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IMAGINATIVE GEOGRAPHIES OF MARS: THE SCIENCE AND SIGNIFICANCE OF THE RED PLANET, 1877 - 1910

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Imaginative Geographies of Mars: The Science and Significance of the Red Planet, 1877 - 1910

by

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Dedication

This dissertation is dedicated to

Magdalena Maria Kost,

who probably never would have understood why it had to be

written and certainly would not have wanted to read it,

but who would have been very proud nonetheless.

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Imaginative Geographies of Mars: The Science and Significance of the Red Planet, 1877 - 1910

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Over several decades spanning the turn of the twentieth century, Western astronomers' claims about the landscape and climate of Mars spurred widespread scientific and popular interest in the possibility that the red planet might be inhabited by intelligent beings far more advanced than humans. This dissertation challenges traditional interpretations of this episode – as an amusing example of science gone awry – with a critical re-investigation of the production of geographical knowledge about Mars in historical context. Based on extensive archival and documentary research, I offer a new explanation for the power with which the notion of an inhabited Mars gripped scholars and citizens alike, showing that turn-of the century scientific narratives about Mars derived much of their power and popularity from ties with the newly established discipline of geography. At the same time, the dissertation

reveals the Mars mania to be integrally connected with the history of geography, suggesting that scientific and popular representations of Martian geography also helped circulate knowledge claims regarding the geography of Earth.

Specifically, the dissertation examines astronomers' use of geographical rhetoric, imagery, method, and themes, analyzing the extent to which these elements contributed to their scientific credibility and popular reputations. I first focus on the development of Mars knowledge through cartography, examining the evolution of cartographic conventions and styles used to portray Mars and revealing how an early geometric map established the authority to influence the cartography of Mars over the next several decades. I show, furthermore, that much of the power and longevity of the inhabited-Mars hypothesis derived from this map's visual authority as a geographical representation, thus explaining why Mars maps were ubiquitous during the canal craze, with astronomers seemingly competing with one another to add cartographic detail. In addition to their deft manipulation of cartographic conventions, astronomers also often employed representational techniques from the popular travel narratives, explorer accounts, and geographical expeditions of the day to imagine a landscape they could never visit. Aligning themselves with the emerging observational geosciences, astronomers prioritized direct observation and rhetorically invoked a geographical gaze to establish legitimacy for their work, producing in the process a familiar, Earthlike picture of Martian geography that contributed to widespread interest in the planet's possible habitability.

These strong links between Mars astronomy and geographical science suggest that scientific claims about the red planet should be re-examined and re-contextualized in relation to terrestrial geographical knowledge production. Illustrating the value of this approach, the dissertation compares several Mars-related tropes with contemporaneous geographical descriptions of terrestrial landscapes and cultures. This analysis shows that Mars was constructed as an arid, irrigated, dying planet in many of the same ways that Earth's own desert regions were portrayed in imperial narratives. As astronomers and science writers drew on various audiences' understandings of arid landscapes, they also used Mars as a site of projection for geographical concerns regarding climate and landscape change. Similarly, dominant representations of Martian culture were influenced by Social Darwinist philosophy and the environmentally deterministic traditions of geographical writing about the non-Western Other. At the same time, however, the construction of a superior Martian in both scientific and popular texts and images indicates that the narratives surrounding Mars departed in significant ways from typical writing about the terrestrial world. The production of geographical knowledge regarding Mars is thus shown as a potential site for re-producing terrestrial geographies during a formative phase in geography's disciplinary history.

Table of Contents

List of Figures

CHAPTER 1. INTRODUCTION

> "Sufficiently like us to seem in part decipherable, Mars is yet sufficiently unlike to baffle the very conjecture it starts. It is this likeness linked to unlikeness in which lies its intellectual charm."
>
> – Percival Lowell, *Mars*, 1894

In the closing decades of the nineteenth century, astronomers reported fantastic advances in their knowledge regarding the geography of the planet Mars. They claimed to see its surface features more clearly than ever before and produced unprecedented maps showing the planet as a complex maze of intersecting land formations and water bodies. They reported for the first time that observed changes in the appearance of Mars could be interpreted with confidence as evidence that the planet was subject to weathering, vegetative growth, and atmospheric circulation. In addition, they announced the regular but temporary emergence of unusual bright and dark markings on the face of Mars.

In publicizing these findings about the Martian landscape and climate, astronomers spurred widespread scientific and popular interest in the possibility that the red planet might be inhabited. Reports regarding seasonal changes on Mars convinced many that the planet was "alive," while the discovery of its complex landscape geometry inspired vivid descriptions of an imagined advanced technological society. The revelation of periodic bright lights and dark lines visible

on Mars further captivated public attention, eventually producing a full-fledged popular mania over the "canals," as the lines were then called. Despite bitter disputes among astronomers over whether the lines actually existed, Mars science became a staple topic in newspapers, general interest magazines, and lecture halls across both Europe and North America.

This eruption of popular enthusiasm for Mars science has long interested historians of science, science fiction, and science popularization. The power with which the notion of an inhabited Mars gripped audiences has often been attributed to the personalities, philosophies, and practices of several influential Mars astronomers. Detailed examinations of these scientists have focused on their immersion in wider philosophical debates about the plurality of worlds, the nature of evolution, and the professionalization of astronomy as a discipline.[1] Many of these works have helpfully demonstrated that prominent astronomers brought their own philosophical and personal agendas into the Mars debates, complicating the processes by which knowledge about Martian geography was gathered, interpreted, and publicized. Sometimes, however, the Mars canal mania is adjudged with the benefit of hindsight

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[1] Steven J. Dick, *The Biological Universe: the Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge: Cambridge University Press, 1996); Michael J. Crowe, *The Extraterrestrial Life Debate 1750-1900: the Idea of a 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. Helen Atkins (Ithaca and London: Cornell University Press, 1983); William Sheehan, *Planets and Perception* (Tucson, Ariz.: University of Arizona Press, 1988); Noriss S. Hetherington, "Amateur Versus Professional: The British Astronomical Association and the Controversy Over Canals on Mars," *Journal of the* British Astronomical Association 86 (1976): 303-8; Noriss S. Hetherington, "Percival Lowell: Scientist or Interloper?," *Journal of the History of Ideas* 42 (1981): 159-61.

simply as an example of science gone awry, in which canal-mapping astronomers were led astray by their imaginations, and non-scientists were caught up in a silly fad.

Instead of dismissing the claims about life on Mars based on the modern scientific consensus that there are no canals or geometrical features of any kind in the Martian landscape, this study seeks to understand how such claims could be accepted as science, by exploring the historical context in which they were produced. To turn-of-the-century audiences, the arguments for an inhabited Mars made sense. Something in their content, their publicity methods, their interpretations, or their relation to other events and issues made them resonate. Scientists' claims inspired popular interest in the subject of Mars, and popular interest, in turn, influenced scientists' ability and willingness to make further claims.

Imaginative Geographies

It is no coincidence that the popular excitement surrounding Mars focused on its geography. Discussions about the planet's celestial dynamics – rotation, orbit, and moons – hardly received mention in the popular press, even though they appeared regularly in the astronomical literature. Instead, popular audiences gravitated strongly toward the topics of Martian landscape, climate and culture, issues that were then the focus of scientific and commercial investigation in many of Earth's regions as well. In their sensationally enthusiastic response to the geographical elements and meanings of scientific Mars reports, popular audiences gave astronomers an incentive

to take up further research in these areas and to publish their findings in the popular press.

At the junction of scientific investigation and popular zeal, a powerful new geography arose to portray the red planet. Although rooted in observational evidence, this geography was largely speculative. As a new *terra incognita* that was fundamentally inaccessible for direct human observation, Mars could be understood only through analogy, extrapolation, and inference. Astronomers easily assumed the vocabulary and narrative style of Earth's geographers to make these analogies and justify their inferences. Existing preconceptions about terrestrial geographies were thus introduced immediately into the discussions about Mars, powerfully influencing the direction of knowledge production.

Edward Said's concept of "imaginative geography"[2] thus provides a good point of analytical embarkation for this study, as it addresses the ways that texts, images, and maps can powerfully condition their audiences' beliefs about foreign landscapes and peoples. Said argued that Western geographic knowledge about the Middle East had long relied on an epistemological narrative that was traceable in the repetition of various tropes and literary conventions that consistently portrayed the Islamic World as inferior to Europe. According to Said, this powerful imaginative discourse, which bore little resemblance to the region's actual geography, was

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[2] Edward W. Said, *Orientalism* (New York: Pantheon Books, 1978).

uncritically accepted and repeated in “Orientalist” scholarship throughout Western Europe.

Said’s call for attention to the ways in which such imaginative geographies are produced, expressed, and circulated through cartography and texts has spurred much productive work by geography’s historians, especially in the last decade and a half. Following J.B. Harley’s now-classic contention that cartography should be viewed as a cultural practice fraught with ideological meanings and distortions that undermine its claims to scientific objectivity,[3] recent scholarship in the history of cartography has re-examined maps in terms of their powerful imaginative functions. Some of the most productive work in this vein has critically examined map series prepared by colonial-era explorers and administrators, especially noting the ways in which imperial cartographies metaphorically justified colonial activities or erased indigenous peoples from desirable territories.[4] These works indicate that even reconnaissance cartographies representing basic geographic data necessarily carry ideological meanings that influence or constrain geographical knowledge.

Scholarship in the broader history of geography and in historical geography has also taken up the issues that concerned Said, directly addressing the power and evolution of geographical ideas, perceptions, and knowledge in historical context.

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[3] J. B. Harley, "Deconstructing the Map," *Cartographica* 26 (1989): 1-20.

[4] Simon Ryan, *The Cartographic Eye: How Explorers Saw Australia* (Cambridge: Cambridge University Press, 1996); Denis Cosgrove, ed., *Mappings* (London: Reaktion Books, 1999); Matthew H. Edney, *Mapping an Empire: the Geographical Construction of British India, 1765-1843* (Chicago and London: The University of Chicago Press, 1997).

The recent work has sought to address many of the nuances that Said's work ignored in regard to the particular historical, national, and academic settings in which geographical knowledge is produced.[5] Again, much of the most productive work toward this end has focused on the colonial and imperial geographies of the nineteenth century, thus examining a critical moment in modern geography's disciplinary history.[6] The usefulness of geographical science and cartography to imperial endeavors helped establish and solidify geography's place in the Western academy. As a result, Western academic geography is still affected by the imaginative geographies that took root during the exact period of the Mars canal mania.[7] The scientific and popular imaginations of a geography for Mars might then be expected to have intersected with the geographical knowledges produced to describe Earth's many *terrae incognitae* contemporaneously.

The dissertation draws from and builds on the post-Said corpus through its exploration of the ways in which certain ideas about Martian geography, once established, powerfully conditioned subsequent representations, perceptions, and

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[5] See especially David N. Livingstone, *The Geographical Tradition* (Oxford: Blackwell, 1993) and David Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: Chicago University Press, 2003).

[6] Felix Driver, "Geography's Empire: Histories of Geographical Knowledge," *Environment and Planning D: Society and Space* 10 (1992): 23-40; Derek Gregory, *Geographical Imaginations* (Oxford: Blackwell, 1994); Anne Godlewska, "Map, Text and Image: The Mentality of Enlightened Conquerors: a New Look at the *Description De L'Egypte*," *Transactions of the Institute of British Geographers* 20 (1995): 5-28; Derek Gregory, "Between the Book and the Lamp: Imaginative Geographies of Egypt, 1849-50," *Transactions of the Institute of British Geographers* 20 (1995): 29-57; Felix Driver, *Geography Militant: Cultures of Exploration and Empire* (Blackwell, 2001).

knowledge claims. It considers the extent to which astronomical imagery and writing served to construct an imaginative geography of Mars that made the planet's unfamiliar landscape conceptually accessible to scientific colleagues and popular audiences. Through repetition and uncritical citation of each other's work, it finds, European and American astronomers created a powerful narrative that represented the red planet as an Earthlike, inhabited, engineered, and irrigated landscape. The dissertation departs from Said, however, by focusing on the nuances of an imaginative geography that varied extensively across time, national context, and social circles. The scientific construction and representation of a superior Other, in fact, is shown to confound the very categories that Said identified as pivotal to the development of European identity.

My analysis thus seeks to answer three primary questions about the Mars mania. First, how did scientific claims about the geography of Mars – as an inhabited desert planet – become so powerful and influential in the late nineteenth and early twentieth centuries? Second, what was the meaning and significance of the popular Mars mania that developed in both Europe and North America in response to scientific claims? And, third, to what extent did the Mars mania reflect and/or influence specific work at that time in the discipline of geography? The dissertation shows clearly that the inhabited-Mars hypothesis derived a significant measure of its

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[7] Neil Smith, *American Empire: Roosevelt's Geographer and the Prelude to Globalization* (Los Angeles: University of California Press, 2002).

power and popularity from methodological and representational ties with the newly established discipline of geography. The extent to which the scientific and popular narratives regarding Martian geography may have worked in reverse to influence terrestrial geography at the same time, however, is less clear. Dominant portrayals of Mars as an arid, irrigated planet peopled by intelligent and peaceful engineers show important parallels with common geographical tropes regarding Earth's own arid regions yet raise numerous discrepancies that require further attention.

Scope of Research

Starting with debates over the mapping of Mars in 1877-1878 and concluding with arguments over new photographs of Mars in 1909-1910, my study examines three decades of conflicting scientific claims regarding the physical and cultural geography of Mars. It profiles a variety of scientific publications, evaluating the narrative voice, literary structures, figures of speech, images, themes, and metaphors that helped establish various claims as credible and persuasive. For the scientific maps that often accompanied these publications, I have analyzed specific cartographic conventions such as scale, framing, selection and coding to make similar determinations regarding the prominence and influence of certain maps.

As a cultural historian of science, I concentrate not only on the content of Mars publications, but also on the circumstances surrounding their production and consumption. My analysis highlights the interactions among astronomers of differing

nationalities, competing institutions, and varying social groups, especially with regard to their contestation and negotiation of particular claims about the geography of Mars. Sources such as astronomers' personal correspondence with one another, with other intellectuals, and with publishers and audiences reveal authorial intentions, publication opportunities, and popular interest, showing the many ways in which individual astronomers skillfully cultivated audiences or accidentally alienated potential supporters. This focus provides a critical view of how astronomers positioned themselves and defined their scientific identities through their studies of Mars.

Additionally, I take up the issue of science popularization, which played a major role in the development of scientific Mars claims.[8] As popular interest in the red planet began to build at the end of the nineteenth century, it had an enormous influence on the fame, credibility, and legitimacy of certain astronomers.[9] The sensational or speculative Martian geographies that emerged in popular genres, therefore, are intimately linked to the construction of more "objective" scientific knowledge. To investigate these connections, I examine a number of primary sources

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[8] For a general overview of scholarship on science popularization, see Stephen Hilgartner, "The Dominant View of Popularization: Conceptual Problems, Political Uses," *Social Studies of Science* 20 (1990): 519-39 and Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science* 32 (1994): 237-67. For an example of recent approaches to the popularization of geography, see David N. Livingstone, "Public Spectacle and Scientific Theory: William Robertson Smith and the Reading of Evolution in Victorian Scotland," *Studies in History and Philosophy of Biological and Biomedical Sciences* 25 (2004): 1-29.

that were developed by writers and artists for popular audiences. Many of these novels, cartoons, newspaper features, poems, songs, sketches, and theatrical productions merely used Mars as a backdrop for other cultural commentary. To the extent that they influenced the popularity of Mars scientists or conditioned audience response to scientific claims, however, I take them seriously.

All of these sources – visual, textual, cartographic, scientific and popular – show that certain representational conventions became established over time in a broad imaginative geography of Mars. Within this geography, dominant narratives regarding Mars' physical and cultural geography helped make the planet's distant landscape conceptually accessible to scientific astronomers and popular audiences. The extent to which these narratives complemented and contradicted one another provides an analytical lens into the processes and meanings of geographical knowledge production for Mars. Through repetition and uncritical citation of each other's work, European and American astronomers created a powerful view of the red planet as an Earthlike, inhabited, engineered, and irrigated landscape. This imaginative geography was certainly more reflective of astronomers' own geographical notions than of the reality of Mars' surface characteristics. Nevertheless, it constrained subsequent investigations and compelled certain perspectives of Mars' geography both within and beyond the discipline of astronomy.

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[9] For a detailed discussion of the best-known Mars popularizer, Percival Lowell, see William Graves Hoyt, *Lowell and Mars* (Tucson, Arizona: University of Arizona Press, 1976).

Dissertation Overview

Primarily, the dissertation's re-contextualization of scientific narratives regarding Mars shows that the production and popularity of Mars science were driven largely by the extensive and remarkable use of geographical rhetoric, imagery, method, and themes.

Chapter Two focuses on the development of Mars knowledge through cartography. From the middle of the nineteenth century, formative early claims about Mars' possible habitability were presented in the quintessential geographical format – the map. The map was the foundation on which knowledge about Mars was built and the primary medium by which knowledge about Mars was communicated. This chapter examines the evolution of cartographic conventions and styles used to portray Mars, showing how an early geometric map gained authority over alternative views of the red planet and established a dominant style that influenced the cartography of Mars for the next several decades. As the geometric map of Mars evolved into a powerful visual icon, it became ubiquitous in the popular press and in scientific publications, thus underscoring the extent to which it helped confer authority on scientists' claims about Mars. When improved technologies of astronomical photography provided a new, more objective, visual format early in the twentieth century, however, the cartographic format lost significant authority. As the geometrical canal-maps became less persuasive, so did many of the inhabited-Mars proponents. The chapter shows, therefore, that much of the power and longevity of

the inhabited-Mars hypothesis derived from the map's visual authority as a geographical representation. This helps explain why Mars maps were ubiquitous during the canal craze, with astronomers seemingly competing with one another to add cartographic detail. It also points out the role of cartographic authority in supporting the credibility of astronomers who otherwise might not have been taken seriously.

Chapter Three expands this analysis to include other non-cartographic geographical representations. In addition to their deft manipulation of cartographic conventions, astronomers also often assumed the style, tone, and rhetoric of classic geographical narratives in their texts about Mars. At several levels, astronomers employed representational techniques from the ubiquitous travel narratives, explorer accounts, and geographical expeditions of the day to imagine a landscape they could never visit. Aligning themselves with the emerging observational geosciences, astronomers prioritized direct observation and rhetorically invoked a geographical gaze to establish legitimacy for their work. In the process, they produced a familiar, Earthlike picture of Martian geography that contributed to widespread interest in the planet's possible habitability. Even when their opinions clashed, astronomers' and science writers' rhetoric and imagery resonated with the geographically literate audiences of the late imperial era, contributing to the popular mania. This chapter shows the extent to which Mars astronomy relied on geographical conventions of observation and representation.

These strong links between Mars astronomy and geographical science suggest that scientific claims about the red planet should be re-examined and re-contextualized in relation to terrestrial geographical knowledge production. Illustrating the value of this approach, Chapter Four compares several Mars-related tropes with contemporaneous geographical descriptions of terrestrial landscapes. The analysis finds that Mars was constructed as an arid, irrigated, dying planet, in many of the same ways that Earth's own desert regions were portrayed in imperial narratives. This comparison posits geographical discourse as the origin of several key tropes about Mars, while also explaining their popularity with Western audiences. Given that seemingly fantastical and outlandish theories about the geography of an inhabited Mars were taken quite seriously at the turn of the century, the analysis finds that the production of an imaginative geography for Mars was part of a complex process of knowledge production. As astronomers and science writers drew on various audiences' understandings of terrestrial landscapes and cultures, they also used Mars as a site of projection for geographical concerns regarding climate and landscape change. The Mars discourse itself thus became a means of re-producing terrestrial geographies.

Chapter Five addresses the same processes, but extends the analysis from landscape to culture. In addition to the narrative that developed to describe Mars' physical geography, a parallel narrative developed around its probable cultural features. Dominant portrayals of Martian inhabitants and civilization strayed

significantly from the cautious statements of most astronomers, becoming the focus of most popularization and non-scientific attention. Just as was true for the representations of Martian landscapes, however, these popularized representations of its culture interacted with contemporaneous geographical narratives and reinforced knowledge about terrestrial cultural geographies. This chapter shows that dominant representations of Martian culture were influenced by Social Darwinist philosophy and the Orientalist tradition of geographical writing about the non-Western Other. At the same time, however, the construction of a superior Martian in both scientific and popular texts and images indicates that the discourse surrounding Mars departed in significant ways from typical writing about the terrestrial world. Martians were typically represented as more intelligent, more organized, more peaceful, and more technologically advanced than humans. Different audiences responded to this new discourse in different ways, however, suggesting that national context had a significant impact on the production, consumption, and circulation of Mars geographies. While British audiences were extremely cautious in their reactions to the inhabited-Mars theory, for example, American audiences enthusiastically embraced the extraterrestrial portrait painted by Lowell and his supporters. This chapter argues that the American willingness to consider the superior Martian as a non-dangerous mentor reflects a broader reframing of the American encounter with the Other. The Martian discourse, in fact, reflects an American Orientalism that

differed from the European construction in its lack of fear, prevalence of optimism, and focus on science and technology as cultural mediators.

Contributions

Propagated for the most part by respected commentators and taken seriously by broad audiences, the inhabited-Mars hypothesis simply cannot be dismissed as an embarrassing episode in the history of astronomy. Rather, I argue, it should be seen as an illuminating episode in the history of geography. Whether intentionally or not, astronomers introduced geographical themes into their work, and audiences came to view Mars news as geographical news during the period of the Mars mania. In essence, Mars was interesting only insofar as it was geographical. Popularized Mars science can thus be analyzed as an imaginative geography that both reflected and influenced geographical ideas, expectations, and knowledge about Earth.

My research contributes to our understanding of the history of geography and geographical ideas in the late nineteenth century by detailing the conceptual connections linking Mars with cultural and physical geographical narratives. As I show, Martian landscape narratives reinforced the dread surrounding terrestrial deserts and fanned fears about Earth's increasing aridity. Similarly, Martian cultural narratives reinforced Social Darwinist beliefs and reflected changing ideas about the relationship between the West and its Others. Despite being produced almost entirely outside the realm of professional and academic geography, these powerful narratives

certainly influenced audiences' perspectives on the discipline's central themes and interests.

Additionally, this dissertation makes contributions to scholarship in the history of cartography by offering a critical analysis of some of the earliest scientific maps of Mars. This cartographic series has never been seriously examined in terms of its production, consumption, and role in negotiating significant scientific conflicts. The maps of Mars were fundamentally important to the representation and circulation of knowledge regarding Mars, and the details of their creation must be considered carefully. My work shows how a dominant cartographic view of Mars arose, how cartographic processes created a powerful visual icon, and how photography eventually reduced the power of Mars cartography and its dependent claims.

Finally, by focusing on the links between astronomy and geography, my research contributes to scholarship in the history of science by offering a new overall explanation for the power and longevity of the Mars mania. Representations of the geographical remoteness of observatories or of the field activities of expedition-going astronomers greatly increased the legitimacy of their claims. The use of geographical imagery and maps likewise enhanced the scientific credibility of astronomers' popular publications. And the establishment of terrestrial landscape analogies made astronomers' claims accessible to popular audiences. By identifying the connections between astronomers' authority and their use of these cartographic, visual and rhetorical modes of geographical representation, I explain why audiences would have

responded so positively to the inhabited-Mars hypothesis in ways that induced further work from scientists that directly addressed geographical themes and news.

CHAPTER 2. THE POWER OF THE MARTIAN MAP

At the root of the inhabited-Mars narratives lay a series of detailed maps. Beyond their role in recording the planet's "areography" (the standard way of referring to Mars' surface geography after 1877[10]), these maps served a complex function in the development of Mars' scientific and cultural meanings. Cartographic conventions lent the red planet a fundamentally geographical or world-like identity, induced nationalistic competitions among astronomers, and authorized a view of its landscape as modified and possibly inhabited. In the process, Mars maps profoundly influenced the nature of planetary investigation and produced an unprecedented scientific and popular acceptance of the possibility that life might exist on worlds beyond Earth.

In this chapter, I examine the pivotal role of maps in the early Mars debates, showing how astronomers' claims about the geography of Mars rose to prominence or fell into disrepute in accordance with the fortunes of their maps. The triumph of specific maps over others depended on the visual authority of each, with the inscription of objectivity, certainty and detail always prevailing over representations of subtlety or simplicity. In addition, the visual authority of specific maps was closely intertwined with the personal authority of specific astronomers. On the one

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[10] This term was used as early as 1868 by the popular astronomy writer R. A. Proctor. See Bernard Lightman, "The Visual Theology of Victorian Popularizers of Science: From Reverent Eye to Chemical Retina," *Isis* 91 (2000): 651-80.

hand, pre-existing personal authority augmented the ability of mapmakers' handiwork to become ingrained as scientific truth. On the other hand, the visual authority of certain maps bolstered the reputation of certain mapmakers, lending more credence to those individuals' speculative theories and hypotheses regarding the nature of Mars.

In explaining the way that maps functioned in Mars astronomers' maneuvers for legitimacy, I also show in this chapter how the visual development of standard scientific Mars maps shaped the rise and fall of a powerful geographic icon. Changing from a naturalistic style in the 1870s to a purely geometrical scheme by the 1890s, the cartographic image of Mars became increasingly abstract. Throughout the 1890s and early 1900s, this iconic image of Mars – showing a planet covered by complex geometrical forms – stood as evidence of intelligence and civilization beyond the planet Earth. The dual strength and weakness of this popular landscape view was the fact that it had been brought into being only through the cartographic projection process. Thus, although the perceived objectivity of the scientific map gave astronomers' theories a persuasive power they might not otherwise have enjoyed, the inhabited-Mars theory rested precariously on the power of the map. Once the legitimacy of the canal-crossed map began to falter, the associated popular mania started to wane as well.

At the time, those who were critical of the inhabited-Mars theory often blamed the long-running canal craze on the sensationalism and misunderstanding of non-scientists. The most popular explanation held that the whole episode rested on a

simple mistranslation of the word “canale” from original Italian maps. Because English translators had used the artificial-sounding word “canal” instead of the more appropriate and natural-sounding word “channel,” they argued, many people had unfortunately developed a mistaken impression that Mars was inhabited. In this chapter, however, I argue that it was the *image*, not the term, that spurred a furor over the Martian canals. The processes and inscriptions of scientific cartography allowed partial and uncertain observations of Mars to become established as objective astronomical truths. So strong was the correlation that those truths evaporated the moment the astronomical map lost its status as a proper scientific representation.

The Maps of 1877-1878

By the late nineteenth century, maps had become the fundamental format for representing knowledge about Mars. Throughout the 1860s and 1870s, most serious Mars observers regularly produced their own maps or at least forwarded their sketches to other astronomers who were known to be producing maps. Within the British astronomical community, for instance, leading planetary observers distributed standardized sketch sheets to their colleagues, provided detailed instructions on observation and drawing techniques, then collected contributors’ notes and sketches for compilation into lengthy reports and detailed maps at the end of each biennial

opposition.[11] (An "opposition" occurs when two planets pass one another in their orbits, forming a line as seen from the sun.) These maps, born of collaborative effort and standardized practice, essentially removed any personal identities and subjectivities from the resulting product. The new cartographic view of Mars thus assumed a powerful authoritative claim to objectivity.

Though a variety of Mars maps were already in circulation, 1877 marked a turning point in the cartography of Mars. On September 5th of that year, Earth and Mars stood in "perihelic opposition," as Earth came into a line between Mars and the sun at a moment when the two planets were each nearest the sun and also to each other along their respective elliptical orbits. With the disk of Mars fully illuminated by the sun during this close approach, terrestrial astronomers enjoyed incomparable views, not only on the day of the perihelic opposition, but also in the days and weeks leading up to and following the actual event. Taking advantage of this rare occurrence,[12] English amateur astronomer Nathaniel Green departed from his usual observing station – in the back garden of his home in St. John's Wood, a suburb of London – and traveled all the way to the Portuguese island of Madeira in search of

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[11] See, for example, N. E. Green, "Notes on the Coming Opposition of Mars," *Monthly Notices of the Royal Astronomical Society* 37 (1877): 424; N. E. Green, "The Approaching Opposition of Mars," *Monthly Notices of the Royal Astronomical Society* 39 (1879): 433; E. Walter Maunder, "Mars Section," *Journal of the British Astronomical Association* 2 (1892): 423-27; Bernard E. Cammell, "Mars Section, 1894," *Journal of the British Astronomical Association* 4 (1894): 395-97.

