. Hale was apologetic that he

---

[567] Ibid.
[568] George Ellery Hale to Giovanni Schiaparelli, January 12, 1910, *George E. Hale Papers*, Caltech Archives, California Institute of Technology. Original letter was written in French, translation by author.
[569] Ibid.
[570] Ibid.

did not have more or better prints, but did not mince words about the interpretation of the photographs that he had.

Hale anticipated the argument made so many times by Lowell and his supporters, that the size of the telescope matters less than the atmospheric conditions surrounding it. But, as he pointed out, the 60-inch at Mount Wilson had both size and clarity of atmosphere. Hale clearly favored the use of large apertures, but also recognized that having both big lenses and a steady climate made for ideal results. According to Hale, "I have frequently observed the Moon under excellent conditions with the 40-inch Yerkes refractor and many other smaller instruments, but have never seen the details so perfectly defined as with the 60-inch reflector on Mount Wilson."[571] This was true with Mars as well. Hale had "no doubt of the decided advantages of a large aperture when the atmospheric conditions are good."[572] Atmospheric conditions were important, like Lowell argued in the popular press for years, but so was using the best instruments and biggest lenses. So why not have both?

"You will see that the photographs show no straight 'canals' or evidence of geometrical structure," Hale affirmed.[573] He made it clear to Schiaparelli that he did not see canals during his observations nor did he believe they existed. That was not to say that the Martian surface was featureless. In fact, the true details of the Martian surface were finer and more complex than Schiaparelli's maps, more intricate than a grid of straight lines. Hale's observations revealed not fewer details, but more. "Much more so

[571] Ibid.
[572] Ibid.
[573] Ibid.

than in any drawing I have ever seen," Hale noticed.[574] Though some areas were "crowded with delicate detail," it remained clear to Hale that "no narrow straight lines, or other appearance of geometrical structure, were detected at any time."[575]

Hale was not the only person to observe Mars with the Mount Wilson 60-inch. He listed six members of his staff who saw the same things he did.[576] In addition to the other Mount Wilson astronomers, Hale also cited Charles Greeley Abbot of the Smithsonian Astrophysical Observatory (and member of Lick's Mount Whitney expedition) and Andrew E. Douglass, "formerly of the Lowell Observatory," as confirming his observations.[577] These eight people, also viewing Mars with the Mount Wilson 60-inch during the opposition, saw nothing resembling canals either. But they did see the fine details that Hale saw and captured in his photographs.

Schiaparelli replied in February, but did not believe or agree with Hale. He maintained that, though Hale's photos did not show them, his channel lines were real. Schiaparelli was polite to Hale and grateful for the prints. "I owe you many thanks for the information you have sent me on your observations of Mars during the last opposition," replied Schiaparelli, "and even more for the beautiful photographs obtained with the powerful instruments of Mt. Wilson."[578] But, to Schiaparelli, the Mount Wilson photographs proved nothing.

[574] Ibid.
[575] Ibid.
[576] Edward Fath, Walter S. Adams, Horace Babcock, Ferdinand Ellerman, Frederick Seares, and Charles Edward St. John.
[577] George Ellery Hale to Giovanni Schiaparelli, January 12, 1910. Douglass was one of Lowell's first assistants at Flagstaff.
[578] Giovanni Schiaparelli to George Ellery Hale, February 10, 1910, *George E. Hale Papers*, Caltech Archives, California Institute of Technology. Translation by author.

Schiaparelli agreed that Hale's photographs did not show any canals, but that this was due to it being the wrong season on Mars. Other observations in Europe during the 1909 opposition "showed no traversing geometric appearance, or regular linear system" and Hale's photographs confirmed these prior interpretations.[579] This, Schiaparelli explained, was just how the waterways on Mars worked. "In consulting my previous observations," Schiaparelli stated, "I see that this result could be expected to a certain measure."[580] The geometric lines, according to Schiaparelli's own observations, were faint or absent during several other oppositions when the timing of the Martian seasons was off. "These are the conjectures that I think are able to be formed now in the presence of proven facts," noted Schiaparelli.[581] He pointed to Lowell's success in photographing the canals and urged Hale to keep trying. According to Schiaparelli,

> Mr. Lowell's experiment in 1907 has shown that photography can reach the point of distinctly representing geometric lines and polygonations: what has been possible at Flagstaff will probably be accomplished at Mt. Wilson.[582]

Perhaps if Hale kept up Martian observations at Mount Wilson during future oppositions, Schiaparelli encouraged, he could accomplish what Lowell had in documenting the true surface features of Mars. The next opposition should occur during the right season.