[12] Although an opposition occurs every 26 months when Earth swings past Mars, a perihelic opposition occurs only about once every 15 years.

good atmospheric conditions for extended observations.[13] Over two months, Green's effort was rewarded with 47 nights suitable for Mars observation, 16 of which he termed "good," "excellent," or "superb." This was less than Green had expected but still "considerably in excess of the average of an English climate."[14] During his expedition, Green produced a series of exquisite sketches that he later compiled into the most detailed map yet known for Mars.[15] (See Figure 2.1) The expedition to Madeira was a major event in Green's avocational career, cementing his status as a serious amateur.[16]

Unfortunately for Green, however, his was not the only interesting map produced after that opposition. The professional Milanese astronomer, Giovanni Schiaparelli, had also taken advantage of Mars' proximity, publishing a radical new map in 1878 that seemed to contradict Green's own work.[17] Where Green had used subtle naturalistic shading to represent a surface mottled with barely perceptible

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[13] Richard McKim, "Nathaniel Everett Green: Artist and Astronomer," *Journal of the British Astronomical Association* 114 (2004): 13-23.

[14] "Meeting of the Royal Astronomical Society, November 8, 1877," *Astronomical Register* 15 (1877): 309-19.

[15] Green, Nathaniel, "Chart of Mars from drawings at Madeira in 1877," map published with Nathaniel Green, "Observations of Mars, at Madeira, in August and September 1877," *Memoirs of the Royal Astronomical Society* 44 (1879): 123-40.

[16] "In Memoriam: Nathaniel E. Green, F.R.A.S.," Journal of the British Astronomical Association 10 (1899): 75-77.

[17] "Mappa Areographica," map published as Table III in G. V. Schiaparelli, "Osservazioni Astronomiche e Fisiche sull'Asse di Rotazione e Sulla Topografia del Pianeta Marte Fatte nella Reale Specola di Brera in Milano Coll'Equatoreale di Merz Durante l'Opposizione Del 1877: Memoria del Socio G.V. Schiaparelli," *Atti Della Reale Accademia Dei Lincei: Memorie Della Classe Di Scienze Fisiche, Matematiche e Naturali*, 3 (1877-1878): 3-136.

"delicate markings,"[18] Schiaparelli had used hard-edged lines to show a detailed landscape of islands divided by parallel and intersecting blue straits he labeled "canali." (See Figure 2.2)

Green was surprised by Schiaparelli's map, as he claimed to have seen no such prominent lines whatsoever during his Madeira observations. Tactfully noting that the two maps otherwise concurred, however, he suggested that the discrepancy could perhaps be chalked up to differences in draftsmanship. At a meeting of the Royal Astronomical Society, Green shared a series of pre-publication sketches that Schiaparelli had sent to him, saying he "hoped he should be excused if he exercised a little artistic criticism on the drawings. He thought the hard and sharp lines must be an error, and were the result of some process which Prof. Schiaparelli had adopted in making the drawings."[19] Similarly, in a personal letter to Schiaparelli, Green wrote that he was "much pleased to find that there is so much agreement in the large and general forms between [the drawings made at Milan], and the series I have made at Madeira. We evidently intend the same thing though we have a different way of expressing it."[20] Schiaparelli did not respond in print, but expressed private

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[18] Green, "Observations of Mars, at Madeira," 123.

[19] "Meeting of the Royal Astronomical Society, April 12, 1878," *AstronomicalRegister*, 16 (1878):115-23.

[20] Nathaniel E. Green to G. V. Schiaparelli, 15 March 1878, in Osservatorio Astronomico di Brera, *Corrispondenza su Marte di Giovanni Virginio Schiaparelli* (Pisa: Domus Galilaeana, 1963), 1:14.

displeasure at what he perceived as Green's "thoughtless" initiation of a controversy between them.[21]

In truth, it was not only draftsmanship that differed in Schiaparelli's and Green's mapmaking methods. Green was a longtime Mars observer with a large network of British colleagues who were active Mars observers throughout the 1860s and 1870s.[22] His 1877 map was a compilation of his own and his colleagues' observations over the years. Green claimed to have put no major marking on the published 1877 map that was not definitively seen by at least three observers,[23] even leaving out prominent items that some of his colleagues insisted should have been included.[24] Green's personal contribution to the map (aside from its rendering) was an augmentation of the detail visible in Mars' southern latitudes, which he recorded in careful color sketches made while he sat at the telescope in Madeira.[25] During the Madeira expedition, Green completed 41 sketches, each of which took approximately two hours to prepare.[26] (See, for example, Figure 2.3.) Twelve of these sketches were published with his lengthy observation memoir, along with the Mercator projection map shown in Figure 2.1, and planar projection maps for the Martian north and south

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[21] G.V. Schiaparelli to Otto Struve, 6 July 1878, in *Corrispondenza su Marte*, 1:14-18.

[22] McKim, "Nathaniel Everett Green."

[23] Green, "Observations of Mars, at Madeira."

[24] "Meeting of the Royal Astronomical Society, April 12, 1878"; "Meeting of the Royal Astronomical Society, December 13, 1878," *AstronomicalRegister*, 17 (1879): 1-20.

[25] McKim, "Nathaniel Everett Green."

[26] Green, "Observations of Mars, at Madeira."

poles. Although Mars' northern latitudes were not visible from Earth in 1877, Green's map covered all latitudes from 80° south to 80° north, based on data he and others had collected at previous oppositions.

Schiaparelli, in contrast, was a first-time Mars viewer. Although he certainly communicated with colleagues about his work while it was in progress,[27] his detailed map included only his own observational data. Despite recording almost no detail north of 40° latitude (due to its invisibility from Earth in 1877-78), Schiaparelli conducted a study of unprecedented length. Whereas most observers typically observed Mars for the few weeks just before and after opposition, Schiaparelli took detailed measurements of the planet's rotation and examined its markings for nearly eight months, including seven months *after* the opposition. Working from the Brera Observatory's rooftop telescope in Milan's stately Palazzo di Brera, Schiaparelli observed Mars from August 1877 to April 1878.[28] His logbooks include 31 complete drawings of Mars' face and more than 100 detailed sketches of various regions that he recorded during fleeting instants of "excellent air."[29] (See, for example, Figure 2.4.) Many of these pencil sketches were later tidied into composite drawings that

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[27] See especially Schiaparelli to Françcois Terby, 20 November 1877, and Schiaparelli to Otto Struve, 23 November 1877, 4 January 1878, 6 July 1878, in *Corrispondenza su Marte*, 1:5-6, 6-7, 10-14, 14-18.

28 Giovanni Schiaparelli, "Vol. 1 del Refrattore di Merz, Minute Originali delle Osservazioni dal 14 Agosto 1875 al 31 Agosto 1877" and "Refrattore di Merz, Tomo II, Minute Originali delle Osservazioni del 1 Settembre 1877 al 13 Febbraio 1879," handwritten logbooks, Fondo Schiaparelli, Archivo Storico, Osservatorio Astronomico di Brera.

[29] Schiaparelli, "Vol. 1 del Refrattore di Merz," "Refrattore di Merz, Tomo II."

Schiaparelli sent to colleagues, including Green, for comment. The full report of Schiaparelli's 1877-78 observations – including the full Mercator projection map shown in Figure 2.2 as well as a planar projection map of Mars' south pole – was published by the leading Italian scientific society.[30]

In their published observation reports, both Green and Schiaparelli used similar rhetorical strategies to claim legitimacy for their discoveries. Both astronomers discussed the power and exactness of their telescopes, the unique atmospheric clarity at their observing locations, the first-hand "eyewitness" quality of their observations, and the essential agreement of their own sketches with the work of earlier observers. Green, for example, emphasized that he had traveled to Madeira because of "its reputation for clear skies during the months of August and September, and because the [atmosphere-distorting] heat at that season is less than at other places on the same parallel of latitude."[31] In the same vein, Schiaparelli lauded his eight-inch refractor as a "noble instrument," despite its "modest size" in comparison with "the gigantic telescopes of which other nations justly boast."[32] Additionally, both astronomers cast themselves as objective, unbiased observers, as in this claim of Green's: "Each drawing was made direct from the telescope, and entirely independent of those which had been produced previously; all comparisons being

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[30] Schiaparelli, "Osservazioni Astronomiche e Fisiche, 1877."

[31] Green, "Observations of Mars, at Madeira," 138.

reserved till the evening was over, so that each view might be as free as possible from bias, or a leaning towards the repetition of similar forms."[33] Despite claiming an unbiased approach to observation, however, Green and Schiaparelli both made much of the agreement between their 1877-78 observations and those made by prior astronomers. Schiaparelli, in particular, repeatedly referred to the work of respected Mars observers from the past. He thus tempered the radical-ness of his new map by claiming that his observations were merely "confirmations" of features that had already been seen:

> Many configurations, which judging superficially by my chart might appear as new, are found to have been described at earlier times, with greater or less evidence; while many details of the previous sketches, of which it has been difficult or impossible to be certain, are confirmed from my observations in this way. It is this mutual confirmation of results, more than the discovery of new details, which in my judgment provides the utility of our essay in areography.[34]

Authorizing a New Martian Landscape

Despite such similarities in argument and structure, Schiaparelli's representation of Mars clearly won out over Green's. In the ensuing three decades, most Mars maps produced in Europe and North America used the Italian's nomenclature and artistic style. Schiaparelli's map was able to achieve this

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[32] Giovanni Virginio Schiaparelli, *Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars*: First Memoir, 1877-1878, trans. William Sheehan (A.L.P.O. Monographs, Association of Lunar and Planetary Observers, 1996 [1878]), 1.

[33] Green, "Observations of Mars, at Madeira," 140.

prominence in part because the perceived objectivity of the cartographic format obscured the substantial procedural differences between his map and Green's. As already noted, Schiaparelli's and Green's maps were fundamentally different in the way they were produced. Green included the observations of other astronomers in his map, while Schiaparelli projected only his own sketches. Green spent hours on each of his sketches, while Schiaparelli dashed off details as quickly as they appeared and then refined the map later. The maps themselves concealed these differences, however, asserting a scientific authority separate from the identities of the mapmakers. Once the landscape of Mars had been inscribed on a latitude/longitude grid, the only differences that mattered were those that could be seen in the visual format.

Since both of the 1877-78 maps were viewed as objective, unbiased representations of the Martian surface, only one of them could be "right," given the discrepancy between the two. Visually, Green's map appeared hazy and indistinct, while Schiaparelli's was detailed and definitive. In addition, Schiaparelli had added a significant amount of new detail and had depicted an intriguing landscape of islands surrounded by blue waters. Schiaparelli's map thus bested Green's by showing a greater level of detail and a familiar-looking landscape. Despite Green's objections that Schiaparelli's artistry and coloration were flawed, his own map faced the impossible challenge of demonstrating *more* authority by presenting *less* detail.

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[34] Schiaparelli, *Astronomical and Physical Observations*, 46.

Where Schiaparelli could claim to have seen something that no one else had seen – the canals – Green was reduced to claiming that he was very sure he had seen nothing of the sort.

In addition to the visual authority of his map, Schiaparelli's view of the Martian landscape also benefited from his own personal authority as a respected astronomer. Although Schiaparelli had not been known previously as a planetary observer (his major career discovery was the theoretical prediction and observational confirmation of the link between meteor showers and comet orbits[35]), his impeccable academic pedigree, long list of publications, and successful directorship of Milan's Brera Observatory had established him as one of the leading astronomers in Europe. As such, he was generally treated with deference and respect, even by those who were skeptical of his unorthodox map. Essentially, Schiaparelli's personal authority bolstered the visual authority of his map.

In society meetings and publications throughout the 1880s, for example, the European astronomical community revealed a willingness to entertain all manner of explanation for Schiaparelli's canals. Green thought the dark streaks might be artistic misrepresentations; Maunder considered them most likely to be the boundaries of differently shaded regions;[36] while another writer for the British journal *The*

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[35] *All'Astronomo G. V. Schiaparelli: Omaggio 30 Giugno 1860 -- 30 Giugno 1900* (Milan: Osservatorio Astronomico di Brera, 1900).

[36] "Meeting of the Royal Astronomical Society, April 14, 1882," *Astronomical Register* 20 (1882): 101-11.

Observatory suggested Schiaparelli might have been using too high a magnifying power for his telescope.[37] Green himself was at pains to make clear, however, that his critique of Schiaparelli's mapping style was not meant as criticism of the astronomer's talent as an observer. Although he enjoyed a prominent reputation in Britain, Green was an amateur observer and clearly did not outrank Schiaparelli within the discipline. Referring to Schiaparelli deferentially and sincerely as "the learned and exact professor,"[38] Green justified his limited criticisms of Schiaparelli's map only on the basis of his own status as a professional portrait artist and drawing-master, restricting his comments to the artistic style of the maps. [39] At a meeting of the British Astronomical Association,

> [Green] began by remarking that the point he wished to raise was purely one of drawing, and not one of seeing. It was one thing to see a difficult marking; it was quite a different matter to represent it accurately and artistically, nor was it any reflection upon an astronomer's ability to call in question his powers of drawing. They had no right to assume, as a matter of course, that such ability would accompany his other attainments.[40]

Lord James Lindsay, president of the Royal Astronomical Society from 1878-79, commented similarly, "Professor Schiaparelli was not likely to be led away by imagination. There might be something peculiar in his telescope, or in his eyes, but

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[37] "Schiaparelli's observations of Mars," *The Observatory* 5 (1882): 138-43.

[38] Green, "Observations of Mars, at Madeira" 130.

[39] For a full discussion of Green's identity as a professional artist, see McKim, "Nathaniel Everett Green."

[40] "Report on the meeting of the Association held December 31, 1890," *Journal of the British Astronomical Association* 1 (1890): 110-111.

he was not likely to publish observations or drawings without being fully persuaded that the appearances actually existed."[41]

By the early 1890s, the scientific, visual, and personal authority of Schiaparelli's map had succeeded in legitimizing the canal-covered landscape. Despite controversies over its artistic style and nomenclature, it had become established as the standard reference for areographers. When asked in 1879 how a controversy over the Martian placenames should be decided, the well-known Scots astronomer, Sir David Gill, responded that

> The question can only settle itself when, party feeling on the subject having been forgotten, a map of Mars, so superior to all others in convenience and accuracy, appears, that by its simple merits alone … it becomes a standard of reference without controversy. The matter, therefore, I think, should be left to the judgment of the man who may be successful in producing a map that shall *command* the position of authority.[42]

In hindsight, we can see that Schiaparelli's map had already met Gill's challenge. The achievement of his map was not its superior accuracy or its ability to erase partisan sentiment but its command of authority.

Naming the Martian Territory

That is not to say that Schiaparelli's authoritative map of 1878 was never challenged. Initial critiques of Schiaparelli's artistic style were soon followed by an

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[41] "Meeting of the Royal Astronomical Society, April 12, 1878," 123.

assault on his distinctive placenames. Although neither of these challenges was successful in the end, they induced a competitive and territorial spirit among European astronomers. In general, this rhetorical territoriality reinforced the new view of Mars as a geographical world by imbuing it with an intriguing, contestable landscape.

Various features of Mars had received their first proper names only a decade before the 1877 opposition, when the English popular science writer Richard Proctor casually applied astronomers' surnames to a map he intended for book publication in 1867.[43] Since that time, various names had been added, changed, or reshuffled on subsequent maps published throughout Europe. For his own books, the well-known French astronomer and popular science writer Camille Flammarion adjusted Proctor's scheme to give it a more continental flavor, presumably because the Englishman had unduly favored his countrymen with the original names.[44] Nevertheless, the general convention of using surnames had caught on. Green's 1877 map, for instance, added to Proctor's nomenclature with new honorary designations such as "Schiaparelli Lake" for features he had discovered that year.[45]

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[42] David Gill, "The nomenclature of markings on Mars," *Astronomical Register* 17 (1879): 95. (Italics in original.)

[43] Richard A. Proctor, "Names of markings on Mars," *Astronomical Register* 17 (1879): 45-46.

[44] Jurgen Blunck, *Mars and its satellites: a detailed commentary on the nomenclature* (Hicksville, New York: Exposition Press, 1977).

[45] Green, "Chart of Mars from drawings at Madeira in 1877," map published with "Observations of Mars, at Madeira."

Schiaparelli's new maps, however, rejected the surname scheme altogether, featuring instead a set of Latin names based on the classical and mythological geography of the Mediterranean world. "Lockyer Land" for instance, was renamed "Hellas" while "Fontana Land" became "Elysium."[46] Schiaparelli made conflicting claims about these changes. On the one hand, he claimed the new nomenclature was based on personal whimsy:

> *I seek neither the collective approval of astronomers nor the honor of seeing it pass into general use.* To the contrary, I am ready to adopt later whatever scheme will be recognized as definitive by the proper authority. Until then grant me the chimera of these euphonic names, whose sounds awaken in the mind so many beautiful memories.[47]

At the same time, however, Schiaparelli claimed that the Mediterranean-geography names were based on observation: "My nomenclature, which was devised at the telescope … is preserved in this memoir only because it describes perfectly what is seen."[48] It is this scientific tenor that probably spurred other astronomers' strong reactions. If the names were merely a matter of preference or aesthetics, they could be changed or forgotten easily. If they were objective descriptions of "what is seen," however, they could not be replaced until a more accurate system was offered.

In using names drawn from Mediterranean geography, Schiaparelli reinforced his map's visual effect of casting Mars as a familiar, Earth-like world. He directly

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[46] "Mappa Areographica," map published as Table III in Schiaparelli, "Osservazioni Astronomiche e Fisiche, 1877."

[47] Schiaparelli, *Astronomical and Physical Observations*, 10, italics in original.

[48] Ibid., 10.

asserted not only a general analogy between Martian and terrestrial topography ("In general the configurations presented such a striking analogy to those of the terrestrial map that it is doubtful whether any other class of names would have been preferable"[49]), but also a specific analogy between the Martian landscape and various regions of Earth:

> The immense region which has received the name Ausonia extends a quarter of the way around the planet's globe, and shows in form and disposition a great likeness to the terrestrial land of Ausonia [Italy]; from this likeness is derived its name and also those of Eridania, Hellas, and lastly Libya, which forms the other land bordering the Tyrrhenian Sea.[50]

Schiaparelli's logbook shows that the first features he sketched were named for actual terrestrial locations, while the more symbolic and mythical names were filled in later,[51] thus confirming that his nomenclature reflected a sense of real analogy with Earth's landforms. His published claims about the nomenclature's whimsical nature thus prove hollow.

Many British astronomers found the new names silly and resented Schiaparelli's unilateral rejection of the existing nomenclature, but could see no reasonable way to reclaim the map. When the editors of the British journal *Astronomical Register* asked readers in 1878 to submit their comments on the

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[49] Ibid., 9.

[50] Ibid., 40.

[51] On September 11, 1877, Schiaparelli first recorded proper names in his observation logbook, referring to a "Mare Tireno" (Tyrrhenian Sea), "Adriatico" (Adriatic Sea), "Grecia" (Greece), and "Ellesponto" (Hellespont [Dardanelles]). Schiaparelli, "Refrattore di Merz, Tomo II."

nomenclature of Mars, one British astronomer lamented that Schiaparelli's contribution had served only "to create wholly needless confusion,"[52] while another dismissed the Latin names as "useless rubbish."[53] Proctor's surname labels, however, were admitted to be problematic in their prioritization of various individuals and nationalities over others. One writer commented, "It may be a *present* compliment, but must be simply ridiculous to *future* astronomers, to call each newly-discovered marking by the names of individuals of no lasting scientific eminence."[54] Another concurred, "The present plan of christening continents and seas by the names of contemporaries may be a very graceful and pleasing act, from a social point of view, but it is unfair, inasmuch as it anticipates the verdict of posterity."[55]

In addition to concerns about convenience, priority, and prestige, there were also important territorial and nationalistic overtones to this debate. When one amateur worried that the surname-scheme would eventually lead to friction among those nations whose astronomers were represented unequally in the map, another countered, "the discovery of any fresh areographical feature renders it, in one sense, a portion of the scientific possessions of the nation in which it may happen to be

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[52] William Noble, "Names of markings on Mars," *Astronomical Register* 17 (1879): 96.

[53] A. Marth, "Nomenclature of markings visible upon the planet Mars," *Astronomical Register* 17 (1879): 24.

[54] E. B. Fennessy, "Nomenclature of markings on Mars," *Astronomical Register*, 17 (1879): 90. (Italics in original.)

[55] Herbert Sadler, "Nomenclature of markings visible upon the planet Mars," *Astronomical Register* 17 (1879): 25.

made."[56] Noble acknowledged, however, that such possession was not of the type to inspire base territoriality: "We are in the last degree unlikely to go to war either with the Belgians or the Italians to obtain a 'scientific frontier' in Mars and I myself cannot see any valid objection to Cape Schiaparelli, or to Terby Sound, upon a map of the planet."[57]

In a sense, however, the British *did* go to war with continental Europe over Mars. In struggling to control the map and protect British prestige, many British astronomers conducted a war of words that functioned in many ways like a classic contest for territorial control. By Schiaparelli's own admission, the geographical placenames and linear canal-markings were powerfully linked: "The existing nomenclature simply proved insufficient for the vast quantity of new objects that had somehow to be named."[58] With the canals and placenames thus jointly inscribed on the map, any attempt to dispute one necessarily required removal of the other.

British astronomers' respectfully worded sniping about Schiaparelli's artistic ability and heated objections to his de-Anglicized nomenclature thus sought to protect Green's status as an equal discoverer of Mars' southern features. If not for the explanation of the maps' differences on the basis of artistic style, Green might have been forced to admit that Schiaparelli saw more, saw better, or saw first, thus devaluing his expedition to Madeira. The failure of heated objections to

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[56] Noble, "Names of markings," 96.

[57] Ibid.

Schiaparelli's nomenclature, however, only solidified the authority of the canal-covered landscape and allowed Schiaparelli to retain "discoverer" status for new features like the canals.

Long after the 1878 nomenclature debate had ended, many British astronomers stubbornly held on to the placenames Green had used, resorting to Schiaparelli's version only when there was no alternative. Twenty years after Schiaparelli's nomenclature was first proposed, for instance, an opposition report in the *Monthly Notices of the Royal Astronomical Society*, reported that "the Kaiser Sea has recently actually encroached upon the continent nearly so far as Lake Moeris, so as to obliterate part of Libya."[59] Such creative amalgamation was due in large part to nationalistic pride, as this retrospective comment in the 1900 *Journal of the British Astronomical Association* (*JBAA*) reveals:

> The only reason I can see for this attempt to discard the old names is that they were of English application, and so hurt the self-love of all who are not English. At any rate the selection of new names seems to have been made on the principle that no English need apply, and to be influenced by the same antipathy that makes our friends across the Channel desirous of removing the initial meridian to pass through Jerusalem or the Canaries, or in mid-ocean (because water is a more stable element than land), or anywhere so it does *not* pass through Greenwich.
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> The names chosen are in many instances of unnecessary length, causing us to have to write or pronounce four or five syllables where two or three would suffice. And they are a remarkably evil sounding

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[58] Schiaparelli, *Astronomical and Physical Observations*, 9-10.

[59] "The Past Opposition of Mars. In the Report of the Council to the Seventy-Seventh Annual General Meeting of the Society," *Monthly Notices of the Royal Astronomical Society* 57 (1897): 286.

> lot. They always remind me of the old lady who found Nebuchadnezzar or Beelzebub such a comforting word.[60]

Aside from reflecting a lingering British bitterness towards Schiaparelli's nomenclature decades after the new names had passed into general use, such statements also reveal that the competition over Mars' placenames was every bit as nationalistic as other scientific competitions of the day. The explicit comparison of Mars debates with the contentious British-French argument over the location of the prime meridian shows that nationalistic territorialism over scientific standards was a major motivation for British opposition to changes in the Mars map.

In addition to provoking such deep-seated territorialism, the newly inscribed names and canals conveyed a sense of placeness and intrigue for Mars that had not existed previously. Although Mars' dark features had long been referred to as "seas" and its light patches as "lands," the map's assertion that Mars boasted a "Libya," an "Arabia," a "Zephyria," and a canal named "Atlantis" cast Mars as a familiar, Earth-like world. And the fact that the map of this world had undergone a long (if civilized) siege only reinforced more strongly the conceptual acceptance of Mars as a geographical and territorial entity – a real world that could be delineated and contested by Europeans.

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[60] Holmes, Edwin. "The Canals of Mars," *Journal of the British Astronomical Association* 10 (1900): 302.

Controlling the Canals

Despite the early debates, Schiaparelli's 1878 map ushered in a new era of Mars cartography, as professional and amateur astronomers across Europe and North America worked to confirm the existence of the canals. Schiaparelli's observations had essentially touched off a canal-hunt, with scores of professional and amateur astronomers across Europe committing themselves to the challenge set out by Schiaparelli's ally, the Belgian astronomer Francois Terby: to "verify the *positive* observations of M. Schiaparelli, whose chart if it were verified would constitute the greatest step made by areography for many years."[61] Green himself wrote before the 1879 opposition that "a careful search should be made for the remarkable dark canals figured by Professor Schiaparelli,"[62] and asked British observers to forward their sketches to him for analysis. Although Schiaparelli alone reported seeing significant numbers of canals in the oppositions of 1879, 1882, and 1884,[63] his observations were finally confirmed by both Terby and the French astronomer Joseph Perrotin in

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[61] Terby, F., "Nomenclature of Martial markings," *Astronomical Register* 17 (1879): 47. (Emphasis in original.)

[62] Green, "The approaching opposition."

[63] G. V. Schiaparelli, "Osservazioni Astronomiche e Fisiche sull'Asse di Rotazione e sulla Topografia del Pianeta Marte Fatte nella Reale Specola di Brera in Milano coll'Equatoreale di Merz: Memoria Seconda del Socio G.V. Schiaparelli," *Atti Della Reale Accademia Dei Lincei: Memorie Della Classe Di Scienze Fisiche, Matematiche e Naturali* 3 (1880-1981):3-109; G. V. Schiaparelli, "Osservazioni Astronomiche e Fisiche sull'Asse di Rotazione e sulla Topografia del Pianeta Marte Fatte nella Reale Specola di Brera in Milano coll'Equatoreale di Merz: Memoria Terza del Socio G.V. Schiaparelli (opposizione 1881-1882)," *Atti Della Reale Accademia Dei Lincei: Memorie Della Classe Di Scienze Fisiche, Matematiche e Naturali* 4 (1886):281-373; G.V. Schiaparelli, "Osservazioni Astronomiche e Fisiche sull'Asse di Rotazione e sulla Topografia del Pianeta Marte Fatte nella Reale Specola di Brera in Milano coll'Equatoreale di Merz: Memoria Quarta del socio G.V. Schiaparelli," *Atti Della Reale*

1886.[64] As if suddenly freed from the constraints of deference to Schiaparelli's British opponents, a wide variety of European astronomers began to see and map the Martian canals after 1886.

At the end of each biennial opposition, results were compared, discoveries were announced, and newly sighted canals were added to the network. Just as was true for many of the terrestrial expeditions of the day, prestige inhered in putting things on the map, not taking them off. Once a credible astronomer had mapped the canals, it was nearly impossible to erase them. Those who claimed to see a canal-free landscape on Mars did not even bother to produce or publish maps, as the reduction of detail was not considered a contribution of any importance. Astronomical maps thus functioned much like the geographical maps of the day. British explorers such as Henry Morton Stanley, who added numerous features to the map of Africa, were hailed as heroes and began to set the agenda for British interests on that continent.[65] Those whose expeditions failed to turn up anything new, on the other hand, were branded failures and had difficulty finding sponsors for subsequent travels. Similar to the terrestrial explorers, Mars astronomers felt the need to include details from earlier maps in order to assert their legitimacy, even when those features could not be

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Accademia Dei Lincei: Memorie Della Classe Di Scienze Fisiche, Matematiche e Naturali 5 (1895-1996):183-240.

[64] "The Canals on Mars," *Astronomical Register* 24 (1886): 268; J. Perrotin, "Observation Des Canaux De Mars Faite a L'Observatoire De Nice," *The Observatory* 9 (1886): 364-65.

[65] Felix Driver, "Exploration by Warfare: Henry Morton Stanley and His Critics," in *Geography Militant: Cultures of Exploration and Empire* (Oxford: Blackwell, 2001), 117–145.

independently confirmed.[66] Increasing numbers of canal reports thus relied on the blending of the authority of map and maker, operating in many ways similarly to the case of the nonexistent "Kong Mountains," which appeared on commercial maps of West Africa for over a hundred years.[67]

By century's end, an explosion of post-Schiaparelli canal sightings had given rise to a map resembling a spider's web in its complexity. By the 1890s, geometric maps had become the standard representation of Mars, while any detailed rendering of shadings and colors was lost in the competitive quest to find and map new canals. Though Schiaparelli had apparently taken some of Green's original stylistic criticisms to heart, once sending his publisher a copy of Green's 1877 sketches with instructions to match the style and color tones for his own sketches,[68] he persisted with the definitive canal markings on composite maps. In fact, the Italian astronomer's maps became increasingly abstract over the years, as he added new canals throughout the 1880s. By 1888, the islands and channels of Schiaparelli's original chart had all but disappeared, replaced by thin lines that appeared inexplicably doubled in places. (See

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[66] For a set of now-classic works exploring the unique authority of the map as a visual text, see J.B. Harley, *The new nature of maps: essays in the history of cartography*, ed. Paul Laxton (Baltimore: Johns Hopkins University Press, 2001).