In his next and final letter to Schiaparelli, in April, Hale compared his photographs directly to those made at Lowell Observatory. Hale asked Schiaparelli, "Do you consider them [the Mt. Wilson photos] equal or inferior to those made at Flagstaff?"[583] Others who had seen Hale's photographs of Mars, particularly Antoniadi

---

[579] Ibid.
[580] Ibid.
[581] Ibid.
[582] Ibid.
[583] George Ellery Hale to Giovanni Schiaparelli, April 4, 1910, *George E. Hale Papers*, Caltech Archives, California Institute of Technology. Translation by author.

as well as "several English astronomers," praised them as very detailed and "seem to regard them as superior to Lowell's." There was also one major problem with Schiaparelli's seasonal explanation. Hale granted that the difference in seasons "might account for our failure to photograph such canals during the recent opposition." But, at the same time, Hale wondered why Lowell, in a "recent number of *Nature*," had claimed to have seen and photographed the canals during the 1909 opposition. If they were not visible that year, how could Lowell see them? Hale did not see how Schiaparelli's account of seasons could be true if "Lowell succeeds in photographing narrow linear canals" when they were supposed to be empty. Along with this letter, Hale sent some enlarged prints of his Mars photographs. He thought it "possible to make photographs decidedly superior" to these, and assured Schiaparelli that he would do so during the next opposition. But the existing ones were good enough to disprove Lowell. Hale assessed, "All of my photographs confirm each other, and leave no doubt in my mind that Lowell's drawing is incorrect."

In this second letter, Hale also explained his interpretation of the Martian surface. To be sure, "There does not seem to me the least reason to doubt that large telescopes, when used under good atmospheric conditions, must give much better images of Mars than small ones." This seemed obvious to Hale. Furthermore, he had "tested this point by reducing the aperture of the 60-inch reflector on several occasions." Given this difference in what can be seen with large and small telescopes,

> My own impression is that the appearance of straight lines on Mars is due, in large measure, to imperfections of the image, and that with powerful instruments, under the best atmospheric conditions, straight lines are not likely to be seen at any time.[584]

---

[584] Ibid.

In the end, according to Hale, the observer was not at fault for seeing such straight lines. He did not want to give Schiaparelli the idea that his "very valuable drawings" were to blame in creating wrong ideas. Hale clarified,

> I merely think that if you had used more powerful instruments, in a better atmosphere, the straight lines would have appeared more irregular. I also believe…that many of the very narrow straight lines drawn by Lowell are illusory, and would not be seen under better conditions."[585]

Schiaparelli did not respond to Hale's April 1910 letter. As it turns out, their correspondence ended there. Schiaparelli, aged seventy-five, died in early July 1910.

The opposition of 1909 brought about convincing evidence against the appearance of canal lines on the surface of Mars and, by extension, a belief in life on Mars in general. This evidence came with the authority of the best technology available at the time, the 60-inch reflector at Mount Wilson. It also came from the authority of a Martian expert, Eugene Antoniadi, a former assistant to Camille Flammarion. Antoniadi also carried with his observations the backing of a sizeable telescope – the 33-inch at Meudon.

In addition to this justification of scientific authority based on technology and technological access, the photographs from Mount Wilson also presented the personal authority of George Ellery Hale as a prominent and popular astronomer. This was not very different than the position that Lowell held with the American population prior to Hale's star began to rise. Both appeared as larger-than-life in the press. Both appealed to exaggerated and romanticized visions of their own work. Both made claims to superior observations based on atmosphere, climate, and elevation.

---

[585] Ibid.

But Hale's images had some clear differences as well. He emphasized the efficacy of large telescopes, where Lowell used atmosphere as a means to undermine the assumption that bigger lens meant better views. Hale also showed a different view of science that moved away from observational astronomy toward astrophysical research. He departed with the notion of lone genius and was anything but an outcast in the world of professional science. Also departing from Lowell, Hale emphasized a view of the scientists not removed from society, as Lowell portrayed himself, but rather holding political influence. This political role for science would manifest on a large scale when, during World War One, Hale organized the National Research Council to mobilize American science for war research. He later turned this model, in cooperation with former allied powers, into the International Research Council. In a manuscript titled "The Responsibilities of the Scientist," notes for an article later published in *Science*, Hale described changes in the relationships between science, government, and society after the first decade of the twentieth century. Hale asked, loftily, "How may they [scientists] best serve the world?"[586]

[586] Ibid., [2].

Conclusion

Martians Die Hard

"Mars will certainly be ignored in the future by really popular science" assessed a satirical article that appeared in the *New York Times* during the 1892 opposition. This prediction came about because, according to popular accounts by Flammarion and Wiggins, Martians were much more advanced than humans. Why, then, would people want to talk to a population of beings that would treat Earthlings with "pitying condescension" or "arrogant contempt?" The more sympathetic readers might have felt sorry for Martians in that their orb was soon to become an oubliette. But, the article reminded these sensitive types, of the Martian's fate, "it is their own fault." Instead of looking to contact a more advanced race of beings, perhaps it would be of more long-term benefit for astronomers to find a more "unenlightened planet" with which to converse. [587]

Beyond this assessment of the value of communication with advanced beings, this article also recognized and described the different conversations occurring in newspapers and magazines about life on Mars. Besides taking aim at those who wanted to communicate with Mars, it also targeted general supporters of Martian inhabitation as well as its critics. Of the latter, the "old-fogy astronomers," and "unenterprising and unimaginative fellows" distanced themselves from the public. They kept their observations out of popular media, at least for a long time. They were "always averse to