[67] Thomas J. Bassett and Philip W. Porter, "'From the Best Authorities': the Mountains of Kong in the Cartography of West Africa," *The Journal of African History* 32 (1991): 367-413.

[68] Schiaparelli's file on printer proofs for his Mars graphics and maps includes a plate of Green's 1877 sketches, marked with his following handwritten note to his publisher: "Queste Tavola si danno per indicare la qualitá del rosso che si deve adoperare e lo stile del lavoro." ("This plate is sent to indicate the quality of red that should be adopted and the style of the work.") Schiaparelli, G.V. "Disegni e 'mappe areographiche' di Marte," Fondo Schiaparelli, Archivo Storico, Osservatorio Astronomico di Brera.

Figure 2.5.) The same trend took place in other astronomers' charts as well. New maps published every couple years visually prioritized the representation of new canals to such an extent that, by the 1890s, maps of Mars consisted mainly of black lines and circles on a white background, with the names of various canals taking more prominence on the map than any subtle shading. (See Figures 2.6 and 2.7.)

Beyond becoming a standard in the scientific journals, this geometric appearance had also begun to assume an iconic status in the popular press by century's end. In books, pamphlets, magazines, and newspapers, the gossamer network of the map – with its interlinked geometry of perfectly straight lines meeting at perfectly round intersections – became a ubiquitous symbol of extraterrestrial life. This owed much to the efforts of American amateur astronomer Percival Lowell, who argued in his first articles and books about Mars in 1895 that the planet's "unnatural" and "artificial" appearance indicated the possibility of intelligent life. Lowell published in general-interest magazines and popular books, reaching a wide and receptive audience with his argument that the geometric lines on Mars should be read as evidence of an advanced civilization.[69]

The root of Lowell's success in gaining support for his inhabited-Mars theory owed much to his active publication strategies (see Chapter 3), but also relied heavily on the visual authority of his maps. Within an established competitive and territorial framework, those astronomers who added the most detail to the map became its most

authoritative interpreters. Although Lowell had begun his Mars research with no professional pedigree, he quickly became one of the most prominent theorists about the landscape and culture of Mars by producing extremely detailed maps. Whereas others' wild theories about the red planet could be dismissed as sensationalist nonsense, Lowell had to be taken seriously because he had added significant detail to the map of Mars. The Lowell Observatory in Flagstaff, established and funded by Lowell himself, dedicated itself to the observation and mapping of Mars. In his first year of observation in 1894`, Lowell confirmed all but two of Schiaparelli's canals and added 116 of his own discovery.[70] (See Figure 2.7.)

Whatever other astronomers might say about Lowell's speculative hypothesis, they had to admit that he deserved respect on the basis of his continued contributions to the Martian map. Simon Newcomb, director of the U.S. Nautical Almanac Office and a noted Lowell antagonist, wrote to Lowell in 1905 to request a map for an encyclopedia article he was then preparing: "I would like a good map of Mars to accompany the article. For this I know no better source than the publication of your observatory."[71] The editor of *Popular Astronomy*, W.W. Payne, likewise commented in 1904 that Lowell's maps were "pieces of astronomical work that are now classical in astronomy … because they were made by the very best means and methods now

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[69] See Hoyt, *Lowell and Mars*, for a full discussion of the popularization of this idea.

[70] Ibid.

[71] Simon Newcomb to Percival Lowell, 30 October 1905. Simon Newcomb Papers, United States Library of Congress, Manuscript Division.

known to that science."[72] This comment probably owed more to the detailed appearance of Lowell's maps than to the actual process he used for mapmaking. In the popular press, praise for Lowell's attainments was even more glowing, as in an article that credited "the most interesting theory of all, the presence of life on Mars" to Lowell, "than whom no astronomer has made more important explorations to the other places in the Cosmos."[73] Whereas Schiaparelli's personal reputation had helped establish the authority of his canal-map, Lowell's legitimacy was produced by an opposite process: the unrivaled detail of his authoritative canal-maps actually produced significant personal authority that was not available to other amateurs.

Despite provoking a somewhat negative reaction from leading astronomers who would have preferred that he confine his publications to the professional scientific journals, Lowell's works powerfully established a link between the geometry of the Martian canals and the intelligence of its supposed inhabitants. By the early 1900s, Lowellian images of Mars had become powerful icons. Popular Sunday papers frequently published geometric images of Mars to accompany articles about the most recent astronomical discoveries. Though these images assumed the general appearance of the scientific canal-maps, they were often unlabeled or did not show any coordinates. (See Figure 2.8.) Such generic abstraction indicates that this cartographic imagery was meant to convey legitimacy rather than information. As a

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[72] Payne, W. W., "The 'Canals' of Mars," *Popular Astronomy* 12 (1904): 366.

simple icon, the geometric image of Mars could be visually equated with abstract drawings of familiar street layouts, rail networks, and irrigation systems (see Figure 2.9), reinforcing the certainty of life and civilization on the red planet.

The Map's Creative Power

The strength of the Mars icon as a visual symbol rested not only on the map's powers of inscription, authorization, and legitimization. It was also supported at a fundamental level by the creative power of the cartographic *process*, which had brought into existence a landscape quite different from that which astronomers reported seeing through their telescopes. Despite the widespread use of geometrical canal imagery, in fact, no astronomer ever actually saw or claimed to see an interlinked canal network while sitting at the telescope. The cartographic authority of the increasingly prominent Mars icon concealed the fact that the canal "network" was actually invisible to the eye. From Earth, the surface of Mars was (and is) notoriously difficult to see. Even under conditions of excellent "seeing" (a measure of the stillness and clarity of Earth's atmosphere), distant Mars shimmered tantalizingly, allowing only fleeting glimpses of its surface. Astronomers constantly complained about their inability to "hold" an image of Mars in the telescope, as detail could be seen only in glimpses and flashes:

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[73] *The Sunday Herald* (Boston, MA), "French Clergyman Combats Theory of Prof. Lowell As to Presence of Some Sort of Intelligent Life on Planet Mars," 4 August 1907.

> It must not be imagined that any drawing represents what the observer sees the moment he looks through the telescope. Instants of exceptional seeing flash out, here and there, at different spots on the planet. It is not till the same phenomena repeat themselves in the same way, in the same place, a great number of times, that the observer learns to trust these impressions. One has to keep one's mind constantly at the highest pitch to catch and retain what the eye sees.
>
> It is like looking at a Swiss landscape from a high Alp, with the summer clouds sweeping about one. Now the mist rolls away, revealing a bit of the valley, and shuts in again in a moment; while in some other spot the clouds break away, and disclose a jagged summit, or a portion of a shining glacier.[74]

To give a quantitative sense for the duration of these moments, the director of the British Astronomical Association's Mars Observing Section wrote in his observation report for 1909 that "a *glimpse* of an object does not last more than 0.3 second; a *short view* of an object lasts from 0.3 to 1 second; and an object *held steadily* is one whose visibility continues for 1 second and above."[75] In essence, then, the art of sketching Mars consisted of waiting intently for a moment of still air, then quickly recording an image before the memory could fade. Given this difficulty, several astronomers insisted that a given feature should be seen, sketched and measured multiple times before it could be definitely said to exist. Otherwise, the opportunity for mistakes – of vision, memory, or depiction – was too great.

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[74] G. R. Agassiz, "Mars As Seen in the Lowell Refractor," *The Popular Science Monthly* 71 (1907): 281.

[75] E. M. Antoniadi, "Section for the Observation of Mars: Report of the Section, 1909," *Memoirs of the British Astronomical Association* 20 (1916): 31. (Italics in original.)

As a result, very few of the sketches that astronomers drew in their observation logbooks or on standardized sketchpads depicted more than a few Martian surface details at any given time. It was only in the process of gathering, compiling, and projecting dozens (or even hundreds) of individual sketches onto comprehensive maps that astronomers gave rise to the view of a geometrical Martian landscape. Schiaparelli's famous chart included details from dozens of sketches recorded in his 1877-1878 logbooks. Green's charts and others published by the Royal Astronomical Society and British Astronomical Association typically compiled the work of at least a dozen observers in London, Edinburgh and many far-flung corners of the British Empire.[76] Lowell's influential maps of the 1890s and early 1900s were made by plotting the details from hundreds of his own and his colleagues' sketches directly onto a wooden globe, which was then tilted to the proper angle and photographed before tracing the negative into a Mercator projection.[77] Thus, very simple sketches (see Figure 2.10) blossomed cartographically into complex and interlinked networks (see Figure 2.11) that had never been seen by any single individual or on any single night. In truth, then, the networked appearance of the

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[76] See, for example, N. E. Green, "The Northern Hemisphere of Mars," *Monthly Notices of the Royal Astronomical Society* 46 (1886): 445-47; E. Walter Maunder, "Section for the Observation of Mars: Report of the Section, 1892," *Memoirs of the British Astronomical Association* 2 (1895): 157-98; E. M. Antoniadi, "Section for the Observation of Mars: Report of the Section, 1896," *Memoirs of the British Astronomical Association* 6 (1898): 55-102.

[77] Lowell described his cartographic process in Percival Lowell, *Mars* (Boston and New York: Houghton, Mifflin and Company, 1895).

canals owed its existence more to the cartographic process than to any reality on the Martian surface.

Though astronomers admitted that the maps showed a landscape invisible to the eye, the authority of the complex scientific map conveyed an objectivity that outweighed the simplistic sketches. Detractors' criticism of the inhabited-Mars theory on the basis of the maps' incongruity with the drawings[78] seem only to have cast suspicion on the simpler drawings, rather than decreasing the legitimacy of the detailed maps. Even the theory's great champion, Lowell, acknowledged that the process of projection created an un-viewable view: "not a single piece of the chart resembles the actual presentation of any part of the planet at any time."[79] Though this comment may have been intended primarily to rebuff criticism from those who were unable to confirm the map's canals through their own telescopes, Lowell seems also to have acknowledged at times the more creative role of cartography in bringing his populated "oases" to life: "*When they are plotted upon a globe*, they and their connecting canals make a most curious network over all the orange-ochre equatorial parts of the planet, a mass of lines and knots."[80] Lowell's one-time associate Pickering made a similar caution: "The maps of Mars look very artificial; but we must remember that they are composites of many drawings, such as are given in this

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[78] See, for example, Holmes, Edwin, "Notes Re Mars," *Journal of the British Astronomical Association* 1 (1891): 256-59.

[79] Percival Lowell, "Mars," *Popular Astronomy* 2(1894): 8.

[80] Percival Lowell, "Mars: Oases," *Popular Astronomy* 2 (1895):346. (Emphasis added.)

article. All the canals shown on the maps are not seen at once; on the contrary, only a very few of them are visible on the same night."[81] Use of a coordinate grid, however, indicated exactness and scientific objectivity; projection of multiple observations into a composite view conveyed unassailable comprehensiveness. As an artifact of projection, therefore, the geometrical image of Mars could not have existed or grown so meaningful except through the format and process of cartography.

Decline of the Martian Map

Tied up as it was in the map, the inhabited-Mars theory enjoyed widespread support only as long as cartography itself was accepted as the most scientific representation of the red planet. After a brief hiatus from his Mars studies between 1898 and 1901 due to illness, Lowell had returned to publishing with a renewed vigor. He published several new maps early in the twentieth century, wrote three new books by 1909, conducted extensive lecture tours on the American East Coast and in Europe, and disseminated his findings to the popular press at every opportunity.[82] His success in reaching the mainstream dailies can be read in the assorted grumbling that surfaced in the astronomical journals. The *JBAA* lamented in 1906, "We had extraordinary reports in sensation-mongering newspapers on this side of the Atlantic to the effect that some American observer, in the course of his nocturnal vigils, had

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[81] William H. Pickering, "The Planet Mars," *Technical World Magazine* (1906): 469-470.

detected the Martians in the act of signalling to the inhabitants of the Earth."[83] Five years earlier, the same journal had claimed, "The idea of opening communication with other planets, and with Mars as a beginning … has been fostered by the sensational rubbish of magazine writers, and the extravagancies of newspaper paragraphists."[84] *Popular Astronomy* cautioned in 1907, "The literature about Mars in the current magazines is, some of it fanciful, some funny, some very mysterious,"[85] having already reacted strongly to Lowell-inspired reports in 1895: "It is a burning shame that such nonsense finds place in our best and greatest daily papers."[86]

At the same time Lowell became more outspoken in his claims about the landscape and civilization of Mars, however, he also became more vicious toward his doubters, inducing many of the most prominent American astronomers and several professionals and amateurs in Britain to turn against him. To combat what they saw as Lowell's willful disregard for scientific professionalism and standards of proof, his detractors retaliated with a sustained effort to disrupt his popularity and undermine his legitimacy.[87] In Britain, the well-known Greenwich Observatory astronomer

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[82] Hoyt, *Lowell and Mars*; David Strauss, *Percival Lowell: the Culture and Science of a Boston Brahmin* (Cambridge, Mass.: Harvard University Press, 2001).

[83] "Report of the Meeting of the Association, Held on June 20, 1906, at Sion College, Victoria Embankment," *Journal of the British Astronomical Association* 16 (1906): 333.

[84] Edwin Holmes, "Communication With Mars," *Journal of the British Astronomical Association* 11 (1901): 202-6.

[85] "The Planet Mars," *Popular Astronomy* 15 (1907): 449-50.

[86] "'The Signals From Mars'," *Popular Astronomy* 3 (1895): 47.

[87] Strauss's *Percival Lowell* provides the most comprehensive analysis of the maneuvering between Lowell and his opponents in the astronomical establishment.

Edward Maunder began to write extensively about the likelihood that Lowell's maps were based on nothing more than optical illusion, provoking significant doubt among those astronomers who had never seen the canals clearly in the first place. At a June 1903 meeting of the British Astronomical Association, for instance, the comment was made that Maunder "had really cut away the ground from under the feet of those who thought they had been able to prove that there were canals. The onus of proof now lay upon those who thought the canals were there."[88] At home in the United States, the elite academic astronomers acted in concert to isolate Lowell from the scientific community, cast doubt on his claims, and minimize his publishing opportunities.[89] Like Maunder, several American astronomers questioned whether Lowell's maps and sketches were distorted by optical illusion.[90]

To counter the many charges being leveled against him, Lowell turned to photography for redemption. After Maunder's first attacks in 1903, Lowell helped pioneer a new method of planetary photography that could capture a clear image with only a short time exposure. [91] When his assistant Carl O. Lampland succeeded in photographing Mars in 1905, Lowell quickly began publishing and circulating the

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[88] "Report of the Meeting of the Association, Held on June 24 1903, at Sion College, Victoria Embankment," *Journal of the British Astronomical Association* 13 (1903): 338.

[89] Strauss, *Percival Lowell.*

[90] See, for example, two letters Simon Newcomb wrote to Percival Lowell, 9 March 1903 and 23 March 1903, Percival Lowell Correspondence, Lowell Observatory Archives.

[91] For a detailed discussion of how Lowell maneuvered to validate this method and cultivate supporters, see Jennifer Tucker, "Science Illustrated: Photographic Evidence and Social Practice in England, 1870-1920" (Ph.D. diss., Johns Hopkins Univ., 1996), Ch. 4.

images to rescue his reputation. For a time, this strategy worked. Despite being small and grainy, the photographs indeed contained some dark markings in areas where Lowell's maps depicted canals, indicating a confirmation. At a June 1906 meeting of the British Astronomical Association, the President A.C.D. Crommelin stated that Lowell's photographs proved the "objective reality of the canals,"[92] reviving belief within the British astronomical community.

In 1907, however, new experiments were carried out in the United States to test the possibility that optical illusion was at work in the Mars observations. An influential experiment conducted by Simon Newcomb found that trained astronomers who were asked to draw what they observed when a small paper disc covered with irregular markings was held at a great distance almost invariably drew straight canal-like lines that did not actually exist.[93] This finding appeared to confirm Maunder's earlier work on optical illusion, thereby producing an immediate reverse sway in scientific opinion over the reality of the canals, despite Lowell's vigorous rebuttals.[94] In the face of what he perceived as an onslaught, Lowell mounted a high-profile photographic expedition to South America for the 1907 opposition, essentially staking his reputation on the new imaging techniques Lampland had developed since

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[92] "Report of the Meeting of the Association, June 20, 1906," 333.

[93] Simon Newcomb, "The Optical and Psychological Principles Involved in the Interpretation of the So-Called Canals of *Mars*," *The Astrophysical Journal* 26 (1907): 1-17.

[94] See especially Lowell's personal correspondence with Simon Newcomb and Walter Maunder, e.g. Lowell to Maunder, 28 November 1903; Lowell to Newcomb, 5 January 1907 and 15 May 1907, Percival Lowell Correspondence, Lowell Observatory Archives.

1905. As British and American magazines and newspapers hyped the expedition, scientific and popular anticipation mounted.[95] When Lowell's photographer finally returned from the Andes with the negatives, however, the images proved a general disappointment.

Lowell claimed that the 1907 photographs dispelled all doubt regarding the existence of the Martian canals. Paradoxically, however, they actually contributed to his further loss of credibility. Typically measuring about half an inch in diameter on the negatives, each photograph showed far less detail than any of Lowell's elaborate maps. (See Figure 2.12) Although the photos could be said to confirm Lowell's simple sketches, showing some isolated lines on the face of Mars' disk, they could not be said to show a definitive canal network. On top of that, they were incredibly difficult to reproduce: they were drastically small at original size but became excessively grainy when enlarged. Lowell agonized over the proper presentation of his photographs in the *Century Magazine*, even asking that they be "retouched" to show the canals better.[96] Having paid a substantial sum for the images' copyright, however, the editor was in no mood to delay publication of the long-promised Martian canal photographs: "There is no time to retouch the photographic plates and we should consider it a calamity to do so, as it would entirely spoil the autographic

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[95] See Tucker, "Science Illustrated", for a discussion of the media's coverage of the expedition.

[96] R.U. Johnson to Percival Lowell, 24 September 1907; George R. Agassiz to Percival Lowell, 27 September 1907 and 14 October 1907, Percival Lowell Correspondence, Lowell Observatory Archives.

value of the photographs themselves. There would always be somebody to say that the results were from the brains of the retoucher."[97]

To counteract his expectation that the "unedited" photographs' would reproduce poorly, Lowell began sending negatives and prints to select astronomers in Britain in the calculated hope that these men would vouch for the photographed canals in their own publications and presentations.[98] This strategy produced some desirable results. The president of the BAA, A.C.D. Crommelin, reported that his personal examination of Lowell's images showed 22 canals.[99] Likewise, the Director of the BAA's Mars Section commented in his report on the 1907 opposition that, "Regarding the objectivity of the canals of Mars, there seems no necessity or room for doubt after the truly splendid photographic results obtained by Messrs. Lowell and Lampland."[100]

Despite this personal vouching, however, the fact remained that Lowell's photographs were not convincing in any of the formats available for mass distribution. They appeared too small, too blurry, or too dark to match the certainty levels that had been inscribed in the maps. Wherever the much-hyped photographs were published, Lowell usually insisted that a disclaimer accompany them. In the

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[97] R. U. Johnson to Lowell, Percival, 8 October 1907, Percival Lowell Correspondence, Lowell Observatory Archives.

[98] Tucker, "Science Illustrated."

[99] A. C. D. Crommelin, "Martian Photography," *The Observatory* 30 (1907): 365.

[100] E. M. Antoniadi, "Mars Section Interim Report on the Australian Observations, 1907," *Journal of the British Astronomical Association* 18 (1908): 401.

1907 *Century* exclusive, for example, Lowell alerted readers that the printed images were three steps removed from the original negative, due to photographic printing, half-toning, and press printing. He further cautioned that use of a magnifying glass would only increase the grain size without revealing more detail. Lowell was thus forced to make a delicate argument. Asserting on the one hand that "to the camera no evasion of the fact avails. They [the canals] are there, and the film refuses to report them other than they are," he was forced on the other to qualify the photographs as "handicapped," claiming the canals' "straightness is *more* pronounced than appears from the photographic print."[101]

Perhaps more damaging than the inadequate reproduction of the tiny photographs, however, was the fact that photography supplanted cartography after 1907 as the proper standard of proof for Mars representations. The buildup of expectations regarding the photographs focused on their purely objective quality and their ability to resolve long-standing disputes among astronomers over the existence of the canals. Once the grainy photographs had been obtained, Lowell's elaborate maps – the basis of his reputation, credibility, and hypothesis – became essentially obsolete as scientific images. In a 1907 letter discussing the illustration of an article on Mars for the 10th edition of the Encyclopaedia Britannica, for example, editor

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[101] Percival Lowell, "New Photographs of Mars: Taken by the Astronomical Expedition to the Andes and Now First Published," *Century Magazine* 75 (1907): 309-310. (Emphasis added.)

Hugh Chisholm wrote to the author Simon Newcomb that he did not want to publish Lowell's maps or drawings:

> I think that only a half-tone reproduction of Lowell's photographs would be scientific. … The whole thing in fact is so much bound up with the Lowell photographs that I shrink from showing anything but the originals (which are decidedly difficult for us to reproduce, and had better be therefore referred to only in their source). … I don't in any case like the idea of mere drawings, which must inevitably 'fake' to some extent the 'canals.' [102]

In the end, Chisholm decided he would publish the encyclopedia's "Mars" entry with no image whatsoever, rather than use any cartographic stand-in for the "scientific" photographs.

Many editors seemingly came to a similar conclusion after the vaunted 1907 expedition, as Lowell's maps rarely appeared in scientific publications after that year. Photography had provided a new imagery of truth that made astronomers' diverse maps appear positively subjective in comparison. The fact that the photographs were blurry and grainy did not diminish their perceived objectivity. It did, however, diminish the certainty of the canals that had been inscribed in Lowell's and others' maps.

When irrevocable doubts were cast on the authority of cartography as an objective format, astronomers' patience with increasingly outlandish claims about Mars finally began to dry up. At the same time, popular enthusiasm for the Mars

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[102] Hugh Chisholm to Simon Newcomb, 5 February 1907, Simon Newcomb Papers, United States Library of Congress, Manuscript Division. (Emphases in original.)

began to show its first signs of waning as well. Though it took much longer for popular interest to die out (it arguably continued with some audiences into the 1950s, if not to the present day), the decreasing power of the map had a marked effect on both scientific and popular audiences' confidence in the supposed Martian inhabitants. Having risen to prominence as the most eloquent and active promoter of the inhabited-Mars hypothesis, it was Lowell who suffered most keenly from this decline of the map.

A Scientific End for the Canals

The final blow to Lowell's scientific credibility came in 1909-1910, when he became embroiled in a debate that bore striking resemblance to the old Schiaparelli-Green disagreement over whether Mars was best represented with hard-edged lines or naturalistic shading. With the authority of his map weakened by the new photographs, Lowell's personal credibility was also newly vulnerable. Whereas he had earlier been able to maintain a spirited defense against all criticisms, he was left after 1907 to argue from a much weaker position. Those astronomers who had long wanted to dismiss Lowell's theories and speculations regarding Martian life suddenly found the proposition much easier.

During the 1909 opposition, the French astronomer Eugene Antoniadi observed Mars at the celebrated 33-inch Meudon Observatory telescope, the largest in

Europe.[103] Though he observed for only nine nights during a month-long stay in Paris, Antoniadi reported seeing Mars so clearly at times that the linear appearance of the canals dissolved into an intricate mess of smaller, irregular details: "the geometrical 'canal' network is an optical illusion; and in its place the great refractor shows myriads of marbled and chequered objective fields, which no artist could ever think of drawing."[104]

As an accomplished draftsman himself, Antoniadi nonetheless attempted to represent the complex markings he had seen, producing an image that looked more like Green's 1877 sketches than anything that had been produced in the intervening 30 years. (See Figure 2.13.) He sent five sketches to Lowell with a letter describing his perfect certainty that they represented an objective view of Mars' surface. Commenting that the clarity of his observations "had surpassed all my expectations," he wrote, "I thought I was losing my senses; and it was only after seeing all these details constantly for hours that I concluded there was no doubt whatever regarding their objective reality."[105] Though Lowell had cautioned Antoniadi in an earlier letter about the danger that a large telescope such as Meudon's might actually show less

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[103] For a detailed discussion of Antoniadi's long involvement in the Mars debate, see Richard McKim, "The Life and Times of E.M. Antoniadi, 1870-1944. Part 2: The Meudon Years," *Journal of the British Astronomical Association* 103 (1993): 219-27.

[104] E.M. Antoniadi, "Mars Section Third Interim Report for 1909, Dealing With the Nature of the So-Called 'Canals' of Mars," *Journal of the British Astronomical Association* 20 (1909): 28.

[105] E.M. Antoniadi to Percival Lowell, 9 October 1909, Percival Lowell Correspondence, Lowell Observatory Archives.

detail (by allowing excess light to overwhelm subtle features),[106] Antoniadi reported, "the tremendous difficulty was not to see the detail, but accurately to represent it."[107] Reprising part of the 1877-78 discussion between Green and Schiaparelli, Antoniadi claimed legitimacy for his sketches by touting his artistic skills: "Here, my experience in drawing proved of immense assistance, as, after my excitement, at the bewildering amount of detail visible, was over, I sat down and drew correctly, both with regard to form and intensity, all the markings visible."[108]

Lowell tried to discredit Antoniadi's claims, but to no avail. In personal letters, he suggested that Antoniadi's telescope aperture was so large it had caused a blurring effect.[109] In response, Antoniadi only became even more certain of what he had seen. He wrote to Lowell later in 1909, "I base all my ideas of Mars on what I saw myself at Meudon; and as I have not seen any geometrical canal network, I am inclined to consider it as an optical symbol of a more complex structure of the Martian deserts, whose appearance is quite irregular to my eye."[110] Antoniadi carefully and politely acknowledged that Lowell (and Schiaparelli) had discovered

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[106] Percival Lowell to E.M. Antoniadi, 26 September 1909, Percival Lowell Correspondence, Lowell Observatory Archives.

[107] Antoniadi to Lowell, 9 October 1909. (Emphasis in original.)

[108] Ibid.

[109] Percival Lowell to E.M. Antoniadi, 2 November 1909, Percival Lowell Correspondence, Lowell Observatory Archives.

[110] E.M. Antoniadi to Percival Lowell, 15 November 1909, Percival Lowell Correspondence, Lowell Observatory Archives.

many real features on the Martian surface, but rejected the possibility that they could be anything other than natural.

Upon the occasion of Schiaparelli's death in 1910, Lowell wrote an eloquent obituary praising the Italian's canal discoveries while also blasting his own opponents for not accepting the reality of the canals.[111] It was to be, however, the last time he actively defended the inhabited-Mars hypothesis in a scientific publication, showing that the tide had finally turned. Antoniadi, on the other hand, wrote more than a dozen well-received scientific articles in 1909 and 1910, most of them directly refuting Lowell's theories. In his official reports for the British Astronomical Association, Antoniadi wrote with confidence and finality of the artificial canals' demise:

> We thus see in the so-called 'canals' a work of Nature, not of Intellect; the spots relieving the gloom of a wilderness, and not the Titanic productions of supernatural beings. To account for their various phenomena, we need only invoke the natural agencies of vegetation, water, cloud, and inevitable differences of colour in a desert region.[112]

To understand how Antoniadi's nine nights of Mars observations succeeded in discrediting Lowell, who had a 15-year record of continuous observation and publication, we must consider the visual authority of Antoniadi's new claims in 1909. Upon completion of his stay at the Meudon Observatory, Antoniadi immediately began circulating his sketches to colleagues within the British astronomical

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[111] Percival Lowell, "Schiaparelli," *Popular Astronomy* 18 (1910): 456-67.

community. At the same time, he wrote a series of articles about his and others' Mars observations in the *JBAA*. In most of these publications and letters, he emphasized the fact that his drawings showed more detail than Lowell's by revealing intricate detail in places where Lowell showed mere lines. He referred to a "vast and incredible amount of detail,"[113] claiming that "the fact that *no straight lines could be held steadily when much more delicate detail was continually visible* constitutes a fatal objection to their crumbling existence."[114]

Antoniadi and his ally, Maunder (an active Lowell critic), also pointed out that the new naturalistic, shaded sketches bore a striking resemblance to the latest photographs of Mars. Using the world's largest telescope (with a 60-inch glass), the staff of the Mount Wilson Observatory in California had taken a series of photographs in 1909 that far exceeded Lowell's 1907 images in clarity and detail. Once again, however, the photographs failed to show any of the hard-edged features that commonly appeared in Lowell's drawings and maps.[115] Antoniadi's 1909

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[112] E.M. Antoniadi, "On the Possibility of Explaining on a Geomorphic Basis the Phenomena Presented by the Planet Mars," *Journal of the British Astronomical Association* 20 (1909): 93.

[113] E.M. Antoniadi, "Mars Section Fourth Interim Report for the Apparition of 1909, Dealing With the Appearance of the Planet Mars Between September 20 an DOctober 23 in the Great Refractor of the Meudon Observatory," *Journal of the British Astronomical Association* 20 (1909): 79.

[114] E.M. Antoniadi, "Mars Section Fifth Interim Report for 1909, Dealing With the Fact Revealed by Observation That Prof. Schiaparelli's 'Canal' Network Is the Optical Product of the Irregular Minor Details Diversifying the Martian Surface," *Journal of the British Astronomical Association* 20 (1909): 141. (Emphasis in original.)

[115] "Report of the Meeting of the Association, Held on Wednesday, December 29, 1909, at Sion College, Victoria Embankment, E.C.," *Journal of the British Astronomical Association* 20 (1909): 119-28.

sketches thus appeared more objective than Lowell's in their similarity with the new photographic imagery.

Finally, it must be noted that Antoniadi's personal authority as a long-standing Lowell supporter made him an especially effective critic. Antoniadi himself had reported seeing canals on numerous occasions[116] and had drawn dozens on them on maps he compiled for the British Astronomical Association in his capacity as the Mars Section director since 1896.[117] Furthermore, Antoniadi had championed the evidentiary quality of Lowell's 1905 and 1907 photographs. In an analysis published for the *Royal Astronomical Society* in 1908, for instance, Antoniadi commented that "the amount of detail shown on [Lowell's] photographs is very considerable"[118] and noted that he could count 17 canals as "more or less discernible on the images."[119] Antoniadi thus could not be dismissed as a feeble observer who rejected the canals because he could not see them himself. He also shrewdly referred to other observers

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[116] See, for example, Eugene Antoniadi, "Mars Section, Second Interim Report for 1898-99," *Journal of the British Astronomical Association* 9 (1899): 367-71; E.M. Antoniadi, "Section for the Observation of Mars: Report of the Section, 1900-1901," *Memoirs of the British Astronomical Association* 11 (1903): 85-142.

[117] Richard McKim, "The Life and Times of E.M. Antoniadi, 1870-1944. Part 1: An Astronomer in the Making," *Journal of the British Astronomical Association* 103 (1993): 164-70; McKim, "The Life and Times of E.M. Antoniadi, Part 2."

[118] E.M. Antoniadi, "Note on Some Photographic Images of Mars Taken in 1907 by Professor Lowell," *Monthly Notices of the Royal Astronomical Society* 69 (1908): 110.

[119] Ibid., 112.

who had reported seeing irregular details within the canals in the last two decades,[120] further supporting his claim.

In the end, Antoniadi won a complete reversal of the 1877 verdict, as his subtle, naturalistic shading won substantial approval from the astronomical communities in Europe and North America, relegating Lowell's hard-edged Schiaparellian-style maps to a weakened status as "startling theories."[121] Maunder claimed at a meeting of the British Astronomical Association that the canals had been irrevocably put to rest:

> There never was any real ground for supposing that in the markings observed upon Mars they had any evidence of artificial action. Had it not been a sensational idea which lent itself to sensational writing in the daily press he [Maunder] did not believe they would ever have heard of it. He considered it was all the better for science that the idea was now completely disposed of. They 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 the Martians after the fashion that Mr. H.G.Wells had so vividly described.[122]

Although his pronouncement was somewhat premature, given that the public did not let go of the canals as quickly as the scientists, Maunder accurately recorded a definitive reversal in scientific considerations of the geography of Mars.

The reasons for this reversal include both photography's rise as a standard of proof as well as Antoniadi's claim that his few sketches showed more detail than

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[120] E.M. Antoniadi, "Mars Section Sixth Interim Report for 1909, Dealing With Some Further Notes on the So-Called 'Canals'," *Journal of the British Astronomical Association* 20 (1910): 189-92.

[121] Antoniadi, "Mars Section Fifth Interim Report for 1909," 141.

Lowell's many maps. Where Green had argued in 1877 only that he saw something *different* than Schiaparelli, Antoniadi argued that he actually saw *more* than Lowell. Visually supported by the photographs – the new scientific imagery of truth – Antoniadi's sketches thus trumped Lowell's maps. After a long assault on the logic of Lowell's theory and the certainty of his methods, it was the dismantling of his map that finally diminished the scientific community's willingness to seriously entertain further talk of Mars' inhabitants.

Conclusion

There is little value in assessing which early maps were "right" or "wrong" in terms of their faithfulness to modern-day imagery of the Martian surface. Maps produced at the turn of the twentieth century are much more valuable for what they reveal about the processes of authorization and legitimization of certain landscape views.

The sharp rise of the inhabited-Mars theory in the late nineteenth century was intimately tied to the perceived objectivity of scientific cartography, the visual authority of specific maps, and the personal authority of various mapmakers. In essence, the apparent objectivity of cartography tended to conceal varying production processes, meaning that maps of Mars were compared and assessed primarily on the basis of their visual appearances, regardless of how they had been made. In 1878,

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[122] "Report of the Meeting of the Association, Held on Wednesday, December 29, 1909," 123.

Schiaparelli's map gained authority over Green's because its visual appearance inscribed greater certainty and detail. The map was also supported in its ascendancy by Schiaparelli's personal authority as one of Europe's best-known astronomers.

Before becoming the new standard, however, Schiaparelli's map, which showed an intricate landscape of islands and canal waterways on the Martian surface, underwent a short period of vigorous competition that set the tone for future debates over Mars. Disagreements over the representations of Martian features as well as over the planet's assigned placenames introduced a territorial competition among astronomers. Not only did the territorial overtones provoke even greater interest in Mars, but they also contributed to the cartographically induced "placeness" of the red planet. The more it was mapped and contested, the more Mars' landscape came to seem like an Earth-like world. The landscape analogy also strongly suggested that the red planet might be capable of hosting intelligent beings.

The competition to add more and more canals to the map of Mars eventually produced a powerful iconic image that transcended the boundary between science and popular culture. This icon – showing a geometrical canal network on the planet's face – came to represent an advanced intelligence and civilization on Mars. In the process, the image of Mars assumed a mantle of scientific objectivity despite admissions that no eyewitness had ever actually seen the canal network as a whole. Again, the functions of the cartographic process had been erased in the visual aspect of the map. By century's end, the geometrical map of Mars – which had come into

being on the strength of Schiaparelli's reputation in the 1870s – was so widely accepted that it was able to reverse the flow of authority. The map itself began to strongly elevate the authority of those astronomers who contributed to its detail, regardless of their pre-existing reputations.

Because the inhabited-Mars theory was so keenly linked with the visual authority of the map and the privileged status of the most active Mars mapmakers, it was delicately dependent on the map's legitimacy. When the perceived objectivity of cartography faltered in the early 1900s in comparison with new photographic technologies, belief in Mars' supposed inhabitants lost considerable ground as well. The maps' waning credibility further weakened the position of astronomers like Lowell, whose stature as advocates of the inhabited-Mars theory was built on the foundation of their maps. By 1910, the astronomical communities of Europe and North America had largely abandoned their 30-year flirtation with the idea of an inhabited Mars, returning to a naturalistic mapping style that closely resembled the pre-1877 maps.

Cartography was integral to the origin, development, and expiration of the scientific conceptualization of Mars as a world possibly inhabited. Through maps, Mars became a geographical place, a contestable territory, and a celebrated locale for extraterrestrial life. In the same way that scientific maps allowed the British to conceptually subjugate India, the French to justify their invasion of Egypt, and European explorers to depict an empty landscape in the heart of aboriginal Australia,

maps of Mars authorized a new view of the red planet's landscape. This new Mars was familiar, inhabited, and advanced.

Figure 2.1 Chart of Mars, by Nathaniel Green, 1877

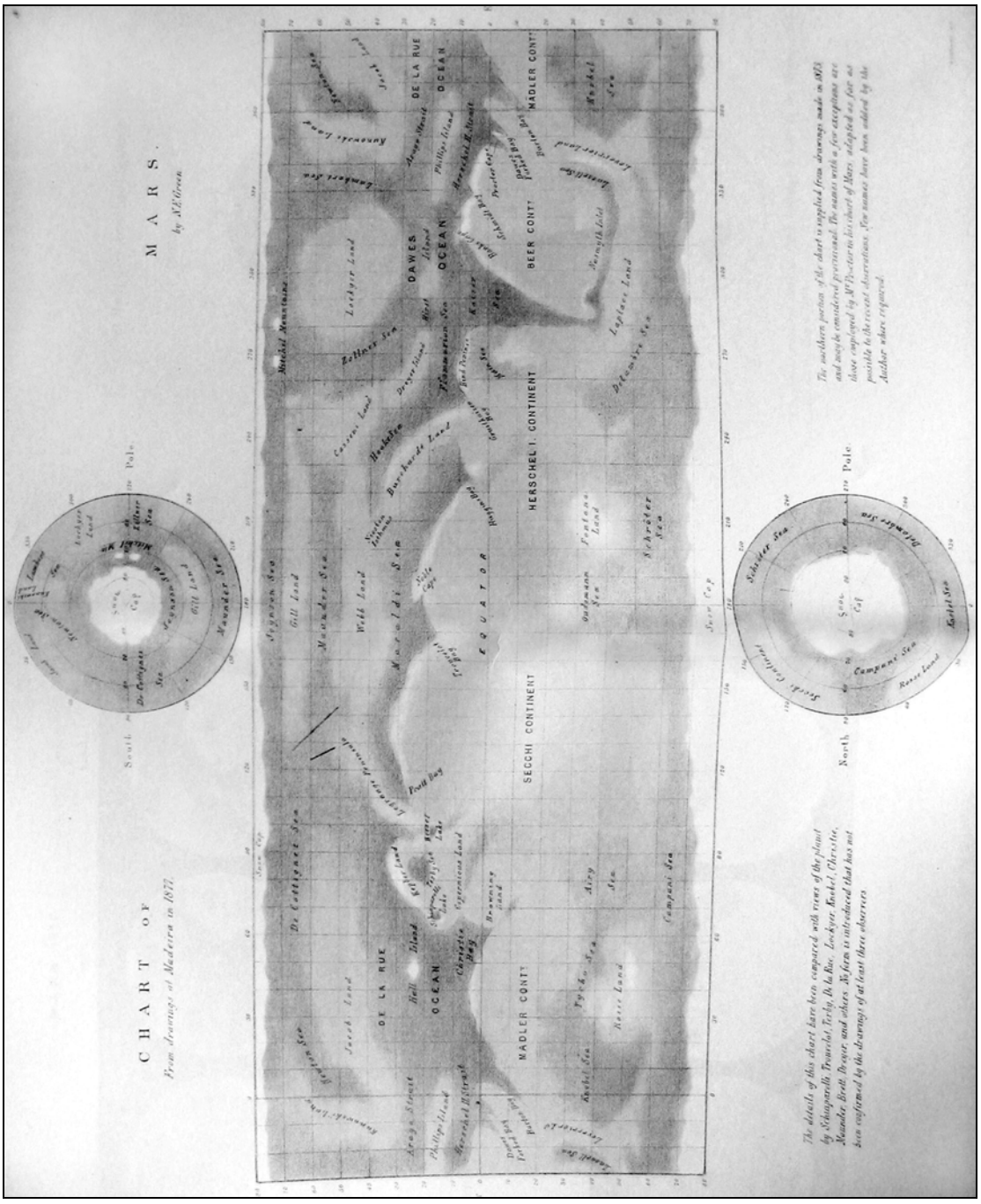


Figure 2.2 Mappa Areographica, by Giovanni Schiaparelli, 1878

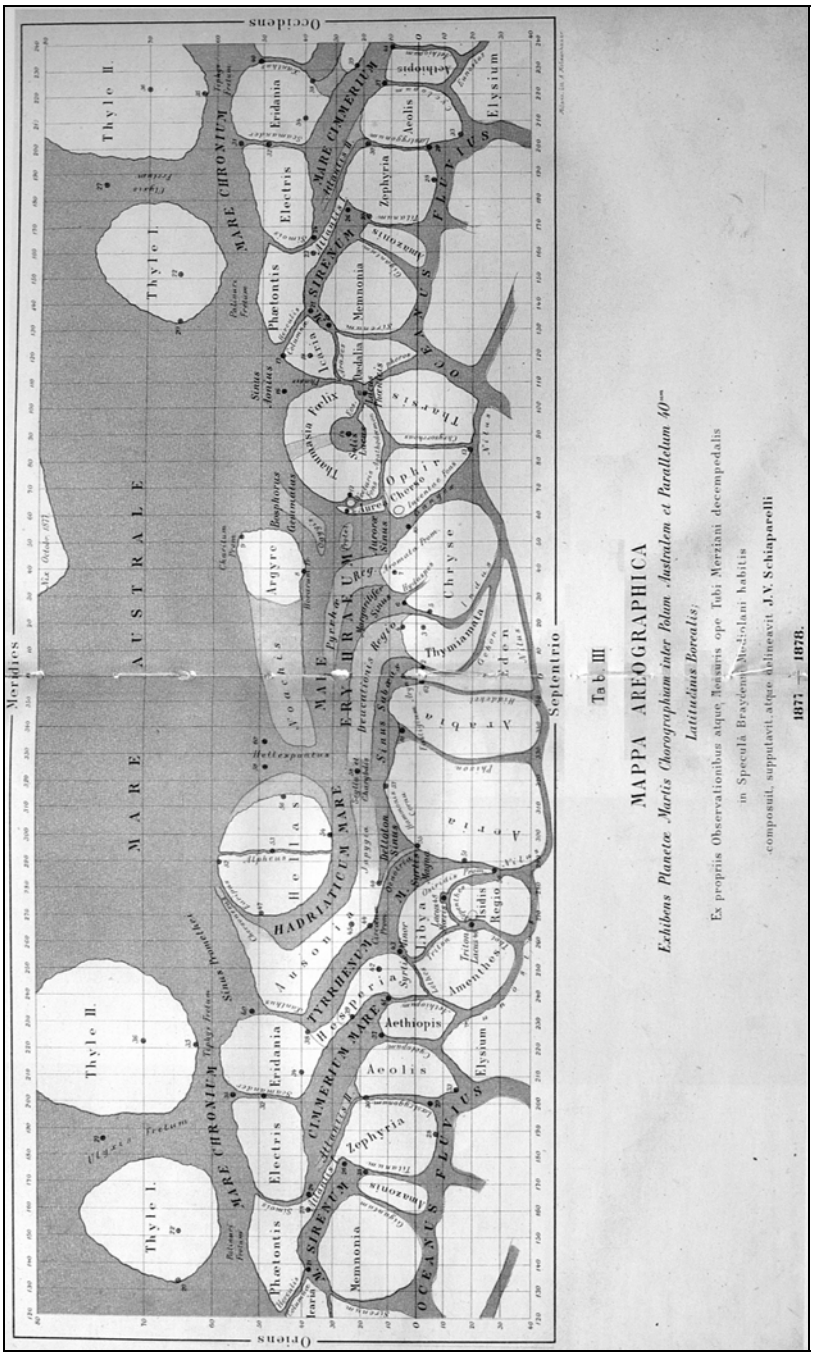


Figure 2.3 Sketch made at the telescope, by Nathaniel Green, 1877

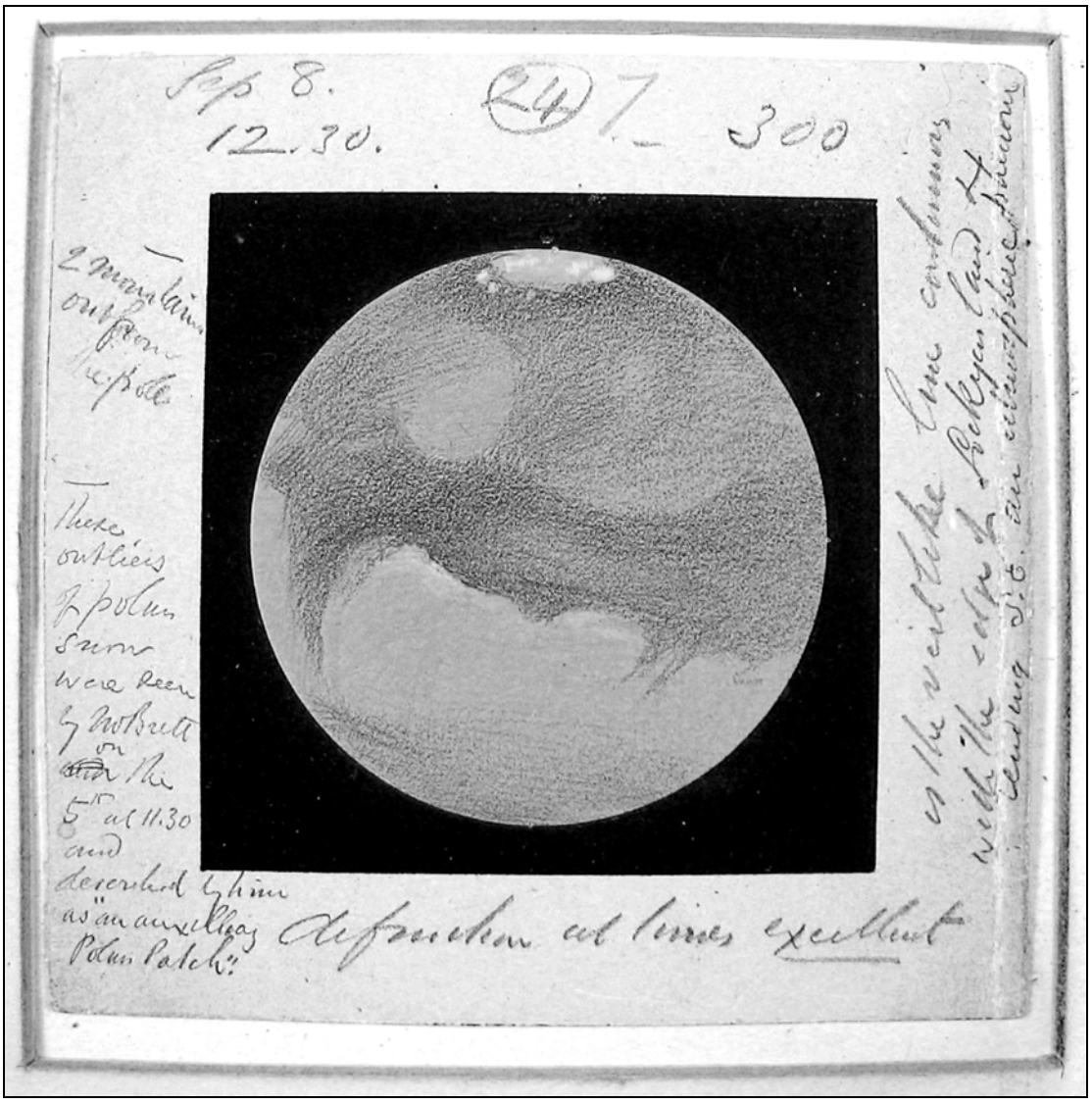


Figure 2.4 Sketch made at the telescope, by Giovanni Schiaparelli, 1878

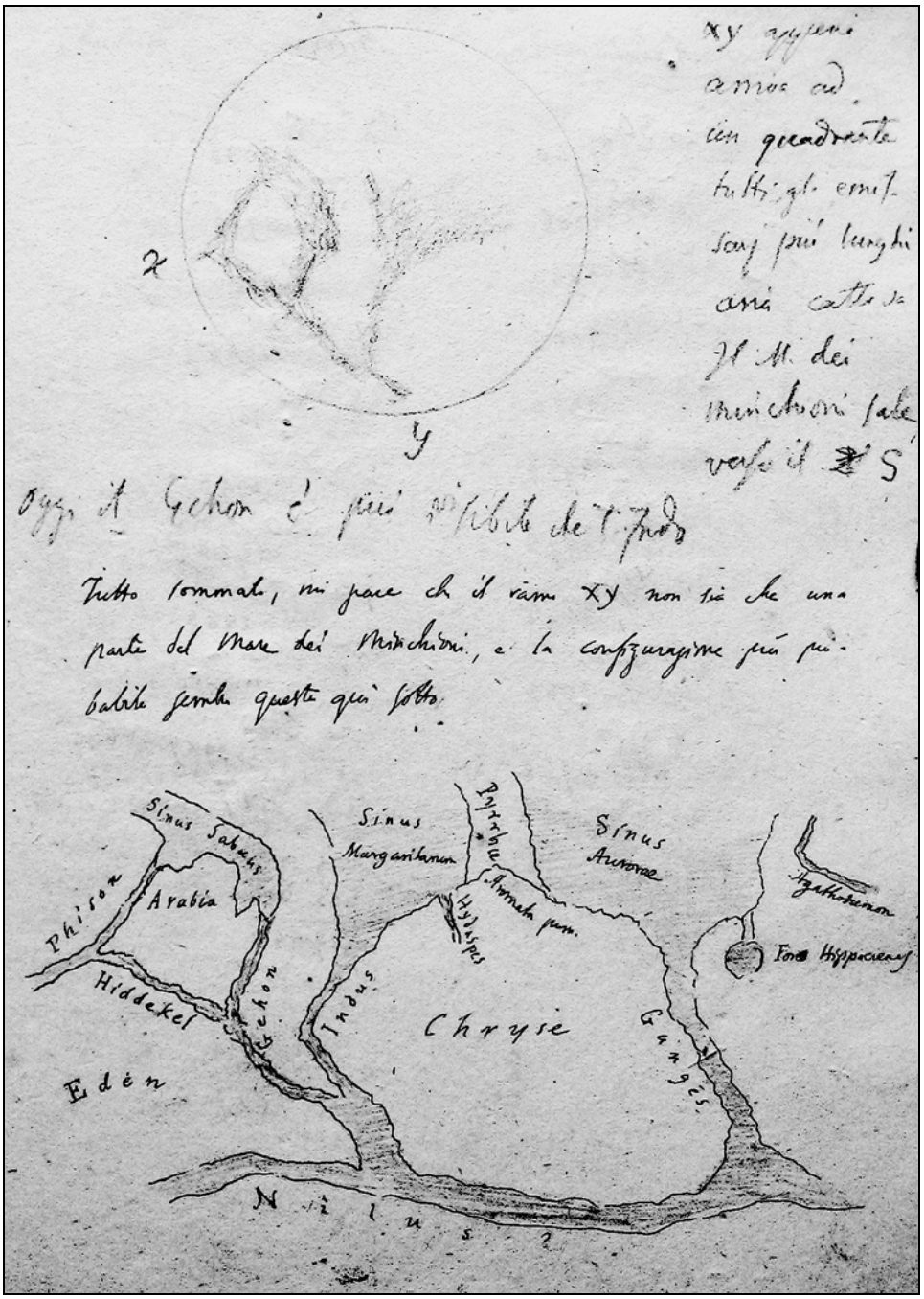


Figure 2.5 Map of Mars, by Giovanni Schiaparelli, 1888

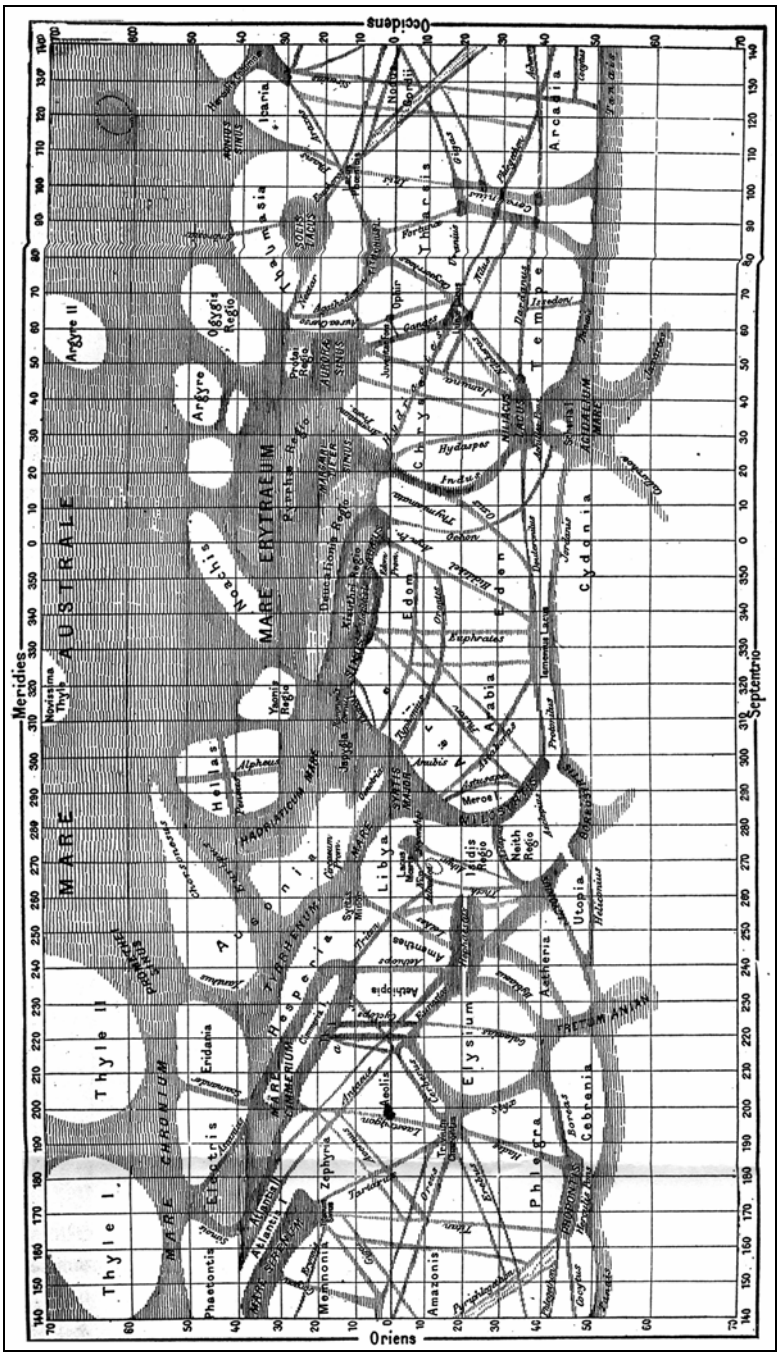


Figure 2.6 Maps of Mars, *Scientific American*, 1896

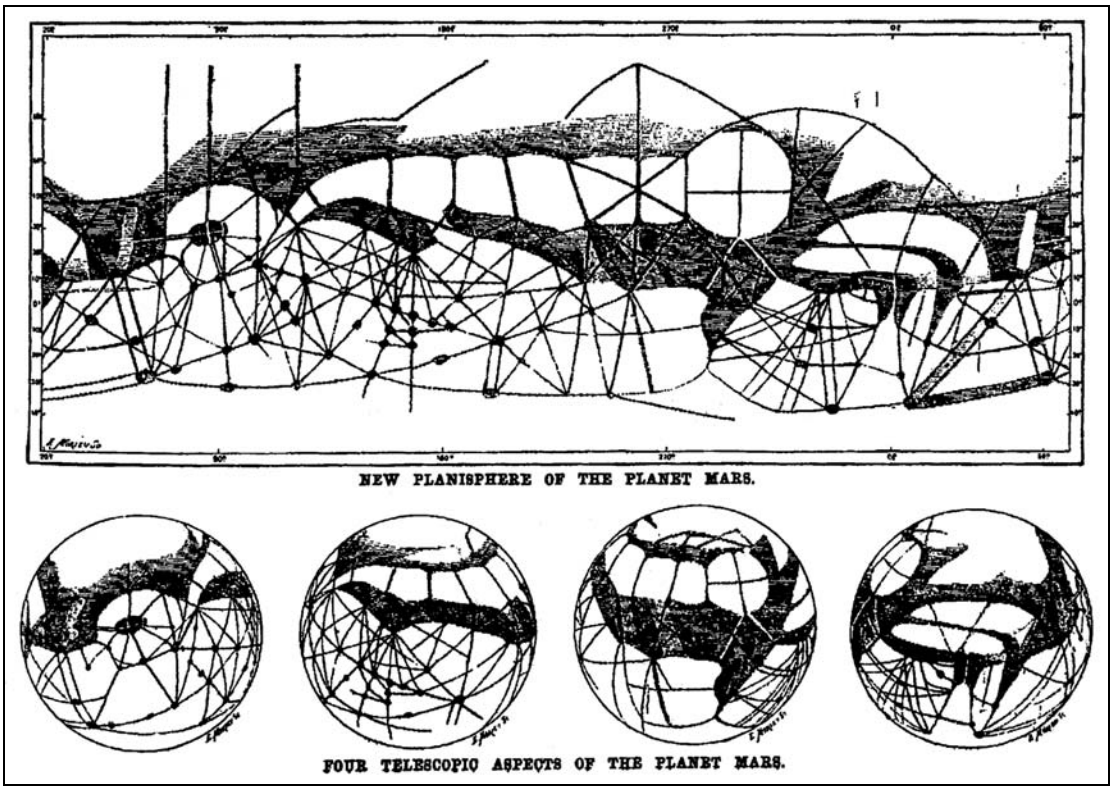


Figure 2.7 Mars 1896-7, by Percival Lowell, 1897

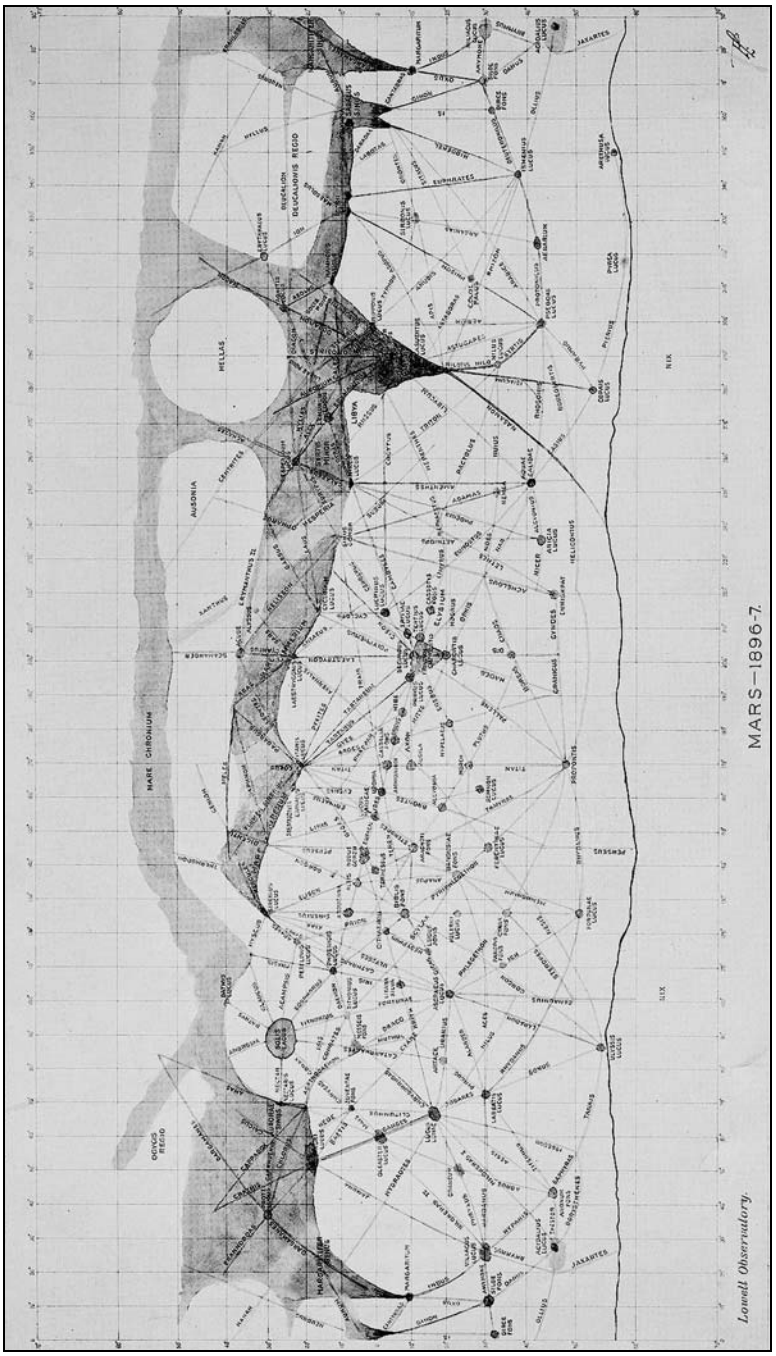


Figure 2.8 Image of Mars, *Boston Sunday Herald*, 1906

NORTHERN HEMISPHERE OF MARS, SHADED PORTION SHOWING SEAS AND CANALS.