[587] "The Folks on Mars," *New York Times* (New York, NY) August 7, 1892.

telling what they know quickly enough to make information available for timely and lively articles in sensational newspapers."[588]

Of the Martian supporters, however, they were only too eager to fill the void. These scientists and science popularizers were far less concerned about "figures and measurements and the dry bones of science." When the old-fogies were unavailable to report their findings, the popularizers were "always willing to tell a great deal more than they know, if necessary, in order to entertain the public." Though satire, the article got to the heart of the fact that no group was truly communicating effectively with popular audiences.[589]

There were tensions between those scientists who sought public audience as a basis of support and credibility and those who preferred to carry out their research outside of the public gaze. The issue of life on Mars brought the issue of how to create and communicate popular science to the forefront. People like Lowell and Flammarion were prolific writers and had talents for appealing to general audiences. Their critics, professional scientists like Newcomb, Campbell, the Pickerings, and others, were aloof at first but soon learned that they needed to communicate more effectively with the public or their criticisms would simply go unheard and unheeded. During the course of the Martian controversy, beginning in the late nineteenth century, professional scientists became more actively engaged in public discourse to try to quell the sensations that they saw science popularizers as wrongly perpetuating.

[588] Ibid.
[589] Ibid.

1892 proved to be a very early point in the controversy about life on Mars. These discourses – the existence of canals, the duties a scientist owes to the community, and how to contact Martians – continued until 1909-10. At this point, it seemed that proof against the presence of canals had settled the debate and a new authority, Hale, emerged to sway public opinion against Martian inhabitation. But, though Hale's photographs and Antoniadi's maps convinced a lot of people, they did not convince everyone. Once an idea becomes popular, it is very difficult to un-ring the proverbial bell.

For some people, Martian canals never receded into the lifeless backdrop of blurred lines and optical illusions. They remained very much a part of reality, or at least possibility. When Hale wrote to Schiaparelli, Schiaparelli did not change his mind about the existence of straight lines on the surface of Mars. He simply made the data that Hale presented him fit into his existing theories about how the Martian channels operated.

Lowell did not change his mind either. In fact, at least at first, he fought on tenaciously for his theories of life on Mars. In 1910, Lowell published three articles in *Nature* arguing for the continued existence of Martian canals. In early February, Lowell wrote "Markings on Mars as seen with Small and Large Telescopes," rehashing his argument that large telescopes showed less definition in planetary surfaces than did smaller ones.[590] Later that month, Lowell's article "The New Canals on Mars" appeared. In this paper, Lowell reported new canals that he saw during the 1909 opposition. They were not new in that he had not seen them before, they were new in that the Martians just built them.[591] In March 1910, Lowell visited Flammarion at Juvisy and, despite the

[590] Percival Lowell, "Markings on Mars as seen with Small and Large Telescopes," *Nature*, Vol. 82, February 3, 1910: 397.
[591] Percival Lowell, "The New Canals of Mars," *Nature*, Vol. 82, February 24, 1910: 489-491.

recent blows to his theories on an inhabited Mars, delivered a talk to the French Astronomical Society.[592] In August 1910, Lowell elaborated on the new canals in "Mars in 1909 as seen at the Lowell Observatory." This article included six canal drawings from the 1909 opposition.[593] He was by no means out of the picture entirely and remained steadfast in his conviction that life existed on Mars and he could almost see them constructing their massive canals.

Numerous members of the public remained committed to canal theory. Lowell, as well as his successors, continued to receive letters from amateur astronomers and other interested readers about the potential for life on Mars. R. Connery of San Antonio, Texas, for example, wrote to Lowell in 1915 about an "important discovery" that he had recently made. Connery, having written several letters to Lowell Observatory already, was still "firmly convinced that in the month of Sept. 1909 I discovered that the Planet Mars is inhabited." [594]

Connery was also still convinced of the ability to contact Martians. He seemed not to realize that Lowell never supported this endeavor. Connery made his important discovery with mirrors and a large magnifying glass. His research was based on the premise that if two planets were inhabited, like Mars and Earth, there would exist "some system of wireless signals between them and if these wireless signals could be caught on a reflector." On that fateful day in 1909, Connery had almost given up hope when, at last, like Tesla did in 1899, he caught wireless signals emitting from Mars. It is unclear

---

[592] Percival Lowell to Camille Flammarion, February 11, 1910 and May 17, 1910, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory. Original in French, translation by author.
[593] Percival Lowell, "Mars in 1909 as seen at the Lowell Observatory," *Nature*, Vol. 84, August 11, 1910: 172-73
[594] R. Connery to Percival Lowell, March 27, 1915, *Percival Lowell Papers*, Lowell Observatory Archives, Lowell Observatory.