Figure 2.9 Comparative pattern imagery, *Mars and its Mystery*, 1906

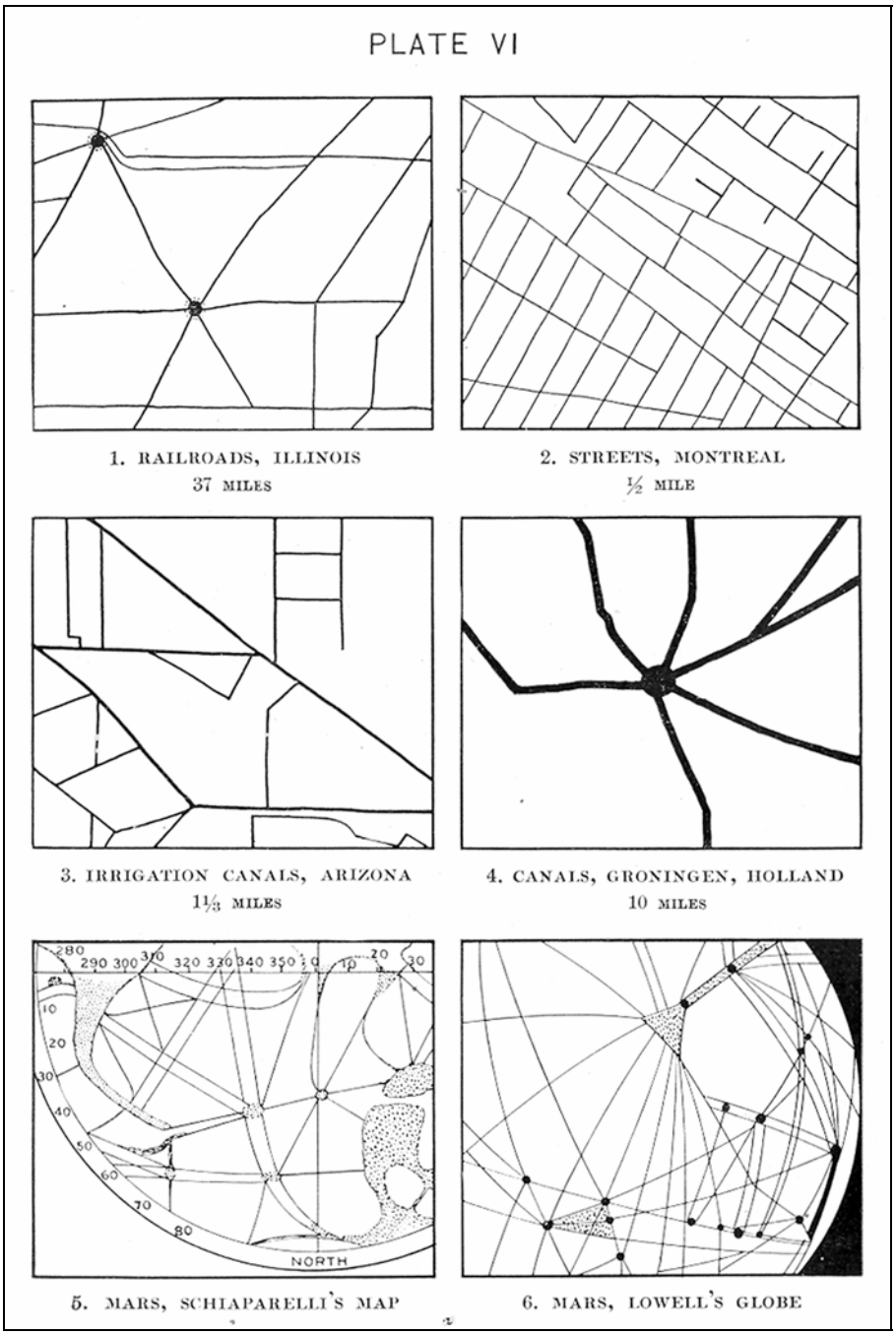


Figure 2.10 Sketches of Mars from Lowell Observatory, 1907

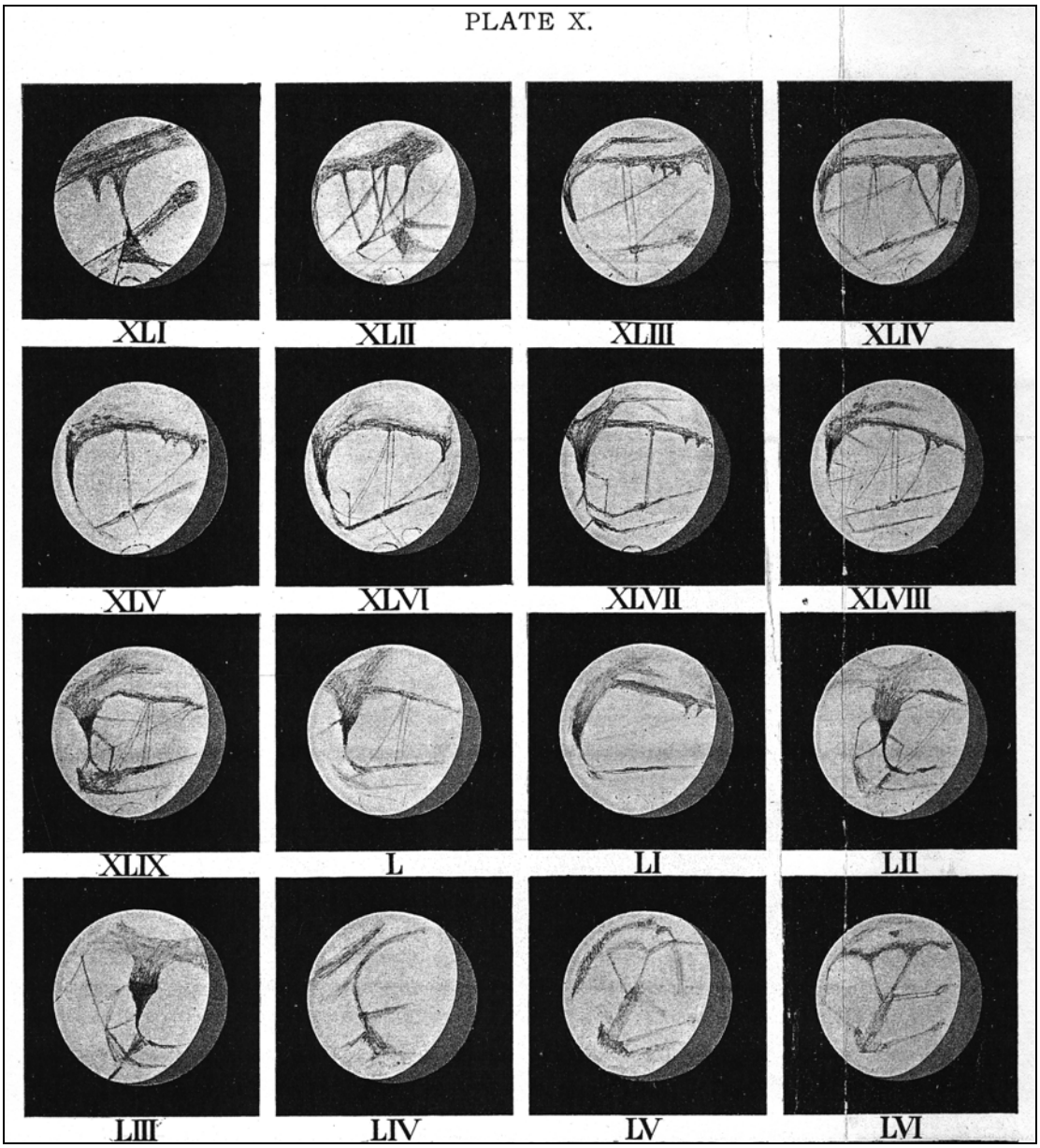


Figure 2.11 Mars, by Percival Lowell, 1905

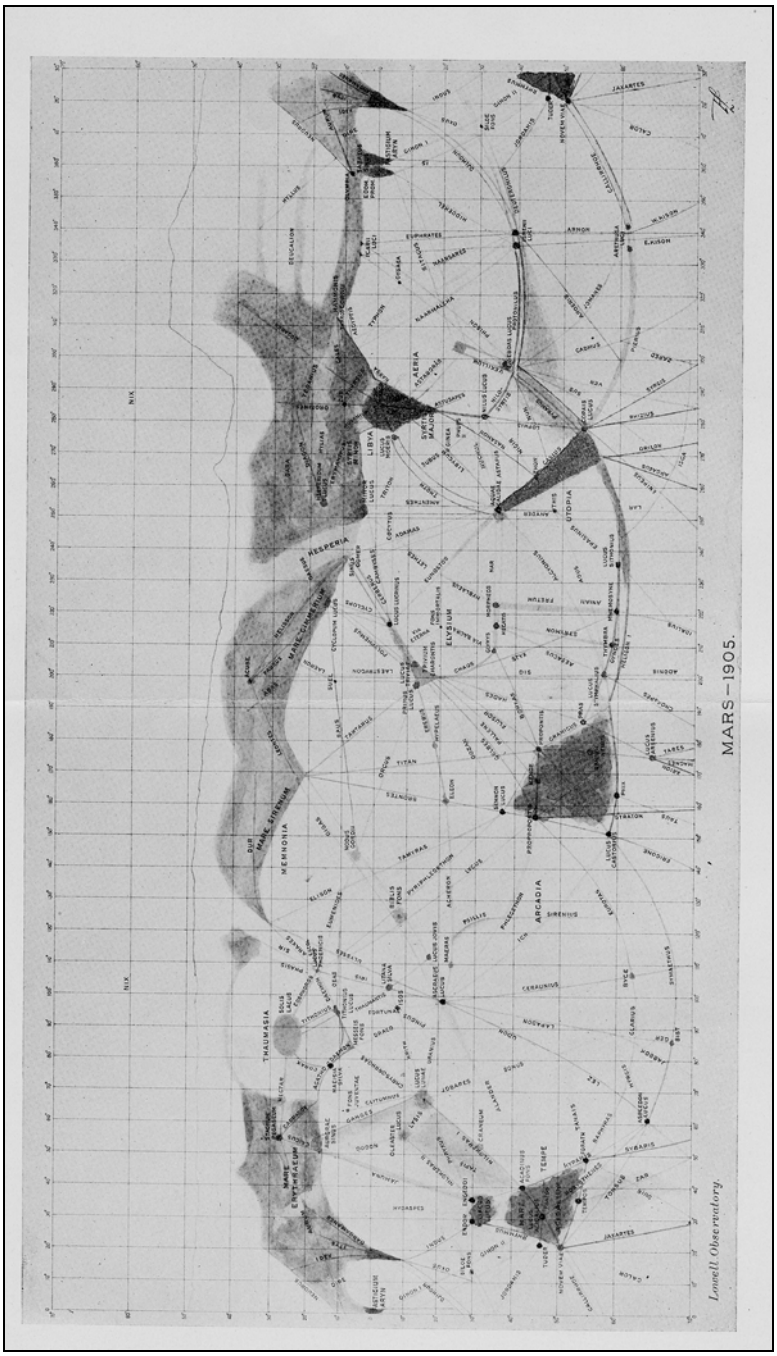
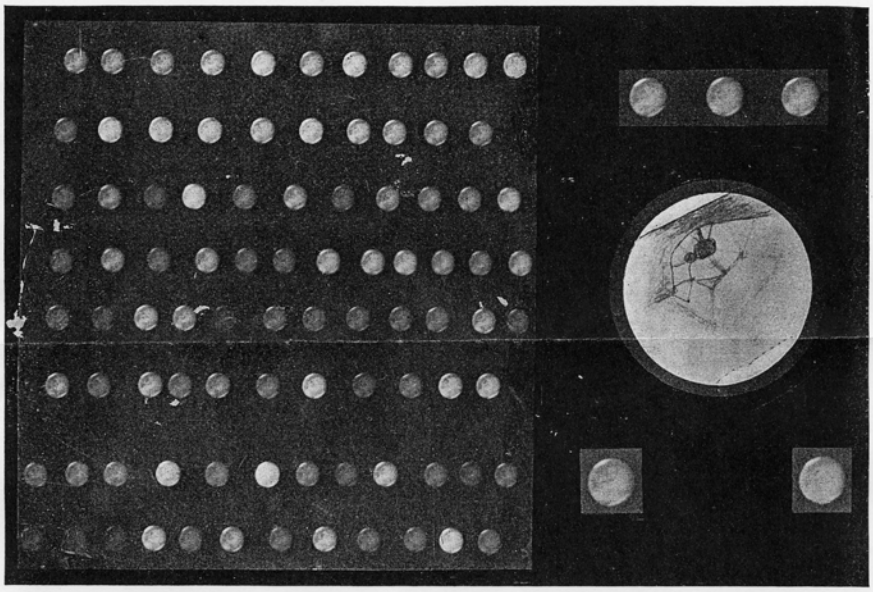


Figure 2.12 Photographs of Mars in *The Century Magazine*, 1907

Before long, cables began to arrive at Flagstaff which showed that the expedition had met with unqualified success—success indeed beyond expectation, and following on their heels as fast as steam could bring them came the actual prints. Even to the expert eyes that scanned them critically they proved little less than astounding. Not only were canals and oases evident there, but these showed with a delicacy of delineation which spoke for the steadiness of the air through which they had been taken as well as for Mr. Slipher's skill in taking them. When we consider that stability in the telescope is essential, and that in this case the instrument was only temporarily set up, the excellence of Mr. Ilse's mounting and of Mr. Slipher's manipulation of it become apparent.

In scrutinizing these views, one should remember two things: first, that what he sees on the printed page is three removes from the magazine sheet. If the old saying be true that "three moves are as bad as a fire," it is clear how much has inevitably been lost in these steps made in order that they might be presented to the general reader at all. Later, the original prints will, I trust, be exhibited in the Natural History Museum of New York, where those interested can scan them for themselves.



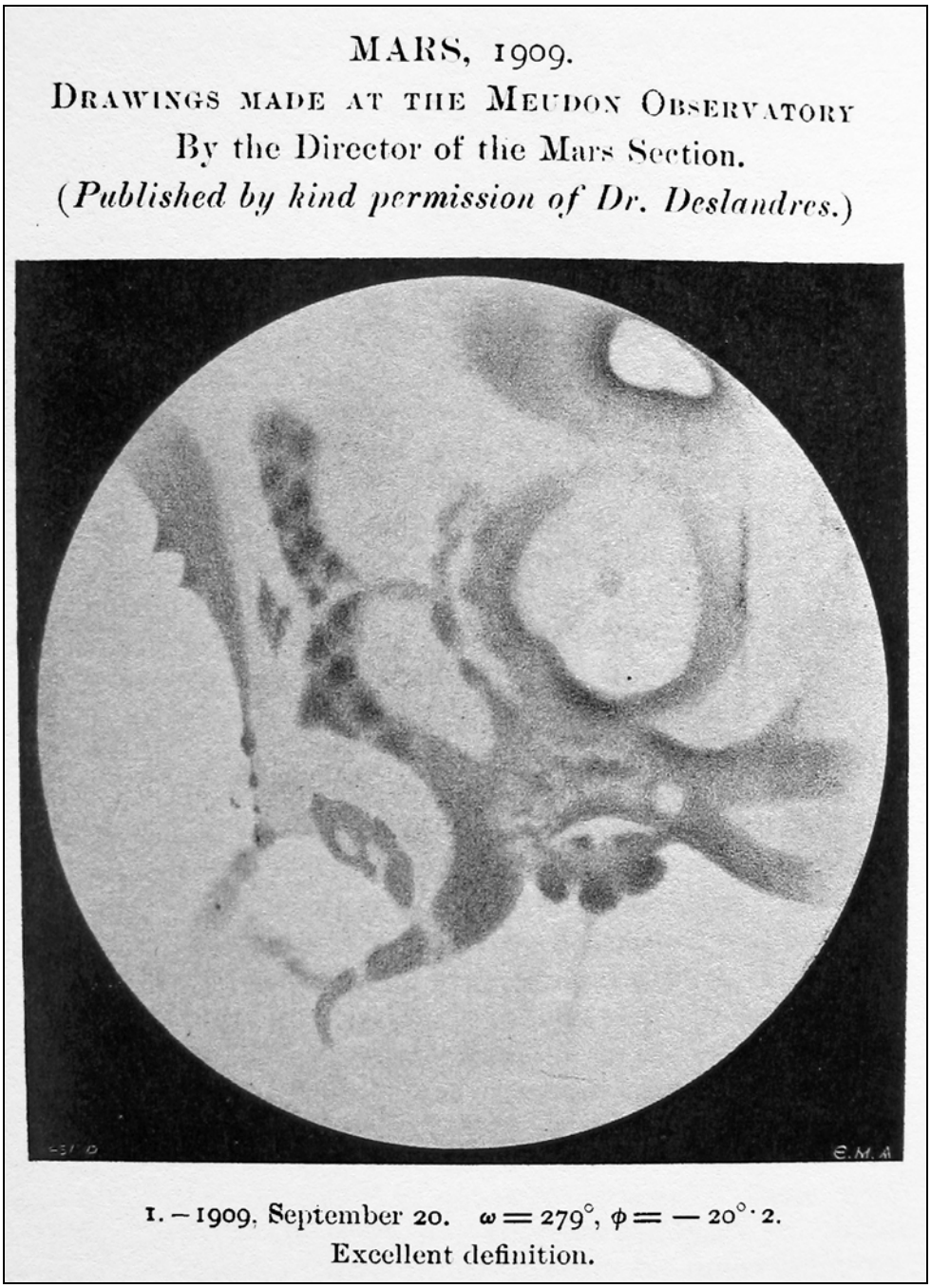
No. 4. SHOWING VARIETY OF INTENSITY OF IMAGE. THE DIFFERENCE IS DUE TO VARIATION IN TIME OF EXPOSURE

REGION OF THE SOLIS LACUS. LONGITUDE OF THE CENTER OF THE PHOTOGRAPH, 90°. ENLARGEMENTS, AND PROFESSOR LOWELL'S DRAWING

Secondly, the reader should be warned against thinking that magnification by a hand-glass will enable him to see them more precisely. For the grain of the plate already magnified opposes itself to any such resolution. For an acute eye they are best as they are, but for those of less penetrating sight a very slight enlargement is necessary. But this must not be overdone.

The small size of these bullets from Mars demanding minute scrutiny to read

Figure 2.13 Drawing of Mars, by Eugene Antoniadi, 1909



CHAPTER 3. AREOGRAPHY AS GEOGRAPHY

Map-making was not the only powerful convention astronomers adopted from the discipline of geography. During the Mars canal debates, geographical modes of observation also played a fundamental role, both in how astronomers conducted their work and in how they established legitimacy for their claims: they prioritized direct observation and sensory perception over theoretical calculation; they asserted that visual intuition was the best guide to understanding the Martian landscape; and they habitually developed analogies with terrestrial geography to interpret the meaning of their observations. Thus observing Martian landscapes in the same way that geographers observed terrestrial landscapes, astronomers were able to reach broad audiences and secure extensive interest in their topic.

During the late nineteenth century, attention to the variations in "seeing" conditions at different geographical locations encouraged astronomers to conduct their Mars observations from remote locations outside the major metropolitan centers. In asserting the superiority of expeditions and tropical observatories, Mars astronomers boosted their credibility by adopting the language and imagery of strenuous fieldwork in their publication. They thus portrayed their science as similar to the popular field sciences of the day.

Astronomy's stated similarity to field science was not merely rhetorical, however. Astronomers also borrowed methodological and evidentiary standards from

disciplines like geography. Professing eyewitness views of the Martian surface, observers relied on an explicit geographical gaze to process and communicate the significance of what they were seeing. Astronomers made sense of Mars by observing its landscape, using their intuition about its surface forms and processes, and then creating analogies to explain its characteristics. This approach was similar to those chronicled in well-known geographical expedition reports of the day.

As the inhabited-Mars hypothesis gained support throughout the 1890s and developed into a full-blown popular mania in the first decade of the twentieth century, astronomers also frequently assumed an explicit explorer-geographer persona in their lectures and texts. Whether consciously comparing themselves to famous explorers or subconsciously adopting rhetoric from the observational sciences, astronomers established a link between their Mars work and the accounts and analyses of contemporary geographers and explorers. They claimed to be practicing a new kind of geography (called "areography") and to be doing it more skillfully than the well-known explorers of the day. This representational hybridity propelled Mars science into the consciousness of geographically-literate audiences. In books, newspaper articles, and popular journals, for instance, geographical news about Mars regularly ran alongside geographical news about the polar expeditions, helping to fuel popular interest.

At the same time, the geographical framing of Mars constructed a view of the Martian landscape as familiar and knowable. Widespread use of terrestrial analogies

to explain the peculiarities of Mars' geography, in particular, served to ingrain the idea that Mars was rather similar to Earth. In significant measure, these geographical conventions, representations, and meanings contributed to the broad Western acceptance of the inhabited-Mars theory. The findings in this chapter thus run counter to traditional explanations of the Mars fad as an episode of over-sensationalism and bad science.

The Geography of "Seeing" Mars

In the late nineteenth century, seeing the red planet was primarily a matter of location. Astronomers have long been concerned with the influence of Earth's atmosphere on their ability to see celestial objects clearly. To an astronomer, "seeing" is a measure of atmospheric clarity and stillness in a given location. Even a keen-eyed observed with a powerful telescope is at the mercy of humidity, temperature, dust, wind, and clouds, all of which can significantly impact astronomers' viewing.[123] Just as the slightest motion of a camera with a long zoom lens will blur the resulting image, so the slightest *apparent* motion of a planet or star (due to disturbances in Earth's atmosphere) will blur the telescopic image available to the stationary astronomer. In conditions of bad seeing, therefore, astronomers are confronted with tremulous, blurry images that preclude the use of magnification

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[123] Fred W. Price, "The Atmosphere and Seeing," *The Planet Observer's Handbook*, 2nd ed. (Cambridge: Cambridge University Press, 2000), 69-72.

eyepieces or even make observation impossible. In conditions of excellent seeing, on the other hand, astronomers can take advantage of atmospheric calmness to magnify their telescopic images and examine fine detail. To account for the impact of seeing, astronomers typically make note of the highly variable atmospheric conditions in which they observe from night to night. In this way, they can report and qualify the exactness of their measurements and sketches for other astronomers who might want to compare results from various locations or times.

In the late nineteenth century, matters of seeing were central to the discussion about Mars' geography. A writer for the British journal *The Observatory* commented in 1882 that British skepticism over Italian astronomer Schiaparelli's reported Martian canals might stem from discrepancies of seeing at different locations: "It is, of course, conceivable that markings which appear distinct and well-defined … when examined in the pellucid air of Northern Italy, would, in our unfortunate climate, be confused together, so as to give the appearance of faintly shaded districts."[124] Variations in observers' claims about the Martian surface features, in fact, prompted an attempt to standardize a numerical "scale of seeing" that could be used by all astronomers, regardless of location or instrument size.[125] The standard scale was proposed as a way of addressing and resolving conflicts that occurred when multiple astronomers all reported "very good" seeing yet showed widely divergent findings in

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[124] "Schiaparelli's Observations of Mars," *The Observatory* 5 (1882): 143.

[125] Douglass, A. E. "Scales of Seeing," *Popular Astronomy*.

their sketches and maps. If all Mars astronomers were forced to calibrate their individual seeing scales (by analyzing the detailed appearance of diffraction rings around bright stars), it was suggested, "the excellence of any region in the most delicate astronomical work will thus be revealed with absolute impartiality."[126]

Reference to the objectively determined atmospheric "excellence of any region," however, indicated that a fundamental reconception of seeing was underway. Whereas seeing had previously been considered an atmospheric characteristic that varied from night to night in a given location, Mars observers recast it as varying from location to location on a given night. Rather than fine tuning one's instrumentation or method to cope with a certain location's seeing, it became preferable to change one's location in pursuit of better atmospheric conditions. Thus British astronomer Green reportedly chose the Portuguese island of Madeira for his 1877 Mars-observing expedition because of its clear skies and stable temperatures. Similarly, the Harvard Observatory sent a Mars-observing expedition to Arequipa, Peru in 1892 to take advantage of steady air. Writing from Peru, American astronomer William Pickering credited "our splendid atmosphere, and southern latitude" for the expedition's ability to produce results rivaling those reported from northern observatories with much larger telescopes.[127]

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[126] Ibid., 16.

[127] William H. Pickering, "Changes and Floods on Mars," *Mars*, (Boston: The Gorham Press, 1921[1892]), 55.

Though astronomical expeditions were fairly common in the nineteenth century, they were generally aimed at seeing a celestial object or event that would be invisible from the home location. A solar eclipse that would be visible only in certain areas of the globe, for example, might require an expedition to northern Africa, or east Asia, or India. For such expeditions, the transport of massive equipment and numerous personnel to a remote site for even a few weeks was a major operation requiring significant advance planning. Savvy astronomers depicted these eclipse-observing expeditions as grand adventures, often publishing expedition chronicles for popular audiences in addition to their scientific reports.[128] The new expeditions to observe Mars followed the model of the solar eclipse expeditions in terms of their logistics and publicity. The Mars expeditions were fundamentally different, however, in that they were oriented around getting a better view, not a unique view. Mars could be observed from the London suburbs, but a mountaintop station in Peru or Argentina came to be considered the more credible due to superior seeing conditions at the remote location. Travel to remote locations thus became an important factor in legitimizing Mars observations.

In addition to sending an expedition, another way of gaining access to locations blessed with good seeing was to be fortunate enough to live there. The British amateur astronomer Molesworth, for instance, was stationed with the British

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[128] For a thorough overview of the practices and representations of solar eclipse expeditions, see Alex Soojung-Kim Pang, "The Social Event of the Season: Solar Eclipse Expeditions and Victorian Culture," *Isis* 84 (1993): 252-77.

military in tropical Ceylon (Sri Lanka), where the seeing was said to be exquisite. Although he devoted most of his energy and spare time to the study of Jupiter, Molesworth also sent reports of his Mars observations to the British Astronomical Association and the Royal Astronomical Society.[129] The sketches which accompanied his reports were repeatedly commended for their "remarkable" nature,[130] allowing Molesworth to use his superior location as a way of dismissing skeptics: "Personally, I am quite convinced of the reality of the great majority of the so-called canals; I think I could have convinced the most sceptical on this point if they could only have spent an hour or two at my telescope on some of the perfect nights in March and April this year."[131]

And for those who didn't live in Ceylon, Madeira, Milan, or Arequipa, there was always the option of establishing a new observatory in the middle of nowhere. This was the route chosen by Percival Lowell, who selected the site for his Mars-focused observatory only after sending an associate to assess the atmospheric conditions at a variety of sites throughout Arizona.[132] Eventually situated on an elevated mesa in the frontier lands of arid Flagstaff, the Lowell Observatory suffered

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[129] Richard McKim, "P.B. Molesworth's Discovery of the Great South Tropical Disturbance on Jupiter, 1901," *Journal of the British Astronomical Association* 107 (1997): 239-45.

[130] Eugene Antoniadi, "Mars Section, First Interim Report for 1898-1899," *Journal of the British Astronomical Association* 9 (1899): 156-58; Antoniadi, "Section for the Observation of Mars: Report of the Section, 1900-1901."

[131] P. B. Molesworth, "Observations of Mars, 1903," *Monthly Notices of the Royal Astronomical Society* 65 (1905): 839.

[132] A. E. Douglass, "The Lowell Observatory and Its Work," *Popular Astronomy* 2 (1895): 395-402.

few of the disturbances common to metropolitan observatories: light pollution, smog, coastal/lake breezes, or cloudy weather. Lowell and his associates took every opportunity to assert the superiority of their Flagstaff location as a means of securing legitimacy for claims about Mars. In his first major publication about Mars, for instance, Lowell noted in the preface that he had departed his home in Boston "for the purpose of getting as good air as practicable," given that "a steady atmosphere is essential to the study of planetary detail: size of instrument being a very secondary matter."[133]

Whatever criticisms other astronomers made about Lowell's claims, they generally admitted the advantages of his location. Simon Newcomb, who never accepted Lowell's theory, nonetheless wrote of his Flagstaff observatory that "its situation is believed to be one of the best as regards atmospheric conditions."[134] Lowell encouraged such comments with his own highly publicized attempts to find a site better than Flagstaff. He investigated a site in northern Mexico in 1896, eventually determining that Flagstaff was still superior.[135] He also traveled to Algeria to investigate possible sites, drawing this comment in the British publication *The*

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[133] Lowell, *Mars*, v.

[134] Simon Newcomb, "Astronomy," in *The New Volumes of the Encyclopaedia Britannica: Constituting in Combination With the Existing Volumes of the Ninth Edition the Tenth Edition of That Work, and Also Supplying a New, Distinctive, and Independent Library of Reference Dealing With Recent Events and Developments*,10th ed., ed. Donald Mackenzie Wallace, A. T. Hadley, and H. Chisholm (Edinburgh and London: Adam & Charles Black, 1902), 25:728.

[135] Percival Lowell, "On the Climatic Causes of the Removal of the Lowell Observatory to and From Mexico," *The Observatory* 20 (1897): 401-4.

Observatory: "He is looking out for the best climate he can get. Notwithstanding he is at present very well satisfied with his position at Flagstaff, Arizona; and his account of the conditions there is certainly enough to fill one with envy."[136] After declaring that the Flagstaff location would be his observatory's permanent site, Lowell continued to participate in expeditions. He accompanied a solar eclipse expedition to Libya in 1901 and sent his own photographic expeditions to observe Mars from the Andes, in 1905 and 1907.[137] All of these activities contributed to Lowell's credibility as an astronomer whose observations were untainted by urban geography.

In the face of nonmetropolitan and tropical astronomers' rising prestige, city-based or weather-bound astronomers were forced to admit the inadequacy of their own results. Irish astronomer Burton, for instance, lamented that his own observations were meager compared to Schiaparelli's: "How rare such [good] conditions are in our climate is, unfortunately, only too well known, no instrument of the class referred to having given more than momentary glimpses of those … details so minute and complex that the smallest tremor of the image suffices to confuse and render them undecipherable."[138] Even those who resisted such self-criticism nonetheless found themselves faced with charges of inadequacy from outside, as

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[136] *The Observatory* 19 (1896): 177.

[137] "Lowell expedition to the Andes," *Observatory* 30 (1907): 429.

[138] C.E. Burton, "Notes on the aspects of Mars in 1882," *The Scientific Transactions of the Royal Dublin Society* 1 (1883): 304.

when Lowell wrote bitingly from Arizona to his critic Maunder in Greenwich that, "If England would only send out an expedition to steady air … it would soon convince itself of these realities [the canals]."[139] Pickering, while associated with the Lowell Observatory, was equally direct: "An astronomer who has never looked through a telescope, except in northern Europe or the eastern United States, has no right to express any opinion on the subject, because he simply does not know what good seeing looks like, and his opinion is therefore valueless. He might as well express his views on electro-dynamics or physiology."[140]

It is not surprising that in trying to ensure their statements would be seen as "scientific," astronomers published images of their impressive instruments and state-of-the-art observatories. An important visual trope in these images, however, is their emphasis on geographical remoteness. As urban observatories were losing credibility in relation to the new observatories along the American frontier, the typical "observatory photo" had to convey geographical information to preserve legitimacy. The majority of "telescope photos" that appeared in Mars-related articles showed telescopes in open air, usually on an expedition where the astronomers were pictured as hardy explorers. (See Figure 3.1) Promotional photographs of the new American observatory sites sometimes didn't even show buildings or instruments at all. Rather, they focused on the desolate landscapes surrounding the observatory, as in two

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[139] Percival Lowell to E. Walter Maunder, 28 November 1903, Percival Lowell Correspondence, Lowell Observatory Archives.

photographs Lowell included in his second book about Mars. Figure 3.2 shows a view of the San Francisco Peaks, which were visible from the Lowell Observatory but did not serve as its actual location. Figure 3.3 shows the residential quarters at the Lowell Observatory. The wide angle image portrays a building labeled "The Hermitage" nestled amongst pine trees, almost like a frontier settler's cabin. In perhaps the most explicit example, an article about Mars in the *Publications of the Astronomical Society of the Pacific* included a powerful image of astronomers in a remote landscape. The "way to the Mount Blanc Observatory" (an observatory that was neither mentioned in the article, nor shown in the image) was shown as a rocky, snow-covered ascent being traversed on foot by three men, each of whom was holding on to a life-rope that connected the group. (See Figure 3.4).

The authority of Mars astronomers therefore depended partly on their own representations of being-in-the-field. In the same way that expeditions to find the source of the Nile or to reach the South Pole cultivated legitimacy with detailed claims about the directness and extent of their field observations, remote and tropical observatories argued they were best positioned to "see" the Martian landscape. Those astronomers in non-remote positions lost some credibility or even admitted inferiority compared with their "field"-based colleagues. These discussions essentially cast astronomy as a field science, in which the instrumentation was secondary to the need

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[140] Pickering, "The Planet Mars," 463-4.

for direct observation. For Mars as for Earth, it seems, the only way to credibly investigate foreign geography was to mount an expedition and get out of town.

Gazing on the Martian Landscape

Once they had made their way into "the field," astronomers still had to demonstrate that their methods of seeing produced credible results. Percival Lowell was key to developing a rhetoric that emphasized the importance of astronomers' individual observations over the quality of their instruments. He argued that astronomical "seeing" should really be addressed as three separate components: atmosphere, instrument, and observer. Regarding the third component, he referred to the observers' contribution as the working of "the mind's eye," arguing that an abstract quality of perceptiveness was just as important as the technical workings of a telescope lens: "Most people see only what they are prepared to see; as is well instanced in astronomy by those observers who manage to mark with surprisingly small instruments what others have already discovered, and yet who make no discoveries of their own."[141] Lowell argued that the ability to perceive and make sense of landscape detail was an important skill, not possessed by every astronomer. Some of his allies in other disciplines echoed the point, arguing that an open mind was more important than astronomical training for the study of Mars. Edward Morse, Lowell's friend and fellow traveler, wrote:

> A student familiar with a general knowledge of the heavens, a fair acquaintance with the surface features of the Earth, with an appreciation of the doctrine of probabilities, and capable of estimating the value of evidence, is quite as well equipped to examine and discuss the nature of the markings of Mars as the astronomer. If, furthermore, he is gifted with imagination and is free from all prejudice in the matter, he may have a slight advantage.[142]

Lowell's "mind's eye" essentially relied on an understanding of Earth's landforms and processes, which could then be used to develop terrestrial analogies for Mars' observed characteristics. The "mind's eye" functioned for astronomers and their audiences as a geographic gaze that bestowed an important legitimacy upon Mars astronomers. Just as geographers produced knowledge about Earth's landscapes by observing and intuitively piecing together the visible elements before them,[143] astronomers claimed an ability to understand the landscape of Mars by looking at it with an open mind. Lowell invited his audiences to do the same, even offering new ways of seeing through advances he pursued in planetary photography. Presenting the tiny discs of the groundbreaking 1907 photographs, for example, Lowell conjured a fascinating world open to the geographical gaze:

> One thing he who scans these circles must understand, or he will miss the full measure of the wonder they contain. His brain must be open to them; not his eye alone. For what is before him is no meaningless articulation of black and white, but the portrait in its entity of another

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[141] Percival Lowell, "Mars: the Canals. I.," *Popular Astronomy* 2 (1895): 257-258.

[142] Edward S. Morse, *Mars and Its Mystery* (Boston: Little, Brown, and Company, 1906), vii-viii.

[143] For a discussion of observation practices in geography, see Gillian Rose, "Geography as the science of observation: the landscape, the gaze and masculinity," in *Nature and science: essays in the history of geographical knowledge*, ed. Felix Driver and Gillian Rose (Historical Geography Research Series, v.28, 1992), 8-18.

> world, imprinted there by that world itself. Sharp set against the black of space this circlet of light displays to him an earth, comparable in grandeur and self-containment with that on which he dwells. Small to the sight, in the brain it takes on its true dimensions, and to the mind's eye becomes the globe it really is, which, could he find himself transported thither, would seem the essential sum and center of the universe, as now to most men our own world comprises all they know.[144]

Lowell's discussion of observer perception or intuition functioned largely to legitimize the work of those who claimed an ability to see the canals. At its core, however, this rhetorical maneuvering relied heavily on a prevailing view in the observational geosciences: that a landscape had to be seen to be understood. Lowell once wrote, "No one who has not seen the planet thus can pass upon the character of these lines,"[145] and he adamantly rejected comments by observers who had not seen the canals.

In addition to his emphasis on mental perception, Lowell and many other astronomers involved in the Mars debates also adopted a rhetoric of direct sensory perception to augment their claims of "seeing" the Martian landscape. In reporting Martian landscape changes and surface features, astronomers wrote as if they had actually visited the planet and witnessed them firsthand. In his influential first book, *Mars,* Lowell claimed, "Quite unlike the markings upon Jupiter or Saturn, where all we see is cloud, in the markings on Mars we gaze upon the actual surface features of

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[144] Lowell, "New Photographs of Mars," 310.

[145] Lowell, *Mars*, 139.

the Martian globe."[146] In a popular article on Mars' polar caps, he used similar language when reporting the existence of a polar sea: "It lies in a valley between two mountain ranges. Of this we are almost as sure as if we had climbed one of the enclosing summits and looked down upon it."[147] In engaging prose, Lowell augmented his own claims of direct landscape perception by evoking a sensory experience for his readers, as in this passage explaining the features of the Martian map:

> We may thus make a far journey without leaving home, and from the depths of our arm-chairs travel in spirit to lands we have no hope of ever reaching in body. We may add to this the natural delight of the explorer, for we shall be gazing upon details of Martian geography never till last summer seen by man. … We will begin our journey at the origin of Martian longitudes and travel west, taking the points of the compass as they would appear were we standing upon the planet.[148]

Lowell was not the only one to use this kind of language, even if he was the most explicit. Writing in the *North American Review*, for instance, popular French astronomer Flammarion claimed, "with our own eyes we see the polar snows melt during the summer and reappear in the winter."[149] By positioning themselves as eyewitnesses to the Martian landscape, astronomers solidified their claims to knowledge about the red planet and cast themselves as observational scientists. They

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[146] Ibid., 93.

[147] Percival Lowell, "Mars: the Polar Snows," *Popular Astronomy* 2 (1894): 55.

[148] Lowell, *Mars*, 92-93, 94.

[149] Camille Flammarion, "Mars and Its Inhabitants," *North American Review* 162 (1896): 546.

also introduced a personal basis for observational legitimacy that could not be assessed in any measurable way or disputed on any objective basis.

Alongside reports written as if astronomers had actually visited the planet and gazed upon its desert landscape, many publications included drawings "straight from the record book" as a way of asserting eyewitness views. These sketches of Mars' surface as it had appeared from specific locations at specific times were very similar to the field sketches maintained by terrestrial expeditions as a matter of course. Though the Mars sketches were much less detailed than any map, they frequently appeared alongside maps as evidence of the exactness of certain observations. (See Figure 3.5) Similar to the quoting of a field scientist's field notebook, these images showed that the map was based on direct observations made by credible astronomers.[150] Thus supported, composite maps and map-like images were able to codify and inscribe certain views of Mars' geography as "truth" based on eyewitness data.

Subjected to evidentiary standards adopted from the field sciences, the planet Mars could no longer be described believably with mere theoretical or mathematical predictions about its conditions. With regard to Mars' temperature, for instance, visual observations of landscape change were seen to be more authoritative than computational analysis of the planet's mass and distance from the sun. According to

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[150] Lightman has argued that the influential maps of Mars made by English science writer Richard Proctor in the 1860s used a stereographic projection precisely so that they could be visually compared with circular sketches from individual astronomers' notebooks, Lightman, "Visual Theology."

such calculations, Mars should be considerably colder than the Earth – probably never above freezing – given that it was smaller and further from the sun. Telescopic observations of the north and south poles of Mars, however, had long revealed large white patches that appeared to enlarge in Martian winter and shrink in Martian summer.[151] Equated with the behavior of polar snow and ice on Earth, this visual evidence from the red planet logically suggested a seasonal melting of ice that would confirm Mars' average temperatures to be considerably above freezing, at least during the summer.[152] Despite some protests that unproven hypotheses about the white patches should not be allowed to negate sound theoretical predictions about extreme cold on Mars,[153] the "melting" of the "polar snows" was widely accepted as conclusive observational evidence that Mars had a temperature comparable to Earth's.[154] During the height of the discussion over Mars' hospitability to life forms, the temperature question strongly contributed to the arguments of those who favored the view that Mars could support life. Even neutral Schiaparelli offered that "as far as

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[151] This phenomenon was first reported by the celebrated English astronomer William Herschel in 1739.

[152] Scientists now believe the white patches at Mars' poles contain small amounts of water ice, but are primarily deposits of carbon dioxide, which sublimates (without melting) at -109°F, well below the warm temperatures that would be required to melt a similar extent of water ice.

[153] Marsden Manson, "The climate of Mars," *Popular Astronomy* 2 (1895):371-74.

[154] It was presented as common knowledge in general publications such as *Reynold's universal atlas of astronomy, geology, physical geography, the vegetable kingdom, and natural philosophy* (London: James Reynolds, 1876); George F. Chambers, *A handbook of descriptive astronomy*, 3rd ed. (Oxford: Clarendon Press, 1877).; Simon Newcomb and Edward S. Holden, *Astronomy for schools and colleges* (New York: Henry Holt and Company, 1879).

we may be permitted to argue from the *observed* facts, the climate of Mars must resemble that of a clear day upon a high mountain."[155]

Another debate, closely related to the temperature question, also reveals the visual evidentiary basis of turn-of-the-century Mars science. Given that the polar caps were believed to melt, many observers logically assumed the planet must have liquid water on its surface at various times throughout the year. When optical tests failed to show any polarized light reflecting from dark areas of Mars' surface,[156] the American astronomer Pickering proposed instead that the dark areas on Mars could be vegetation instead of oceans. This theory, which shortly became central to Lowell's inhabited-Mars hypothesis, rested on detailed analysis of the visible patchiness and variability in the colors of Mars' surface.[157] Although subsequent spectroscopic analyses were inconclusive in determining whether the water vapor necessary for vegetative growth existed in Mars' atmosphere,[158] the new vegetation theory achieved widespread acceptance because it made visually intuitive sense as an explanation for the mottled "green" areas on Mars. Even the reddish areas could be

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[155] Giovanni Schiaparelli, "The planet Mars," *Astronomy and Astro-Physics* 13 (1894):635-640, (first of two installments reprinting an article that originally appeared in Italian in *Natura ed Arte*, 1893), 640. (Emphasis added.)

[156] G.H. Lepper, "An examination of the modern views as to the real nature of the markings of Mars," *Journal of the British Astronomical Association* 15 (1905):133-37; J.R. Holt, "The solar image reflected in the seas of Mars," *Astronomy and Astro-physics* 13 (1894):257-58; "An image of the sun on the Martian seas," *Journal of the British Astronomical Association* 4 (1894):260-261.

[157] William H. Pickering, "Mars," *Astronomy and Astro-physics* 11 (1892):668-75; William H. Pickering, "Colors exhibited by the planet Mars," *Astronomy and Astro-physics* 11 (1892):449-53.

[158] "The atmosphere of Mars," *Observatory* 17 (1894):341-42.

explained as vegetation: "there is certainly no impossibility in the conception that vast forests of some such trees as copper-beeches might impart to continental masses hues not unlike those which come from Mars."[159] Again, this rhetoric and logic prioritized landscape-level observational analysis over theoretical or experimental findings.

Despite the difficulties of actually "seeing" the red planet from 35 million miles away (at its closest), personal observation thus became the basis of legitimacy for claims about Mars. Disagreements between various astronomers or observatories about the temperature, atmosphere, and landscape of Mars often turned on the eyesight or perception of various individuals[160] or the atmospheric clarity of various locations – paramount issues for claims based on observational evidence. Astronomers used the evidence, rhetoric, and methods of observational field scientists, employing the geographic gaze to powerful effect. Just like the landscapes of central Africa or south Asia, Mars became knowable when it became visible. And Mars astronomers became credible when they claimed to have seen its landscape directly with their own eyes.

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[159] Robert S. Ball, *In the high heavens* (London: Isbister and Company Limited, 1893), 145.

[160] Newcomb, "Optical and psychological principles"; E. Walter Maunder and Annie S. D. Maunder, "Some experiments on the limits of vision for lines and spots as applicable to the question of the actuality of the canals of Mars," *Journal of the British Astronomical Association* 13 (1903):344-51; Percival Lowell, "On the kind of eye needed for the detection of planetary detail," *Popular Astronomy* 13 (1905):92-94. See also Sheehan, *Planets and perception*.

The New Explorers

The new emphasis on seeing, perception, location, and direct observation contributed to the development of a powerful new persona for astronomers: as explorers and geographers. Despite often being rooted in place by their mammoth telescopes (even on expeditions), Mars astronomers successfully cultivated a reputation as adventurers. From the start, many conceived of and labeled their activity as a geographic exercise, essentially giving themselves a new identity by association. Schiaparelli, for instance, explicitly referred to geographical work in his 1877-78 observation report:

> In order to establish the topography of Mars on an exact basis, I have followed the same principles that have been adopted in terrestrial geography. A certain number of points, distinct and easy to recognize, distributed with as much uniformity as may be over the surface of the planet, creates a fundamental network for which the positions are determined with the greatest possible precision. … [T]he topographical description of the regions in between can be inferred without too much uncertainty from the sketches, precisely in the way that a geographer finishes the description of a country on earth by interpolating between the geometrically determined points.[161]

In the same publication, Schiaparelli used the term "areography" to describe his study of the Martian surface. This term, which cleverly modified the word "geography" by substituting the Greek name for Mars, "Ares," in place of the Greek name for Earth, "Geos," had been used as early as 1868 by R. A. Proctor.[162] After Schiaparelli's use, it quickly became the standard term for Mars science. Even 20 years later, Mars

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[161] Schiaparelli, *Astronomical and Physical Observations*, 3, 1.

astronomers still claimed a fundamental connection between their work and geography, as seen in Lowell's pronouncement that "areography is a true geography, as real as our own."[163]

Outside their Mars work, quite a few of the more prominent Mars astronomers were actually associated with geographical work and participated in social networks that included geographers. Schiaparelli, for instance, published on the meteorology and topography of Milan,[164] and his personal papers show that he corresponded extensively with Italian and other European geographers. The draft for his second major memoir on the planet Mars, in fact, was handwritten on the back of correspondence received from such geographically inclined institutions as the Italian Alpine Club, the Society for Commercial Exploration in Africa, the Third International Geographic Congress, the Society for the Promotion of Scientific Exploration, the Italian Geographical Society, the Geographical Institute, and the Italian Meteorological Association, among others.[165] Similarly, the director of the U.S. Nautical Almanac Office Simon Newcomb, who became involved in the Mars debate as a proponent of the optical illusion theory, corresponded with American

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[162] Lightman, "Visual Theology."

[163] Lowell, *Mars*, 93.

[164] G.V. Schiaparelli, "Topografia e clima di Milano," in *Le Opere di G.V. Schiaparelli* (Milano: Ulrico Hoepli, 1943 [1881]), 11:355-96.

[165] G.V. Schiaparelli, "Marte. Capitolo III. Osservazioni Sull'Aspetto Presentato Dalle Vari Regioni Del Pianeta Durante L'Opposizione 1879," Fondo Schiaparelli, Archivo Storico, Osservatorio Astronomico di Brera.

geographers and even served as an adviser to President Theodore Roosevelt on a proposed expedition to the Philippines.[166]

Percival Lowell, the most active and influential advocate of the inhabited-Mars theory at the turn of the century, boasted the most impressive geographical credentials of all his fellow Mars astronomers. Before he founded his observatory in 1894, Lowell had enjoyed a decade-long career as an Orientalist, traveling independently throughout East Asia in the 1880s. In the process of reporting on his travel experiences and personal observations of Asian landscapes and peoples in books and articles that were published in the United States,[167] Lowell became fluent in the language of popular geographic writing. His own books combined physical and cultural landscape description with the moralistic championing of Western culture,[168] which was characteristic of much popular geographic writing at the time.[169] Adopting a Spencerian view, Lowell's works generally argued that the mild East Asian landscapes (as compared to the more "complex" environment of Europe) had given rise to an evolutionarily inferior society characterized by a distinct lack of

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[166] Theodore Roosevelt to Alexander Agassiz, 26 December 1902, Simon Newcomb Papers, United States Library of Congress, Manuscript Division.

[167] Percival Lowell, *Chosön: the land of the morning calm: a sketch of Korea* (Boston: Ticknor and Co., 1886); Percival Lowell, *Noto: an unexplored corner of Japan* (Boston: Houghton, Mifflin and Co., 1891); Percival Lowell, *Occult Japan or the way of the gods: an esoteric study of Japanese personality and possession* (Boston: Houghton, Mifflin and Co., 1894).

[168] Strauss, *Percival Lowell*.

[169] See, for example, David Spurr, *The rhetoric of empire: colonial discourse in journalism, travel writing, and imperial administration* (Durham, N.C.: Duke University Press, 1992); Tim Youngs, "'My footsteps on these pages': the inscription of self and 'race' in H.M. Stanley's *How I found*

individuality.[170] Against the backdrop of wide public interest in exploration accounts from Africa,[171] reports from the North and South Pole expeditions, and newspaper coverage from the emerging American imperial spheres, Lowell's views on how Japanese and Korean peoples fit into a global spectrum of socio-racial development resonated with his American readers. Just because Lowell shifted his attention to Mars does not mean he lost interest in the geographical themes that had preoccupied him during his travels. His ideas about the environmental basis of cultural hierarchy were central to his theory about Martian civilization, as the next two chapters address in detail.

In the process of introducing such blatantly geographical themes into mainstream astronomical writing, Lowell made liberal use of geographers' textual and visual styles in his publications about Mars. While generally maintaining an authoritative objective voice, he often lapsed into a travel-guide style, telling readers what they might expect to see or experience in the event of a visit to Mars. In discussing his observatory's work, he often wrote in the first-person, narrating a story of adventurous exploration that easily matched the tone and appeal of well-known reports of scientific geography, such as those by John Hanning Speke from Africa,

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Livingstone," Prose Studies, 1990, *13*:230-249; Mary Louise Pratt, *Imperial eyes: travel writing and transculturation* (London: Routledge, 1992).

[170] See especially Percival Lowell, *The soul of the Far East* (Boston and New York: Houghton Mifflin Company, 1888) and Strauss's analysis of Lowell's work in *Percival Lowell*.

[171] See, for example, Driver, *Geography Militant*; Felix Driver, "David Livingstone and the Culture of Exploration in Mid-Victorian Britain," in *David Livingstone and the Victorian Encounter with Africa*, ed. John MacKenzie (London: National Portrait Gallery, 1996), 109-35.

Robert Peary from the Arctic, or John Wesley Powell from the rivers of the American West.

Visually, Lowell's work also contributed to the linking of his astronomical work with geographical publications. In asserting an analogy between the landscapes of Earth and Mars, Lowell frequently used maps and geographical diagrams to illustrate his arguments. In *Mars as the Abode of Life*, for example, he used an illustration from Geikie's *Elementary Lessons in Physical Geography* to illustrate a discussion regarding the effects of topography on microclimate (See Figure 3.6). In the same section, he also discussed Humboldt's work on the role of plateaus in moderating elevation's effects on temperature, illustrating his points with a series of drawings that likewise could have come from a geography textbook (See Figure 3.7). Lowell's lavishly illustrated book, in which he summarized and restated his comprehensive theory about Martian life for the last time, included geological maps of North America, a world map of the Earth's desert regions, and a variety of historical Mars maps, all of which contributed to the geographical tenor of the work.

One of Lowell's friends and allies, Edward Morse, wrote a book about Mars that also made extensive use of terrestrial landscape imagery.[172] In defending the much-maligned theories of his Boston neighbor and fellow Asian traveler, Morse argued that the patterns observed on Mars' surface were much more geometrical than any natural features observed on Earth. He included a photograph of field cultivation

in Puerto Rico, diagrams of street and rail networks, and both photographs and sketches of natural crack patterns (see Figures 3.9 and 3.10) to make the point. A number of Morse's diagrammatic comparisons – which would have been equally at home in an expedition report or atlas – soon resurfaced in the American newspapers (See Figure 3.11), visually reinforcing the geographical identity of Lowell's work for a wide audience.

The most powerful way in which astronomers developed a persona as adventurers or geographers, however, was by directly comparing themselves with the famous polar explorers of the day. Visual observations of the Martian polar caps had long been key to the inhabited-Mars theory; and sketches of the red planet's polar regions appeared regularly in the scientific literature. In the popular press, astronomers took advantage of this convergence. By claiming an unimpeded view of the Martian poles, astronomers claimed to have achieved a long-sought terrestrial triumph, drawing interest from audiences still captivated by polar mania and thus cultivating legitimacy in the public eye.[173] Several savvy astronomers exploited this enthusiasm by asserting their own superiority over the many failed expeditions in terrestrial Arctic and Antarctic regions. Mars' poles, in fact, were frequently said to be more visible and better known than Earth's, given that astronomers gazed on it

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[172] Morse, *Mars and its Mystery*.