how he caught these signals – perhaps it bounced off the mirrors, through the magnifying glass, and onto some kind of recording device. Nonetheless, Connery assured Lowell, "if you desire any information I would be glad to give it to you." The inventive amateur astronomer sitting impatiently on this monumental discovery expressed is faith in the man who inspired him, telling Percival Lowell, director of Lowell Observatory in Flagstaff, Arizona, "I always believed in your theory."[595]

In 1957, eighty years after Schiaparelli's maps, Earl Slipher, director of Lowell Observatory at that time, still held out that canals were possible. In part of a six-episode Disney special called "Mars and Beyond," Slipher explained that though definitive photographic proof of Martian canals had "never been obtained," they had not been entirely disproven either. Half a century had passed since the younger Slipher served as the chief photographer on the Lowell Expedition to the Andes (1907), yet the lack of conclusive photographic proof of canals was not, in his estimation, because they were not there. The real reason was more general; no one had been able to get close enough to take irrefutable photographs of the Martian surface. Adding further to the possibility for the canals to someday reappear, exposure times for planetary photographs were still between one and two seconds. An improvement from fifty years prior, no doubt, but still not ideal. [596]

After his older brother retired in 1952, Earl Slipher took over the directorship of Lowell Observatory. "Mars and Beyond" described him as "one of the world's foremost authorities on Mars." Decades after Lowell's death, Lowell Observatory still stood as the

---

[595] Ibid.
[596] *Mars and Beyond (Part IV: Mars from Earth),* directed by Ward Kimball (1957; Burbank, CA: Walt Disney Pictures, 2004), DVD.

premiere authority on all things Mars. Despite that "there is a certain amount of guesswork about the surface of Mars" and all ideas about life on Mars were "pure speculation," Slipher still allowed for the possibility that canals were real."[597] He died in 1964, about three months before *Mariner 4* launched. In July 1965, *Mariner 4* went on the first flyby of Mars and sent back images from the planet's surface showing lot of craters, but no canals. At this point, canal theory was truly over.

---

[597] Ibid.

Bibliography

Archival Collections:

George E. Hale Papers, Caltech Archives, California Institute of Technology

Lick Observatory Records: Correspondence, University Archives, University of California, Santa Cruz.

Percival Lowell Papers, Lowell Observatory Archives, Lowell Observatory.

V. M. Slipher Papers, Lowell Observatory Archives, Lowell Observatory.

Published Sources:

"A Mysterious Call." *Daily Press*, Newport News, Virginia, August 10, 1907.

Abbot, C.G. "Water Vapor on Mars." *Science* 31, No. 808 (1910): 987-988.

Abbott, Arthur Vaughan. "Our Neighbor Mars." *Frank Leslie's Popular Monthly* XXXIV, No. 4 (1892): 28-34.

Aitken, R.G. "A Review of the Recent Observations of Mars." *Publications of the Astronomical Society of the Pacific* 22, No. 131 (1910): 78-87.

"Among the Stars: Prof. Wiggins Discourses Learnedly on Unknown Things." *Los Angeles Times*, August 5, 1894.

"An Immense Light on Mars." *New York Herald*, May 30, 1903.

"Astronomical Lecture: Director of Mount Wilson Will Show Remarkable Views and Tell of Discoveries." *Los Angeles Times*, January 28, 1909.

Ball, Robert S. "Signaling to Mars." *The Independent…Devoted to the Consideration of*

Politics, Social and Economic Tendencies, History, Literature, and the Arts Vol. 53, No. 2740 (1901): 1315-16.

Bartusiak, Marcia. *The Day We Found the Universe*. New York: Vintage Books, 2010.

Baum, Andreas W. "Varieties of Popular Science and the Transformations of Public Knowledge: Some Historical Reflections." *Isis* 100, No. 2 (2009): 319-332.

Bensaude-Vincent, Bernadette. "A Historical Perspective on Science and Its 'Others.'" *Isis* 100, No. 2, (2009): 359-68.

Bigg, Charlotte, David Aubin, and Philipp Felsch. "The Laboratory of Nature: Science in the Mountains–Mountains in Science, from the Late Eighteenth to the Early Twentieth Century." *Science in Context* 22, No. 3, (2009): 311-321.

Broks, Peter. *Understanding Popular Science*. New York: Open University Press, 2006.

Burnham, John C. *How Superstition Won and Science Lost: Popularizing Science and Health in the United States*. New Brunswick: Rutgers University Press, 1987.

Burnham, Sherburne Wesley. *Report to the Trustees of the James Lick Trust of Observations Made on Mt. Hamilton with Reference to the Location of Lick Observatory*. Chicago: Knight & Leonard Printers, 1880.

Campbell, William Wallace.

- "An Explanation of the Bright Projections on the Terminator of Mars." *Publications of the Astronomical Society of the Pacific* 6, No. 35 (1894): 103-112.
- "Wonders of Science." *Los Angeles Times*, June 14, 1894.
- "Concerning an Atmosphere on Mars." *Publications of the Astronomical Society of the Pacific* 6, No. 38 (1894): 273-283.

- “The Solar System.” *Albuquerque Evening Citizen*, January 22, 1907.

- “The Lick Observatory.” *The Outlook* 90, No. 5 (1908): 255

- “Comparative Power of the 36-inch Refractor of the Lick Observatory.” *Popular Astronomy* XVI, No. 9 (1908). In *Popular Astronomy Volume XVI*, edited by William W. Payne & H.C. Wilson. Northfield, MN: Goodsell Observatory, 1908): 560-562.

- “Note on the Spectrum of Mars.” *Science* 29, No. 743 (1909): 500.

Campbell, W.W. and Sebastian Albrecht “On the Spectrum of Mars as Photographed with High Dispersion.” *Science* 31, No. 808 (1910): 990-992.

Cerullo, John J. *The Secularization of the Soul: Psychical Research in Modern Britain*. Philadelphia: Institute for the Study of Human Issues, 1982.

Cooter, Roger. *The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth-Century Britain*. Cambridge: Cambridge University Press, 1984.

Cooter, Roger and Stephen Pumfrey. “Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Public Culture.” *History of Science* 32 (1994): 237-267.

Crossley, Robert.

- “Mars and the Paranormal.” *Science Fiction Studies* 35, No. 3 (2008): 466-484.

- *Imagining Mars: A Literary History*. Middleton, CT: Wesleyan University Press, 2011.

Crowe, Michael J. *The Extraterrestrial Life Debate: The Idea of the Plurality of Worlds from Kant to Lowell*. Cambridge: Cambridge University Press, 1986.

"Current Astronomy." *New York Times*, November 13, 1907.

Daston, Lorraine and Peter Galison. *Objectivity*. Brooklyn: Zone Books, 2010.

"Deny Mars Has Canals: British Association Hears Astronomers' Views Combating the Theory." *New York Times*, December 30, 1909

"Detective Work in Astronomy." *Current Literature* XLVI, No. 4 (1909): 441-442.

Dick, Steven J. *The Biological Universe: The Twentieth Century Extraterrestrial Life Debate and the Limits of Science*. Cambridge University Press, 1996.

Donald, Aida D. *Lion in the White House: A Life of Theodore Roosevelt*. New York: Basic Books, 2007.

Evans J.E. and E. Walter Maunder. "Experiments as to the Actuality of the 'Canals' Observed on Mars." *Monthly Notices of the Royal Astronomical Society* 63 (1903): 497.

"Flagstaff vs. Harvard." *New York Times*, November 9, 1909.

Flammarion, Camille.

- *Urania*. Translated by Mary J. Serrano. New York: Cassell, 1890.
- "New Discoveries on the Planet Mars." *The Arena* XV (1891): 2-18.
- "The Unknown: Part II," *The Arena* XX (1891): 160-171.
- *La Planète Mars et ses Conditions D'Habitabilité*. Paris: Guathier-Villars, 1892.
- "Extract from a Letter from M. Flammarion Relative to the Eclipse Comet of 1893, and to Bright Projections on the Terminator of Mars." *Publications of the Astronomical Society of the Pacific* 6, No. 38 (1894): 289.
- "A Séance with Eusapia Paladino: Psychic Forces," *The Arena* XVIII, (1897): 730-49.

- *Astronomy for Amateurs*. Translated by Frances A. Welby. New York: D Appleton and Company, 1904.

- *Death and Its Mystery: At the Moment of Death*. Translated by Latrobe Carroll. New York: The Century Company, 1922.

Flournoy, Theodore. *From India to the Planet Mars: A Study of a Case of Somnambulism with Glossolalia.* New York: Harper & Brothers, 1900.

"For a Better View of Mars." *New York Times*, November 24, 1909.

Fowler, Helen Thorneycroft. "The Planet Mars." *Current Literature* XI, No. 4 (1892): 431.

Fyfe, Aileen and Bernard Lightman. *Science in the Marketplace*. Chicago: University of Chicago Press, 2007.

Gregory, Jane and Steven Miller. *Science in Public*. New York: Plenum, 1998.

Golinksi, Jan. *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820*. Cambridge: Cambridge University Press, 1992.

Gordin, Michael D. *The Pseudo-Science Wars: Immanuel Velikovsky and the Birth of the Modern Fringe*. Chicago: University of Chicago Press, 2012.

Green, Nathaniel E. "Observations of Mars, at Madeira, in August and September 1877." *Memoirs of the Royal Astronomical Society* 44 (1879): 123-140.

Guthke, Karl S. *The Last Frontier: Imagining Other Worlds, from the Copernican Revolution to Modern Science Fiction*. Translated by Helen Atkins. Ithaca, NY: Cornell University Press, 1990.

Hale, George Ellery. *Ten Years' Work of a Mountain Observatory*. Washington, DC: Carnegie Institute, 1915.

Haynes, Renée. *The Society for Psychical Research 1882-1982: A History*. London: Macdonald, 1982.

Hetherington, Norris S. *Science and Objectivity: Episodes in the History of Astronomy*. Iowa State University Press: Ames, 1988.