[173] For the popular interest in polar exploration, see Robert G. David, *The Arctic in the British Imagination, 1818-1914* (Manchester and New York: Manchester University Press, 2000); Pierre Berton, *The Arctic Grail: the Quest for the North West Passage and the North Pole, 1818-1909* (New York: Viking, 1988).

from afar. Lowell was perhaps most explicit in the comments he aimed at popular readers: "at much less expense and at absolutely no hazard, astronomy has quietly conducted polar expeditions to Mars so successfully that we now know more about the Martian south polar regions than we do about either of our own." [174] In discussing one of his polar maps, Lowell similarly quipped: "There are advantages in thus conducting polar expeditions astronomically. One not only lives like a civilized being through it all, but he brings back something of the knowledge he went out to acquire."[175]

As this rhetoric reveals, astronomers' self-comparison to the polar explorers was no accident. Astronomers clearly conceived the importance of their work to be in some sense geographical, and rhetorically positioned themselves to appear successful alongside a string of polar expeditions that had captivated public attention and support. When Lowell reported that "On July 1 our Martian polar expedition disclosed what used to be the supreme quest of earthly expeditions, – that dream of arctic explorers, an open polar sea,"[176] he was making a bid for public attention that would legitimize his Mars work.

By characterizing their Mars research as geographical exploration, astronomers succeeded in attracting wide interest from popular audiences. Whereas astronomical subjects had previously been confined primarily to scientific journals,

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[174] Lowell, "Mars: the Polar Snows," 54.

[175]Percival Lowell, "Mars: the water problem," *The Atlantic Monthly* 75 (1895):749-58.

textbooks, observing guides, and a few popular works on the history of astronomy, the new Mars science began to appear in mainstream publications everywhere that geographical news appeared.[177] By the late 1890s and throughout the first decade of the twentieth century, Mars news was surfacing regularly in Sunday newspapers, books, pamphlets, and general-interest magazines and reviews such as *The Century, The Atlantic Monthly, Scientific American, The Living Age,* and *North American Review,* among others.

The development of this broad publication range, which shows the extent to which Mars became a household topic, owes much to the associations astronomers had cultivated between their work and the topics of geography and exploration. The popular press appears to have accepted without reserve the rhetorical self-positioning of astronomers as heroic observers. In *The National Review,* for instance, a writer introduced the topic of Mars to his readers in typical prose: "Astronomers are the explorers in this case, and by their telescopes they have been able to find out much more concerning the southern frozen seas of Mars, which, at its nearest, is thirty million miles away, than is known of our own Antarctic regions."[178] Writers also sometimes directly linked Mars news and expedition reports, indicating the extent to which astronomical and geographical sciences were presented to similar audiences.

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[176] Lowell, *Mars,* 88.

[177] For a chronology of the popularization of Mars news, see Hoyt, *Lowell and Mars*.

[178] R.A. Gregory, "Mars as a world," *The Living Age* 225 (1900): 22. [Reprinted from *The National Review*.]

Popular science writer Brewster, for instance, opened his *Atlantic Monthly* review article on "The Earth and heavens" with a discussion of the Peary and Scott Arctic expeditions then continued without transition:

> There seems to be no need for either Pearys or Scotts among Mr. Lowell's Martians. Our nearest planetary neighbors ought to know their flat and sea-less world far more completely than the children of men know theirs. In fact, even our own maps of the Martian surface have no tantalizing blank spaces at top and bottom, while, thanks to the nearly complete annual melting of its snowcaps, the poles of that other world are as familiar to the inhabitants of both as are the regions between. A mountain on Mars a quarter of the height of unknown peaks in Alaska and Antarctica or on the Roof of the World would have been seen years ago. A few miles of perpetual ice prove to be a more impassable barrier than sixty millions of empty space.[179]

Consciously or unconsciously, then, astronomers gave the red planet an aura of geographical importance. As popular writers and publishers accordingly steered the topic toward geographically literate audiences, Mars gained a sense of everyday relevance that eluded most other astronomical news.

Mars in the Image of the Earth

In the process of casting themselves as explorers, astronomers helped establish a sense of familiarity between Earth and Mars. As the previous sections have shown, the red planet's geography was generally constructed as observable in the same ways that Earth's landscape was known to be observable (and conceptually

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[179] E. T. Brewster, "The Earth and the Heavens," *The Atlantic Monthly: a Magazine of Literature, Science, Art, and Politics* 100 (1907): 262.

controllable) by the Western explorer and his geographically literate popular audiences. At a much more specific level, however, popular and scientific works depicted the Martian landscape and culture as explicitly similar to exact locations and peoples on Earth.

Mars was regularly referred to as Earth's "nearest neighbor" or the planet in the solar system with "the greatest analogy" to Earth.[180] Such phrasing persisted despite the fact that Venus was commonly known to be closer to Earth in both size and orbit. Other similarities between Earth and Mars were noted, including the fact that the Martian day (termed a "sol") is almost exactly the same length as a day on Earth, or that the axis of Mars has nearly the same inclination as Earth's, thus producing seasons of similar intensity. And in terms of its visible landscape, Mars was clearly thought to be more analogous (and interesting) than the cloud-enshrouded Venus:

> Though little more than half the Earth's size Mars has a significance in the public eye which places it first in importance among the planets. It is our nearest neighbor on the outer side of the Earth's path round the Sun, and viewed through a telescope of good magnifying power shows surface markings suggestive, with the aid of imagination, of continents, mountains, and valleys; of oceans, capes, and bays, and all the varying phenomena which the mind readily associates with a world like our own.[181]

This general visual analogy gave rise to a certain intrigue surrounding the red planet. As the well-known Irish science writer Sir Robert Ball wrote in 1892, "This globe is

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[180] These phrases appeared repeatedly in the works of both scientists and popular writers.

of particular interest to us; for it is natural to feel curious with regard to the neighbouring globe, which is in many respects placed in much the same conditions as is our earth."[182]

Even acknowledgements that the Mars-Earth analogy was imperfect does not seem to have dimmed the overall enthusiasm for comparison. When cautioning that the absence of clouds on Mars indicated a fundamental difference from Earth, Lick Observatory astronomer Edward Holden nonetheless stated clearly many points of similarity:

> In some respects Mars appears in the telescope to be very much like the earth as we know it. There are certain markings, both reddish and dark-colored, which are, in a general way, fixed in position, in outline, and in color, and they are distributed so that a map of Mars does not at once appear to be violently unlike a map of the earth. If we take the dark areas on Mars for 'seas' and the red areas for 'land' (which has been done since the time of Galileo), the chart of the planet shows a southern hemisphere which is nearly all sea and a northern which is composed of many rounded islands or continents deeply intersected with gulfs and lakes and 'canals.'… There are also 'polar-caps' of a brilliant white color (near the poles) and also certain 'islands' in the southern hemisphere, which are often brilliantly white. …
>
> I have said that the surface of Mars is not unlike that of the earth *as we know it*. But it is very unlike the surface of the earth as it would appear when viewed from another planet – from Mars itself, for example. ... If the earth were to be viewed from a distant planet we should certainly see its envelope of clouds; and its continents and seas could only be seen in the clear regions. The earth would appear far more like the planet Venus than like the planet Mars. The analogies of

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[181] E. Vincent Heward, "Mars: Is It a Habitable World?," *The Living Age* 254 (1907): 741.

[182] Robert S. Ball, *In Starry Realms* (London: Isbister and Company, 1892), 150.

> telescopic appearance are thus very slight between the earth and Mars.[183]

Popular writers acknowledged such refutations of the basic analogy but were unwilling to let go of the many examples of striking landscape similarities. Referring specifically to the work of Holden and other Lick astronomers, for example, the Welsh astronomy writer Arthur Mee admitted, "on the whole, their testimony does not make in favour of terrestrial analogies, which seem to diminish, the closer and more critical the examination of the planet."[184] At the same time, however, Mee wrote as if convinced that the analogy was correct: "the general aspect of the planet reminds one strangely of the probable appearance of our earth could we view it at the distance of Mars. On the rare occasions when I have been fortunate enough to secure good views of the planet, the impression of sea and land and polar snow was overwhelming."[185]

The strength of the Earth-Mars analogy extended to claims regarding its similarity to specific terrestrial locations. Whether writing for scientific or general readers, many astronomers analogies to help readers understand foreign subjects in familiar (if simplistic) terms. Sir Norman Lockyer, an eminent English astronomer, for instance, described sketches of Mars thus in an astronomy textbook: "In the upper [drawing] a sea is seen on the left, stretching down northwards; while, joined on to it,

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[183] Edward S. Holden, "What We Really Know About Mars," *The Forum* 14 (1892): 362.

[184] Arthur Mee, *Observational Astronomy, a Book for Beginners* (Cardiff: Daniel Owen and Company, 1893), 55.

as the Mediterranean is joined on to the Atlantic, is a long narrow sea, which widens at its termination … The coast-line on the right strangely reminds one of the Scandinavian peninsula, and the included Baltic Sea."[186] Lowell compared the size and probable operation of the Martian canals to the well-known waterway at Suez and contrasted their geometric appearance with the winding Mississippi River.[187] He also frequently used terrestrial metaphors for literary effect, as when he remarked that a feature appeared to be "a beautiful cobalt blue, like some Martian grotto of Capri."[188] Many other Mars observers equaled him in this regard, with various Martian features being compared at one time or another to Switzerland, Ireland, Amsterdam, London's Hyde Park, Ohio, Puerto Rico, Scandinavia, the Mediterranean Sea, the Strait of Malacca, Lake Tanganyka, the South African veldt, etc. Such comparisons generally served to "tighten the knot of analogy between Mars and the Earth" and reinforce the idea that Mars was "a small version of the Earth."[189]

In addition to using analogies to explain how the geography of Mars appeared, astronomers also used analogies as a guide for interpreting what such appearances meant. In trying to establish the characteristics of certain Martian landscapes,

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[185] Ibid., 52.

[186] J. Norman Lockyer, *Elementary Lessons in Astronomy* (London: Macmillan and Co., 1894), 120, 123.

[187] See Percival Lowell, "Mars: canals," *Atlantic Monthly* 76 (1895):106-19; Lowell, "New photographs of Mars."

[188] Lowell, "Mars: canals."

[189] Schiaparelli, *Astronomical and Physical Observations*, 49, 52.

astronomers typically assessed their apparent correspondence to landscapes on Earth. Similarity was generally taken as logical proof. The earliest case of this can be traced to the famous English astronomer William Herschel, who analyzed the variable white spots on Mars in 1739.

> "The analogy between Mars and the earth," he wrote, "is perhaps by far the greatest in the whole solar system. Their diurnal motion is nearly the same, the obliquity of their respective ecliptics not very different; of all the superior planets, the distance of Mars from the sun is by far the nearest alike to that of the earth; nor will the length of the Martial year appear very different from what we enjoy when compared to the surprising duration of the years of Jupiter, Saturn, and the Georgium Sidus. If we then find that the globe we inhabit has its polar regions frozen and covered with mountains of ice and snow, that only partially melt when alternately exposed to the sun, I may well be permitted to surmise that the same causes may probably have the same effect on the globe of Mars; that the bright polar spots are owing to the vivid reflection of light from frozen regions; and that the reduction of these spots is to be ascribed to their being exposed to the sun."[190]

Just as Herschel's assessment of the polar caps laid the groundwork for decades of interest in the Martian poles, his logic of analogy was also commonly used well into the twentieth century. Schiaparelli wrote in 1878 that observed differences in Mars' dark shading should be interpreted as variations in sea depth, based on similar observations "by sailors in the terrestrial seas, many of whom are convinced of the difference in color between the Mediterranean and the Baltic or North Sea."[191]

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[190] Quoted in Simon Newcomb, "Mars," *Johnson's Universal Cyclopaedia*, ed. Charles Kendall Adams (London: D. Appleton & Co., 1893), 5:571.

[191] Schiaparelli, *Astronomical and Physical Observations of Mars*, 49. On this point, Schiaparelli cited Matthew Fontaine Murray's *The Physical Geography of the Sea* (New York: Harper & Brothers, 1855).

Similarly, Amherst astronomer David Todd reported after his 1907 Lowell-funded expedition to South America that he had increased his understanding of the Martian landscape by learning more about Earth's:

> Old earth again furnishes a ready clue to the mystery. ... During this last summer, in the desert of Tarapacá and in similar wastes of Peru, I saw vast areas, or oases, saved from engirdling sands by just a little water – water not in great gulfs or rivers or lakes, but a tiny rivulet merely, systematically diverted from its course again and again, with the parched soil divided and subdivided in geometric figures till nothing was left of the original stream but an infinitude of trickles. But as we approached these oases of the Chilean mountains, or receded from them, they seemed one vast and consecutive mass of vegetation, much darker than the desert around. Imagine yourself suspended high about such terrestrial sands, as in a balloon, only hundreds or thousands of miles away, and the likeness of Mars to the earth and the earth to Mars would be compelling."[192]

Geographical analysis of Earth was thus linked to the development of knowledge regarding Mars, thereby reflecting the intricate ways in which Mars science had come to be conceived as an essentially geographical activity.

Just as the geographer-astronomer persona raised public interest in Mars, the Earth-Mars analogy imbued Mars with a sense of relevance to mainstream audiences. Primarily, this relevance was tied to the habitability of the red planet, as expressed by Holden:

> There is certainly no more important question in planetary astronomy than to determine whether our neighboring planets are or are not inhabited; but, as I have previously had occasion to remark, the problem of astronomy is at present far narrower. This problem is to

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[192] David Todd, "Professor Todd's Own Story of the Mars Expedition: First Article Published From the Pen of the Leader of the Party of Observation," *Cosmopolitan Magazine* 44 (1908): 350.

> determine whether or no any of the planets are fit for habitation. To solve this question it is necessary to construct the most accurate map of the planet's surface and to observe with the greatest care all the phenomena as well as possible by means of terrestrial analogies, if this be possible, or at least by means of analogies with other bodies in the solar system.[193]

The use of basic landscape analogies contributed directly to the conception that Mars was indeed inhabited. Upon reading that "the smallest object that would be discernible on Mars must be as large as London [and that] it would not be possible to see a point so small as would either Liverpool or Manchester be if they were on that planet,"[194] readers had to make only the smallest conceptual leap to imagine actual Martian cities. Similarly, reports that the annual melting of Mars' polar ice caps "is of as much importance as the annual inundation of the Nile is to the Fellaheen of Egypt"[195] helped cast Mars as a specific, legible, populated landscape. Lowell's publications used the Mars-Earth analogy eloquently, inspiring readers' interest in the possibility that Mars could be an inhabited world.

> For all practical purposes Mars is our nearest neighbor in space. Of all the orbs about us, therefore, he holds out most promise of response to that question which man instinctively makes as he gazes up at the stars: What goes on upon all those distant globes? Are they worlds, or are they mere masses of matter? Are physical forces alone at work there, or has evolution begotten something more complex, something not unakin to what we know on Earth as life? It is in this that lies the peculiar interest of Mars.[196]

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[193] Holden, "What We Really Know About Mars," 360.

[194] Robert S. Ball, "Mars," *Living Age* 195 (1892): 203.

[195] Gregory, "Mars as a world," 23.

[196] Lowell, *Mars*, 2-3.

For many scientists and popular readers, then, geographical analogy took the place of more rigorous forms of proof, ingraining the idea that Mars was like Earth: inhabited.[197]

Even when claiming that Mars was totally different from Earth, astronomers consistently used terrestrial analogies to construct Mars' physical geography. For instance, Schiaparelli wrote in 1893 that the general topography of Mars "does not present any analogy with the Earth" but then continued that the canals could be "produced by the evolution of the planet, just as on the Earth we have the English Channel and the Channel of Mozambique."[198] Similarly, Holden argued in a critique of Lowell that terrestrial analogies failed to explain the changes on Mars, but then in the same paragraph suggested a terrestrial analogy to explain the faintly colored regions of Mars: "Are they vast shoals like the Grand Banks of Newfoundland?"[199] Antoniadi, another major critic of Lowell, reasoned by way of analogy that the Martian landscape was essentially a desert: "On the Earth we find deserts showing a ruddy yellow hue; and as vast areas of Mars offer a similar colour, we deem it not

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[197] Crowe asserts in *The Extraterrestrial Life Debate* that logical fallacies – such as the mistaking of analogy for proof – were instrumental to most of the claims made by early Mars scientists.

[198] Giovanni Schiaparelli, "The planet Mars," *Astronomy and Astro-Physics* 13 (1894):714, 719, (second of two installments reprinting an article that originally appeared in Italian in *Natura ed Arte*, 1893).

[199] Edward S. Holden, "Note on the Mount Hamilton observations of Mars, June-August 1892," *Astronomy and Astro-physics* 11 (1892): 668.

illogical to believe that a considerable part of the Martian surface is covered with desolate wilderness."[200]

Although mainstream scientific interest in Mars never really progressed beyond the question of whether Mars was habitable, popular interest conditioned by these analogies quickly jumped ahead to questions of whether the planet was indeed inhabited and what the inhabitants were probably like. It is at this point that the Earth-Mars analogy started to break down in interesting ways. Acknowledgements that Mars' landscape was not entirely like Earth's produced a wide variety of speculations over what the Martians might be like. Perhaps in response to critics, Lowell tried to dampen enthusiasm for the idea that Martians were just like men: "Amid the surroundings that exist on Mars, surroundings so different from our own, we may be practically sure other organisms have been evolved of which we have no cognizance. What manner of beings they may be we lack the data even to conceive."[201] In a twist, then, the strength of the analogy that had been created between Earth and Mars both supported the idea that the red planet hosted inhabitants and also conditioned the imagination of what they might be like. When the analogy was said to be absent, it was just as powerful as when it was invoked as present: "The significance of Mars is essentially derived from those points of resemblance to the

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[200] Antoniadi, "On the possibility of explaining," 90.

[201] Lowell, *Mars*, 211.

earth which are now engrossing attention. Mars is clearly a possible world, presenting both remarkable analogies and remarkable contrasts to our own world."[202]

Conclusion

The popular discourse of an inhabited Mars continued long after scientific support had collapsed in 1909-1910. Although some amateur astronomers kept up the debate, most leading astronomers turned their attention to other subjects. In the newspapers, however, sensational Mars news was reported well into the 1910s. Fiction works also blossomed in the 1910s, with Edgar Rice Burrough's serialized adventures stories about the planet Barsoom (Mars) probably the most notable. This continuing interest shows that the discourse surrounding Mars was cemented in the popular consciousness not on the basis of scientific credibility, but on the basis of popular credibility. This chapter has shown that these remarkable levels of popular credibility were established, cultivated, and prolonged through numerous direct and indirect associations with the discipline of geography.

By arguing for the validity of results produced by expeditions and remote observatories, Mars astronomers cast their work as a new type of field science. They negotiated their legitimacy as observers on the basis of their remoteness, regularly emphasizing the necessity of secluding themselves in distant and pristine landscapes. In images and texts, the advocates of the inhabited-Mars theory portrayed their

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[202] Ball, "Mars," 198.

scientific activities as rigorous, strenuous, and adventurous, thus asserting superiority over their critics in the metropolitan centers. Not only did this have a significant positive impact on the credibility of astronomers such as Lowell and Schiaparelli, but it also began to gain the interest of non-specialist audiences.

Additionally, astronomers adopted the rhetoric, evidence and methods of observational disciplines like geography to legitimize their research. Most importantly, they employed an explicit geographical gaze to observe Mars, claiming to see the planet with a direct, unimpeded view and then making sense of that view through intuition and analogy. The extensive use of terrestrial analogy – either to general topographical features and geographical processes, or to specific landscapes, cities, and countries – was a rhetorical staple not only of the inhabited-Mars proponents, but also of their critics. The entire discussion about Mars therefore contributed to the sense that Martian geography was essentially Earth-like.

In the process of explaining their observational work and publicizing their findings, astronomers also cast themselves as actual explorers. They referred to their work as "areography," cited geographers in their texts, and promoted their successes above those of the well-known polar expeditions. Those astronomers who were most successful in this regard often had extensive personal experience with geographical work or were regularly exposed to geographers in their professional and social circles. As a result, they easily forged a link between astronomy, geography and

exploration in representations of their work, thus captivating the attention of popular audiences.

Regardless of whether any astronomer consciously decided to emulate geographical work, the techniques and representations that solidified belief in an inhabited Mars were clearly and extensively similar to the specific techniques and representations that were being used in scientific geography at that same time. To audiences well versed in the geographical language of scientific exploration and conquest, these conventions not only rendered Martian landscapes more familiar for the general reader, but also reinforced the idea that Mars was wholly analogous to the Earth, from its landscape to its history and culture. Geography was thus ingrained in the astronomical Mars narratives of the turn of the century – in both method and representation.

Figure 3.1 Photograph from *The Century*, 1907

THE AMHERST TELESCOPE IN POSITION AT ALIANZA, CHILE

The telescope was mounted in a cemented tennis-court, 4200 feet above sea-level. The large weight attached by means of a rope was for the purpose of counterbalancing the increased weight of the tube in the Southern hemisphere, it having been constructed for use at 42° North latitude. The planetary camera (not shown here) about five feet in length, was attached to the lower end of the telescope. The observing chair is in the background at the right. The members of the expedition, from left to right, are Professor David P. Todd (in charge), Mrs. Todd, Robert D. Eaglesfield, A. G. Ilse, and E. C. Slipher.

Figure 3.2 “The San Francisco Peaks,” printed in *Mars and its Canals*, 1906

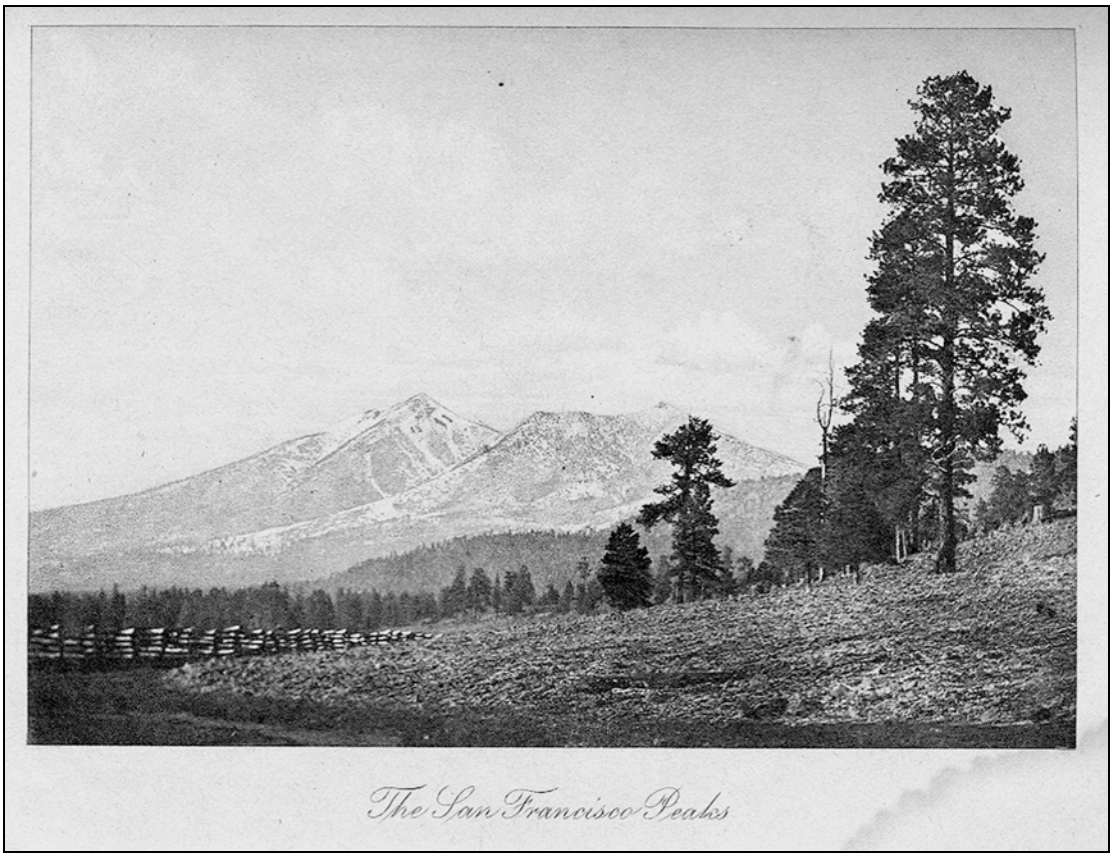


Figure 3.3 “The Hermitage,” printed in *Mars and its Canals*, 1906

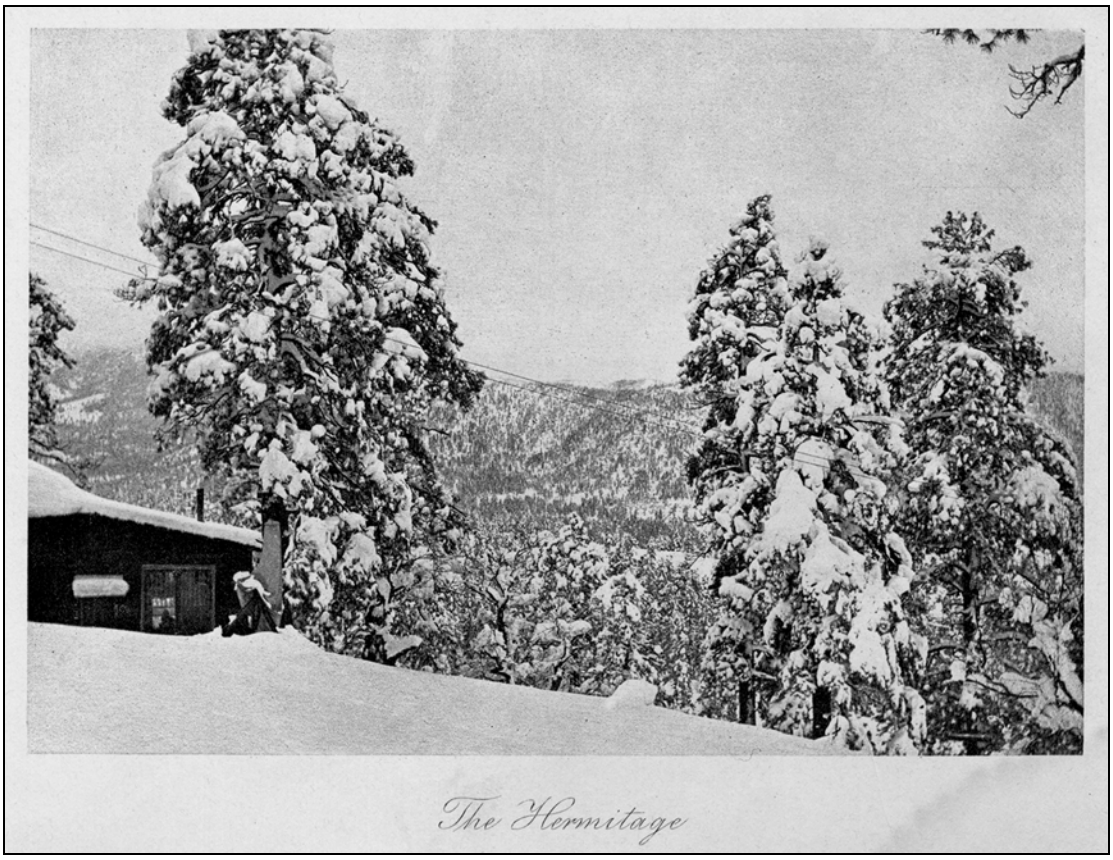
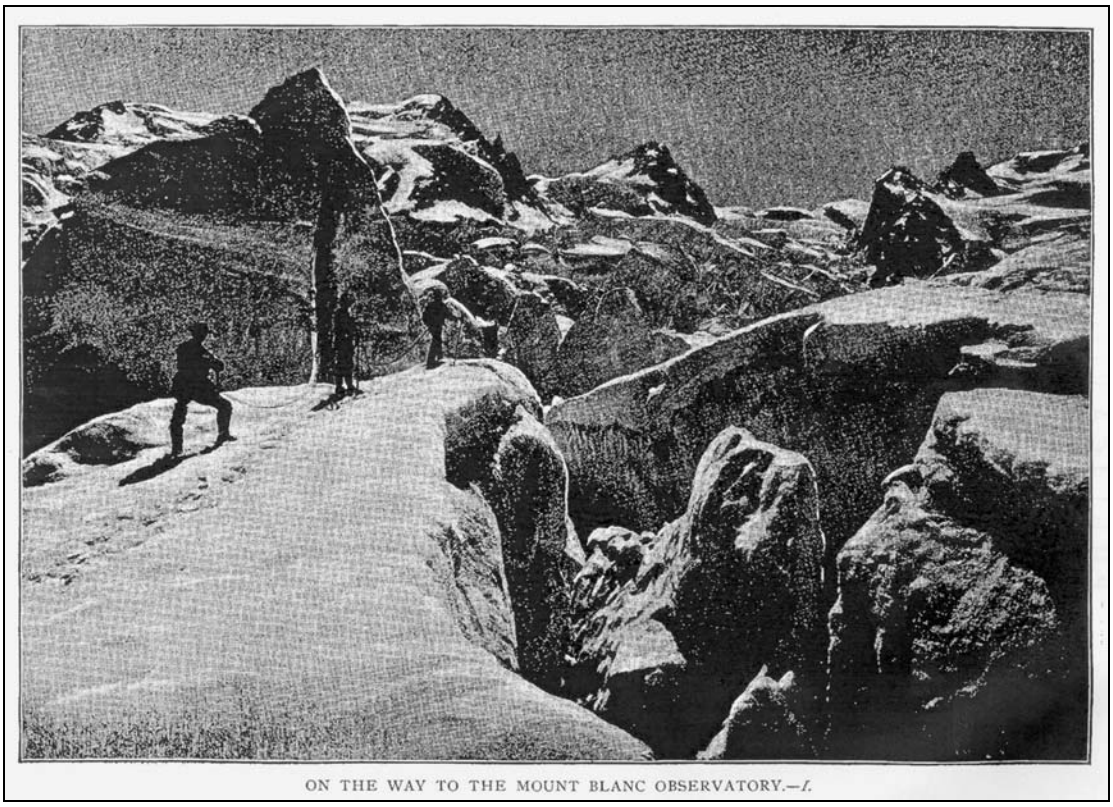


Figure 3.4 “On the Way to Mount Blanc Observatory,” printed in the *Publications of the Astronomical Society of the Pacific,* 1893



ON THE WAY TO THE MOUNT BLANC OBSERVATORY.—*I.*

Figure 3.5 Map and Individual Sketches, printed in *Knowledge,* 1902

the other worlds have not the self-same positions for different observers. A query of scepticism might be

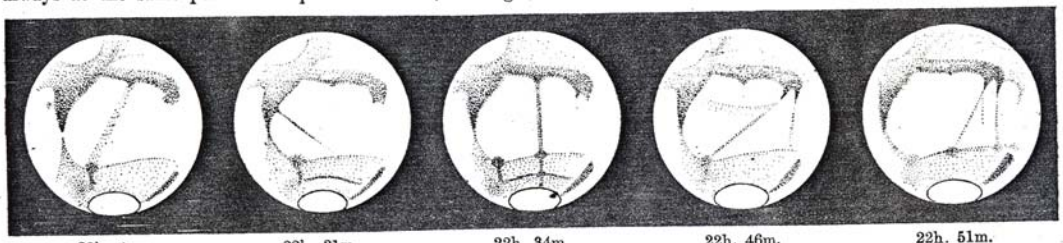
FIG. 4.—Mars in 1900-1901. Long. = 270°.

attached to a fugitive, non-recurring impression of a dark line splitting a planetary disc. But if an analogous impression occur, again and again, on the same night, and always at the same point of the planet's surface, shifting

Mr. E. W. Maunder pointed out what he thought was the reason of the visibility of the Martian canals, namely, that different dark points on the planet's surface, too small to be appreciated individually, produced on the retina the idea of diffused lines. Mr. Maunder predicted then that the next discovery on Mars would be that of small dots, or "lakes." The forecast has been since verified to the letter. In 1895, we had Mr. Lowell's numerous dots or "oases," while last year my friend, M. G. Millochau, the able and industrious astronomer of the Meudon Observatory, using the largest refractor in Europe, the noble 33-inch object-glass of the Brothers Henry, wrote:—"I have seen the canals like some sort of chaplet of small, dark, irregular masses."