Hewerd, E. Vincent. "Mars: Is it a Habitable World?" *The Living Age* 254, No. 3298: 741-52.

Holden, Edward S.

- *Hand-book of the Lick Observatory of the University of California*. San Francisco: The Bancroft Company, 1888.
- "What We Really Know About Mars." *Forum*, November 1892: 359-368.
- "Men of Mars." *Los Angeles Times*, July 22, 1894.
- "The Lowell Observatory, in Arizona." *Publications of the Astronomical Society of the Pacific* 6, No. 36 (1894): 160-169.
- "The Latest News of Mars," *The North American Review* 160, No. 462 (1895): 636-638.

Holden, E.S., J.M. Schaeberle, J.E. Keeler, and W.W. Campbell, "White Spots on the Terminator of Mars." *Publications of the Astronomical Society of the Pacific* 2, No. 10 (1890): 248- 249.

"Honors for Prof. Hale." *New York Times*, June 13, 1909.

"Hope to Show Life May Exist on Mars: Lick Observatory Astronomers Go to Mountain Top to Examine Planet's Spectrum." *New York Times*, September 9, 1909.

Houk, Rose. *From the Hill: The Story of Lowell Observatory*. Flagstaff: Lowell

Observatory, 2000.

Hoyt, William Graves. *Lowell and Mars*. Tucson: The University of Arizona Press, 1976.

Hughes, David Y. "*The War of the Worlds* in the Yellow Press." *Journalism & Mass Communication Quarterly* 43, No. 4 (1966): 639-646.

Hussey, W.J. "Report on Certain Sites in Arizona and California." *Report of Committee on Southern and Solar Observatories.* Washington, DC: Carnegie Institution, 1903.

"Irrigating an Arid World." *Los Angeles Times,* May 5, 1907.

"Is Earth Inhabited?" *The Oregonian*, February 2, 1908

"Is Mars a Delusion? Greenwich Observatory Man Finds No Martians and No Canals." *New York Times*, January 16, 1910.

"Is Not Convinced of Life on Mars." *New York Times*, August 31, 1907.

Kevles, Daniel J. *The Physicists: The History of a Scientific Community in Modern America.* New York: Alfred A. Knopf, 1978.

Kripal, Jeffrey J. *Authors of the Impossible: The Paranormal and the Sacred*. Chicago: Chicago University Press, 2011.

LaFollette, Marcel. *Making Science Our Own: Public Images of Science 1910-1955*. Chicago: University of Chicago Press, 1990.

Lane, K. Maria D.

- "Astronomers at Altitude: Mountain Geography and the Cultivation of Scientific Literacy." In *High Places: Cultural Geographies of Mountains, Ice, and Science*, edited by Denis Cosgrove and Veronica della Dora, 126-146. New York: I.B. Tauris, 2009.

- *Geographies of Mars*: *Seeing and Knowing the Red Planet*. Chicago: University of Chicago Press, 2011.

Lankford, John and Ricky L. Slavings. *American Astronomy: Community, Careers, and Power: 1859-1940*. Chicago: Chicago University Press, 1997.

Leonard, Louise. *Percival Lowell: An Afterglow*. Boston: Gorham Press, 1921.

Lightman, Bernard. *Victorian Popularizers of Science: Designing Nature for New Audiences*. Chicago: University of Chicago Press, 2009.

Lockyer, William J.S. "Review of Is Mars Inhabitable? A Critical Examination of Prof. Lowell's Book, 'Mars and Its Canals,' with an Alternative Explanation by Dr. Alfred Russell Wallace." *Nature*, February 13, 1908. In *Nature: A Weekly Illustrated Journal of Science*: *Volume LXXVII Nov 1907-Apr. 1908*. London: MacMillan, 1908: 337-339.

Lowell, A. Lawrence. *Biography of Percival Lowell*. New York: MacMillan, 1935.

Lowell, Percival.

- "Explanation of the Supposed Signals from Mars of December 7, and 8, 1900." *Popular Astronomy* 10: 185-194.

- *Mars and Its Canals*. New York: The MacMillan Company, 1906.

- "First Photographs of the Canals of Mars." *Proceedings of the Royal Society* 77, No. 515 (1906): 132.

- "A General Method for Evaluating the Surface-Temperature of the Planets; with Special Reference to the Temperature of Mars." *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science* 14, No. 79 (1907): 161-176.

- "Is Mars Inhabited?" *Outlook* 85, No. 15 (1907): 844-48.

- "Mars in 1907: Observations at the Lowell Observatory." *Nature* 76, No. 1974 (1907): 446.

- *Mars as the Abode of Life*. New York: MacMillan, 1908.

- "The Habitability of Mars." *Nature* 77, No. 2003 (1908): 461.

- "The Plateau of the San Francisco Peaks in its Effect on Tree Life in Two Parts." *Bulletin of the American Geographical Society* 41, No. 6 (1909): 257-270, 365-382.

- "Markings on Mars as seen with Small and Large Telescopes." *Nature* 82 (1910): 397-398.

- "The New Canals of Mars," *Nature* 82 (1910): 489-491.

- "Mars in 1909 as seen at the Lowell Observatory," *Nature* 84 (1910): 172-73.

"Los Angeles County: Correspondence from Its Cities." *Los Angeles Times*, July 19, 1909.

"Los Angeles County: Its Cities and Towns, Pasadena, Solar Union Amid Roses." *Los Angeles Times*, July 12, 1909.

Major, John. *Prize Possession: The United States and the Panama Canal: 1903-1979*. Cambridge: Cambridge University Press, 1993.

Markley, Robert. *Dying Planet: Mars in Science and the Imagination*. Durham, SC: Duke University Press, 2005.

Mars and Beyond (Part IV: Mars from Earth). Directed by Ward Kimball. 1957. Burbank, CA: Walt Disney Pictures, 2004, DVD.

"Mars Holds Secret Well: Astronomers Find no Hint of Life on Planet." *Los Angeles*

Times, September 15, 1909.

Maunder, Walter. “The Canals of Mars.” *Knowledge* 36, No. 217 (1903): 249-251.

McCray, W. Patrick. *Giant Telescopes: Astronomical Ambition and the Promise of Technology*. Cambridge, MA: Harvard University Press, 2004.

McNeil, John. *Something New Under the Sun: An Environmental History of the Twentieth-Century World*. New York: Norton, 2000.

“Measures Water Vapor” *Los Angeles Times*, September 2, 1910.

Miller, Nathan. *Theodore Roosevelt: A Life*. New York: William Morrow & Co. 1992.

Mitchell, S.A. “Water Vapor on Mars.” *Scientific American* 98, No. 12 (1908): 201-204

“Mlle. Smith, Medium.” *New York Times*, August 18, 1900.

Morus, Iwan Rhys. “Worlds of Wonder: Sensation and the Victorian Scientific Performance.” *Isis* 101, No. 4 (2010): 806-816.

“Mount Whitney Expedition” *Annals of the Astrophysical Observatory of the Smithsonian Institution III*. Washington DC: Smithsonian Institution, 1913.

Moyer, Albert E. *A Scientist’s Voice in American Culture: Simon Newcomb and the Rhetoric of Scientific Method*. Berkeley: University of California Press, 1992.

“Mythical Canals of Mars.” *Los Angeles Times*, January 23, 1910.

Nash, Roderick. *Wilderness and the American Mind*. New Haven, CT: Yale University Press, 2001.

“New Tests Indicate No Life on Mars.” *New York Times*, September 16, 1909.

“New Views About Mars.” *Littell’s Living Age* 211, No. 2733 (1896): 533.

“No Message from Mars.” *New York Times*, November 14, 1901.

“No Signals Sent from Ruddy Mars.” *San Francisco Call* 87, No. 50: 6.

"Nonsense about Mars." *Current Literature* XXX, No. 3 (1901): 257.

"Observations of the Planet Mars." *Nature* 46, No. 1194 (1892): 482-83.

"Offer Balloon to Todd." *New York Times,* May 7, 1909.

"Offer Money to Signal Mars." *New York Times*, April 27, 1909.

Osterbrock, Donald E., John R. Gustafson, and W.J. Shiloh Unruh. *Eye on the Sky: Lick Observatory's First Century.* Berkeley: University of California Press, 1988.

Osterbrock, Donald E. *Pauper and Prince: Ritchey, Hale, & Big American Telescopes*. Tucson: University of Arizona Press, 1993.

Pandora, Katherine. "Knowledge Held in Common: Tales of Luther Burbank and Science in the American Vernacular." *Isis* 92, No. 3 (2001): 484-516.

Pickering, William H.

- "An Explanation of the Martian and Lunar Canals" *Popular Astronomy* 12. No. 7 (1904): 439-442.
- "Different Explanations for the Canals of Mars," *Harper's Monthly Magazine,* January 1908: 29-34.

"Pickering vs. Lowell." *New York Times,* December 22, 1907.

"Pickering's Idea for Signaling Mars." *New York Times,* April 25, 1909.

Porter, Theodore. "How Science Became Technical," *Isis* 100, No. 2 (2009): 292-309.

Mary Proctor, "Astronomers are Alert as Mars Draws Near" *New York Times*, January 13, 1907.

Putnam, William Lowell. *The Explorers of Mars Hill: A Centennial History of Lowell Observatory*. West Kennebunk, ME: Phoenix Publishing for Lowell Observatory, 1994.

Reidy, Michael. “John Tyndall’s Vertical Physics: From Rock Quarries to Icy Peaks.” *Physics in Perspective* 12, No. 2 (2010): 122-145.

“Report on the Meeting of the Association, Held Wednesday, December 29, 1909, at Sion College, Victoria Embankment, E.C.” *Journal of the British Astronomical Association* 20, Issue 3: 119.

“Roosevelt Boasts of Canal.” *New York Times,* March 24, 1911.

Schindler, Kevin. *Images of America: Lowell Observatory*. Mount Pleasant, SC: Arcadia Publishing, 2016.

Secord, James A.

-*Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation*. Chicago: University of Chicago Press, 2003.

- “Knowledge in Transit.” *Isis* 95, No. 4 (2004): 654-673.

Shapin, Steven and Simon Schaffer. *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life*. Princeton: Princeton University Press, 1985.

Sheehan, William.

- *Planets and Perception: Telescopic Views and Interpretations: 1609-1909*. Tucson: The University of Arizona Press, 1988.

- *The Planet Mars: A History of Observations and Discovery*. Tucson: The University of Arizona Press, 1996.

“Shining Specks on Mars.” *New York Times*, August 5, 1894.

“Signaling Mars Impossible: Sir Robert S. Ball in The Independent” *New York Times*, June 23, 1901.

"Signals Mars from a Balloon," *New York Times*, May 1, 1909.

Slipher, Earl C. *A Photographic Story of Mars, 1905-1961*. Flagstaff: Lowell Observatory, 1962.

Slipher, Vesto Melvin

- "An Attempt to Apply Velocity-Shift to Detecting Atmospheric Lines in the Spectrum of Mars." *Lowell Observatory Bulletin* 17 (1905) in *Bulletins of the Lowell Observatory* I (Flagstaff: Lowell Observatory, 1911): 118.
- "Air and Large Telescopes." *Outlook*, December 1908: 867.
- "The Spectrum of Mars." *Astrophysical Journal* 26 (1908): 397-405.

"Something Like Human Intelligence on Mars." *New York Times*, October 27, 1907.

"Special to the New York Times." *New York Times*, July 7, 1907.

"Spirits May Talk to Mars." *Los Angeles Times*, May 6, 1909.

Strauss, David. *Percival Lowell: The Culture and Science of a Boston Brahmin*. Cambridge, MA: Harvard University Press, 2001.

"Strengthen Mars Theories: Prof. Lowell Received Additional Photographs Which Confirm Canal Belief." *New York Times*, September 6, 1907.

"Telephoning to Mars." *Los Angeles Times*, May 6, 1894.

"Tesla and Mars." *The Independent…Devoted to the Consideration of Politics, Social and Economic Tendencies, History, Literature, and the Arts* 53, No. 2720 (1901): 171.

Tesla, Nikola.

- "Talking with the Planets." *Collier's Weekly Journal of Current Events* 26, No. 19 (1901): 4-5.

- "How to Signal Mars." *New York Times*, May 23, 1909.

"That Message from Mars," *Scientific American* LXXXIV, No. 3 (1901): 34.

"The Folks on Mars." *New York Times*, August 7, 1892.

"The Lowell Observatory." *Boston Commonwealth*, May 26,1894.

"The Scheme to Signal Mars." *Popular Mechanics* 12, No. 1 (1909): 10.

"The Truth and Fiction of Astronomy." *Los Angeles Times*, August 8, 1894.

"There is Life on the Planet Mars." *New York Times*, December 9, 1906.

"To Spy the Martians When Earth is Nearest." *Los Angeles Herald*, January 15, 1907.

Very, Frank W.

- "The Presence of Water Vapor in the Atmosphere of Mars Demonstrated by Quantitative Measurements." *Science* 29, No. 735 (1909): 191-93.
- "Water Vapor on Mars: Reply to Campbell's Criticism." *Lowell Observatory Bulletin* 43 (1910) in *Bulletins of the Lowell Observatory* I (Flagstaff, AZ: Lowell Observatory, 1911): 239-240.

Wallace, Alfred Russel. *Is Mars Habitable: A Critical Examination of Professor Lowell's Book 'Mars and Its Canals,' With an Alternative Explanation*. London: MacMillan, 1907.

Wallis, Roy. *On the Margins of Science: The Social Construction of Rejected Knowledge*. Keele, UK: University of Keele Press, 1979.

"Water on Mars: Prof. Campbell's Observations Do Not Disproves Its Possibility." *New York Times*, November 20, 1909.

"Water Vapor in Mars Atmosphere." *New York Times*, February 26, 1908.

"Water Vapor in the Atmosphere of the Planet Mars." *Science* 30, No. 771 (1909): 474-

475.

H.G. Wells, *The War of the Worlds*. Edited by Martin A. Danahay. Toronto: Broadview, 2003.

"We May Talk to Mars, Says Prof. Pickering." *Los Angeles Times*, April 19, 1909.

"What of Interest Happened in a Day Up and Down the Great Pacific." *Los Angeles Times*, September 15, 1909.

"Will the New Year Solve the Riddle of Mars?" *San Francisco Call*, January 6, 1907.

Wright, Helen.

-*Explorer of the Universe: A Biography of George Ellery Hale*. New York: E.P Dutton & Co, Inc, 1966.

- *James Lick's Monument: The Saga of Captain Richard Floyd and the Building of the Lick Observatory*. Cambridge: Cambridge University Press, 1987.