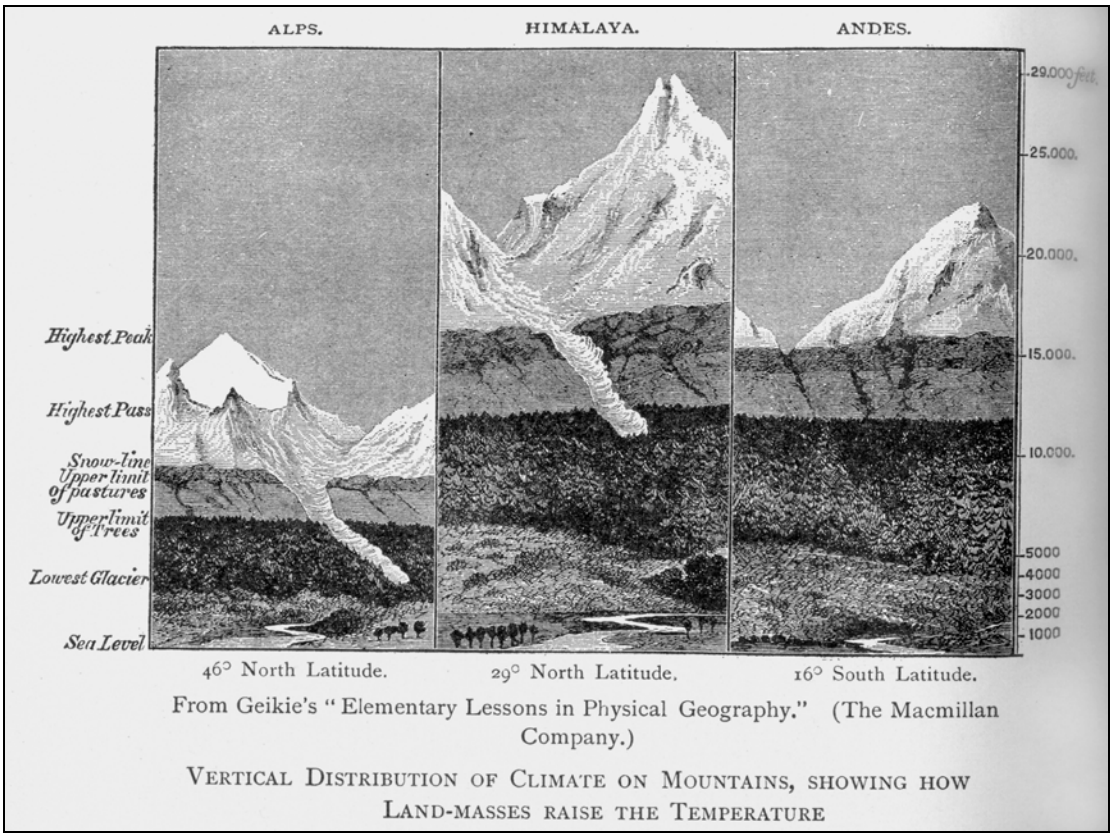
The resolution of the canals into their components is evidently reserved to powerful instruments only.

Another significant fact about the canals is that many of them form the boundaries of half-tones. This discovery, due to the late Mr. Green, has been verified in 1899 by the Rev. P. H. Kempthorne, of Wellington College, and, subsequently, by a very great number of first-class observers. As will be gathered by an inspection of Figs. 1 to 4, embracing the whole of the writer's impressions in 1900-1901, a considerable part of the planet's northern hemisphere was covered with a delicate shading, whose southern edge was limited by the canals "Nasamon," Nilosyrtis, Protonilus, Deuteronilus, Gehon II., Tanais, Erebus, Styx, Chaos, Hyblæus, and Eunostos. The intensity of this half-tone was far from uniform, being lightest in Cydonia, great in Phlegra, between the Hades and Styx, and very great in Utopia, where it formed a "marsh," to which was given the name of "Copais Lacus." Generally, the canals are very difficult objects, being perceptible by rare glimpses only. The appearance of Mars on the accompanying Plate* is the summation of the successive fugitive impressions shown



22h. 8m. Duration = 2s.
22h. 21m. Duration = ½s.
22h. 34m. Duration = ½s.
22h. 46m. Duration = 1s.
22h. 51m. Duration = ½s.

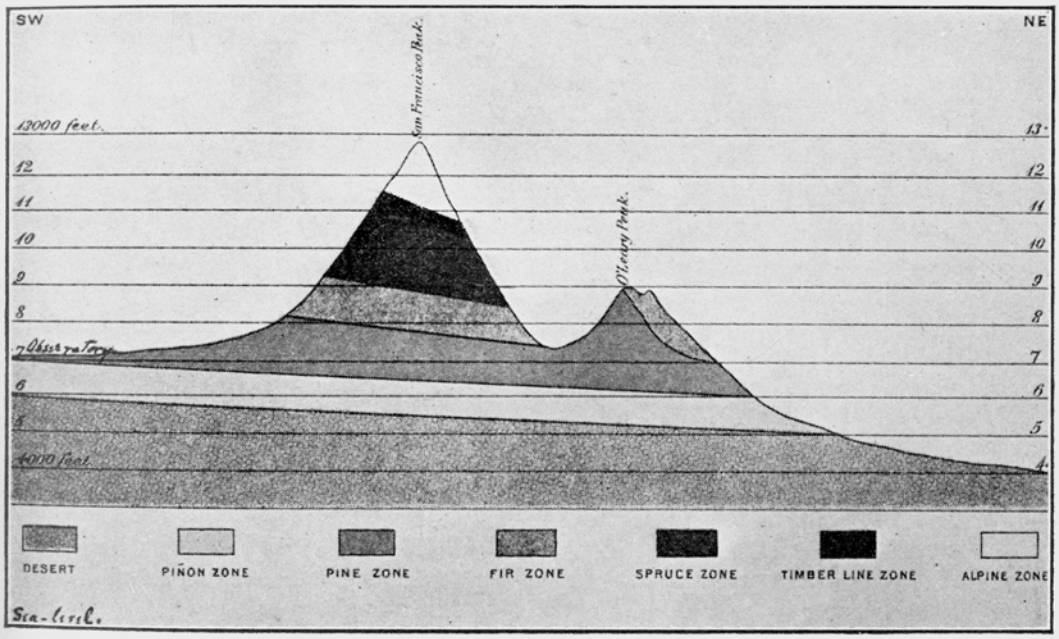
Figure 3.6 Figure from *Mars as the Abode of Life*, 1908



From Geikie's "Elementary Lessons in Physical Geography." (The Macmillan Company.)

VERTICAL DISTRIBUTION OF CLIMATE ON MOUNTAINS, SHOWING HOW LAND-MASSES RAISE THE TEMPERATURE

Figure 3.7 Diagram from *Mars as the Abode of Life*, 1908



After a plate in "North American Fauna, No. 3," U. S. Dept. of Agriculture, Division of Ornithology and Mammalogy, by Dr. Merriam.

DIAGRAMMATIC PROFILE OF THE SAN FRANCISCO AND O'LEARY PEAKS, FROM SOUTHWEST TO NORTHEAST

The diagram shows the several life zones and the effects of slope exposure, but also shows what is unnoticed by the monograph, the effect of a plateau upon life. The location of the Lowell Observatory is indicated by the star.

Figure 3.8 Geometric landscape comparison, *Mars and its Mystery*, 1906

Figure 3.9 Natural pattern illustrations from *Mars and its Mystery*, 1906

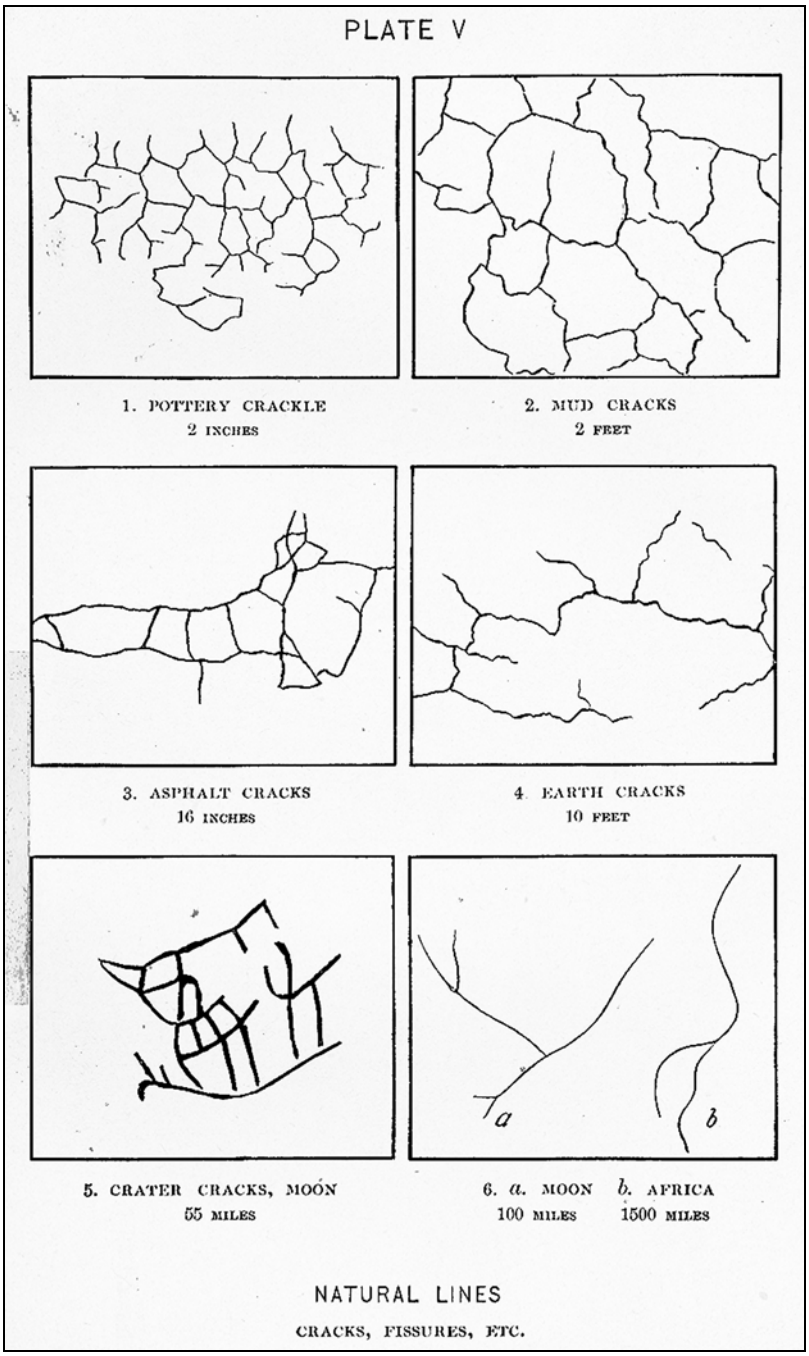


Figure 3.10 Random crack pattern example, Mars and its Mystery, 1906

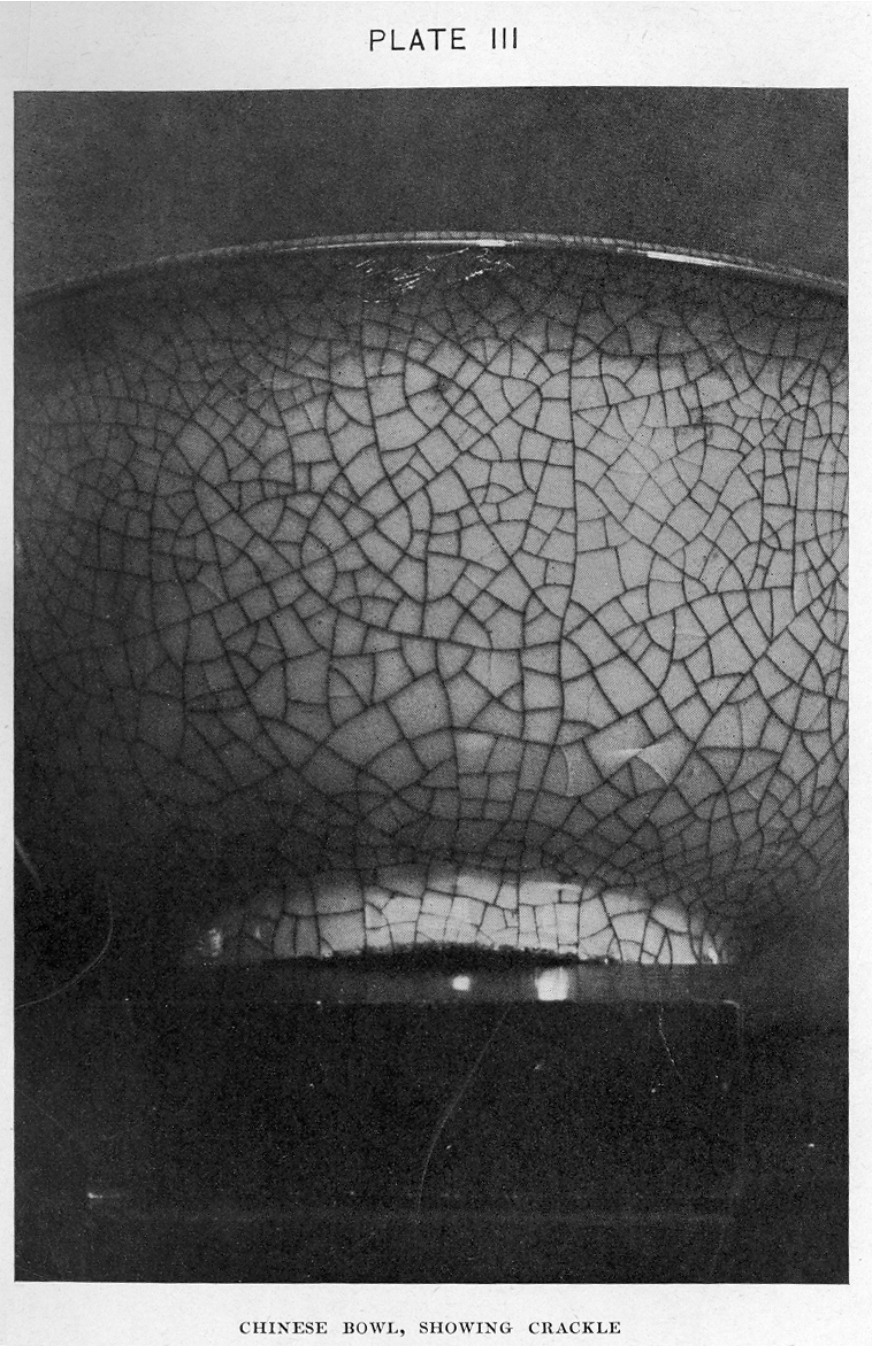


Figure 3.11 Article in The World Magazine, 1906

MY 34 NIGHTS ON MARS

How Prof. Edward S. Morse has been Studying the Great Planet through the Lowell Observatory Telescope and his own Interesting Account of What he Discovered there.

TOBACCO CULTIVATION UNDER CLOTH PORTO RICO. A POSSIBLE EXPLANATION OF MANY WHITE AREAS ON MARS

THE IRREGULARITY OF MUD CRACKS DISPROVING the THEORY that the CANALS on MARS are of NATURAL FORMATION

PROF. E. C. MORSE

What Men of the Earth Might Do on Mars.

A baseball player could knock a baseball the distance from the Battery to City Hall.

A gunner handling a 16-inch gun could shoot the distance from New York to Poughkeepsie.

A pole vaulter could scramble to the roof of a five-story building.

Men could run almost as fast as horses run on the earth.

In case of fires men might jump from third-story windows without injury.

What Science Says of Mars.

SIR ROBERT BALL.

SIMON NEWCOMB.

PROF. TODD, Amherst College.

PROF. GEO. W. MORHOUSE.

PROF. PERCIVAL LOWELL.

PROF. SCHIAPARELLI.

BY PROF. EDWARD S MORSE.

Member National Academy of Sciences.

PROF. GIOVANNI SCHIAPARELLI

PROF. PERCIVAL LOWELL

ARTIFICIAL EARTH LINES COMPARED WITH THE CANAL WORKINGS ON MARS

24 INCH TELESCOPE AT LOWELL OBSERVATORY

OCTOBER 7, 1906. THE WORLD MAGAZINE. PAGE NINE.

CHAPTER 4. A FAMILIAR MARTIAN PHYSICAL GEOGRAPHY

The use of geographical representation modes was fundamental in helping Mars science reach broad popular audiences by the end of the nineteenth century. Once claims regarding an Earth-like, inhabited Mars began to circulate widely, in turn, popular interest began to have a significant influence on the activities of Mars scientists. Due to the popularity of Mars-related news articles, magazine features, and lecture tours, for example, astronomers often found themselves forced to respond to claims they considered absurd, sensational, and nonscientific. Some opponents of the inhabited-Mars theory were obliged to take time away from other projects they clearly considered more important in order to state their positions in the Mars controversy.[203] Thus, the popular appeal of Mars news acted as a catalyst for continued research, influencing research directions, publication outlets, and funding opportunities.[204] In fact, the mania over Mars seems to have extended the lifespan of the inhabited-Mars hypothesis well beyond the extent it probably would have reached

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[203] Simon Newcomb, for instance, chastised Percival Lowell in personal correspondence for focusing so much attention on Mars when he could have been making other astronomical advances: " Are you not well situated for making better observations of the spectra of zodiacal light than any heretofore obtained? Another class of desirable observations is the most exact observations practicable of the position of the axis of the light through a period of an entire year. It is most astonishing to me that when people are making so many sporadic observations, which are of no importance whatever, all the stations near enough to the equator to make a continuous series of value are doing nothing in the matter." Simon Newcomb to Percival Lowell, 21 September 1905, Percival Lowell Correspondence, Lowell Observatory Archives.

[204] As Strauss describes in *Percival Lowell*, leading American astronomers banded together to discredit Lowell because they felt his Mars work was influencing astronomy's disciplinary direction in

if confined to the pages of scientific journals. Popular audiences helped maintain the legitimacy of the inhabited-Mars hypothesis, despite significant doubts from within the astronomical community.

Given that the powerful appeal of the inhabited-Mars theory rested largely on geographical knowledge, geographical arguments, and geographical images, astronomers' works must be re-examined in a new context. Regardless of whether anyone intended that their Mars works be read as geographical texts, scientific and popular treatments of Mars engaged in classic geographical discourses. This chapter and the next accordingly re-contextualize the dominant Mars narrative that developed at the intersection of science and its popularization. Both chapters examine whether this popularized Mars science, through its use of the language and concepts of geography, carried geographical significance beyond its astronomical meanings. When debating the realities of Mars, I argue, scientists were often projecting ideas derived from their observations of Earth. This is not to say that astronomers were deliberately manipulative or that they manufactured bogus claims about Mars to advance geographical arguments at home. Rather, in the process of making sense of their astronomical observations, scientists relied on their knowledge about Earth, thereby introducing beliefs about terrestrial geography into the discussion of Mars. The propensity of certain astronomers, writers, and publics to accept or reject various

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unhealthy ways. Lowell's own correspondence shows how skillfully he took advantage of the huge bonuses available to astronomers who offered exclusives to magazines and newspapers.

theories about Mars was thus intimately connected to their willingness to accept the related and underlying arguments about terra firma.

This chapter specifically examines the many tropes that were used to explore and explain the physical geography of Mars. (The next chapter will take up tropes regarding Martian cultural geography.) I argue that an imaginative geography of landscape familiarity, which depicted Mars as an advanced miniature version of the Earth, functioned to address many terrestrial concerns that preoccupied both geographers and popular audiences of the day. The common perception of Mars as a dying desert world dependent upon its irrigation infrastructure, for instance, was linked to a deterministic understanding of the relationship between culture and environment that played off stereotypes regarding arid, irrigated, and degraded landscapes. As these stereotypes were adopted and extended by popular writers, Mars was cast as an ominous harbinger of Earth's future. The narrative of an inhabited, engineered Mars was thus no silly, make-believe story. Rather, it was a deeply meaningful narrative that dealt with serious concerns regarding landscape change and its effects on civilization. Astronomical claims about Mars functioned as an important means of circulating and modifying geographical beliefs about Earth.

Artificial Mars

One of the first fundamental characterizations of the Martian landscape – as "artificial" – soon became one of the most ubiquitous and meaningful tropes in the

planet's representation. The peculiar geometric appearance of the Martian landscape quickly raised questions as to whether its patterns were "natural" (formed by geologic, climatic, or biological processes) or "artificial" (created by intelligent beings). Animated debate on this topic relied largely on comparisons with Earth's known landforms, showing the extent to which geographical analogy and a rhetoric of familiarity would be used to describe and understand Mars.

From the first appearance of Schiaparelli's 1878 map, commentators reacted strongly to the geometrical look of its landscape. Throughout the 1880s, as Schiaparelli's maps became increasingly abstract and geometrical, several astronomers offered physical explanations for the perplexing markings. Burton thought they might be "furrows" plowed by meteors striking the planet at oblique angles but was stumped by the number of lines that seemingly converged at circular intersections.[205] Proctor suggested they were rivers, but was at a loss to explain why rivers would be so straight or how natural topography could explain so many intersections.[206] Pickering claimed that the lines were more likely geological fissures formed by the rapid cooling of Mars' surface that released sufficient heat and water vapor to support strips of vegetation.[207]

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[205] C. E. Burton, "Canals on Mars," *Astronomical Register* 20 (1882): 142.

[206] Richard A. Proctor, "Note on Mars," *Monthly Notices of the Royal Astronomical Society* 48 (1888): 307-8.

[207] William H. Pickering, "An Explanation of the Martian and Lunar Canals," *Popular Astronomy* 12 (1904): 439-42; Pickering, "The Planet Mars."

None of these physical explanations gained any significant foothold in the literature, however, because they lacked a convincing terrestrial analogy. If the lines could not be fully explained by any process known to occur naturally on Earth, it seems, the next obvious interpretation pointed toward intelligent life. Schiaparelli himself did not assert that the lines on Mars were of synthetic origin, but neither did he reject the idea. In a line that was frequently quoted by inhabited-Mars advocates, Schiaparelli wrote in 1893: "It is not necessary to suppose them [the canals] the work of intelligent beings [but] I am very careful not to combat this supposition, which includes nothing impossible."[208]

Percival Lowell, entering the debate in 1894, found the intelligent design of the canals not only possible, but in fact fundamental to a full understanding of the Martian world. Noting that the chance of multiple perfectly straight watercourses intersecting at a perfectly circular lake was "millions to one"[209] in nature, he argued that the canals appeared "supernaturally regular" in straightness, width, and "systematic radiation from special points."[210] Relying on an understanding of processes known to affect Earth's geography, Lowell said, "Physical processes never, so far as we know, produce perfectly regular results. … Too great regularity is in itself the most suspicious of circumstances that some finite intelligence has been at

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[208] Schiaparelli, "The Planet Mars," 719, 722.

[209] Lowell, "Mars: oases," 344.

[210] Lowell, "Mars: canals," 111.

work."[211] Using basic analogical reasoning, then, Lowell insisted that the incidence of straight lines and circular intersections on Mars indicated certain evidence of intelligent beings:

> The whole system is trigonometric to a degree. If Dame Nature be at the bottom of it all she shows on Mars a genius for civil engineering quite foreign to the disregard for prosaic economy with which she is content to work on our own work-a-day world. Her love for elementary mathematics is evidently greater than is commonly supposed.[212]

Although the original discovery of the canals in 1878 had upset existing assumptions about the analogy between Mars and Earth by announcing a class of features that could *not* be explained by terrestrial environmental processes,[213] the desire to equate the two planets remained. As Ball wrote in 1892 regarding the canals, "We naturally try to obtain from terrestrial phenomena some clue to their explanation."[214] Lowell's contribution was in extending the analogical framework to include manmade structures. In essence, the inhabited-Mars rhetoric that blossomed in the wake of Lowell's bold pronouncements relied on a direct comparison of the landscapes of Mars and Earth. For those who followed Lowell's logic – that landforms unexplainable via known natural forces proved the existence of intelligent

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[211] Ibid., 111, 112.

[212] Lowell, "Mars: oases," 348.

[213] Robert Markley, *Dying Planet: Mars in Science and the Imagination* (Durham, N.C.: Duke University Press, 2005).

[214] Ball, *In Starry Realms,* 167.

beings – the similarities between features on Mars and manmade features on Earth were overwhelming.

In both text and image, Mars was regularly said to appear as would the most intensively inhabited or cultivated areas of Earth if viewed from a distance. Morse's popular *Mars and its Mystery* graphically compared maps of the Martian canals with diagrams of street and rail networks.[215] (See Figure 2.9.) Morse contrasted the canals' resemblance to these manmade landforms against the less regular patterning of cracked mud, cracked asphalt, or tectonic faults. (See Figure 3.9.) He also commented that

> If in the mind's eye we were to survey the Earth from Mars the only feature we should find at all paralleling the lines in Mars would be found in the level regions of the West, where, for thousands of miles, the land extends in vast stretches. In these regions would be found lines of railroads running in straight courses, starting from definite places, converging to common centres, their sides, in certain seasons, conspicuous with ripening grain fields, or again the work of the United States Reclamation Bureau running its irrigation canals in various directions throughout that great region. Both these kinds of lines would be artificial and both designed for purposes of conveyance – in the one case, merchandise and passengers, in the other case, water.[216]

Lowell himself noted that from Mars, any visible evidence of human activity on the Earth would be limited to "such semi-artificialities as the great grain-fields of the West when their geometric patches turned with the changing seasons from ochre to

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[215] Morse, *Mars and its Mystery*. Strauss argues that Morse wrote this book and otherwise supported Lowell's arguments regarding planetary evolution to repay Lowell for his earlier support of Morse's own "crusade to preserve evidence of traditional [Japanese] culture in the face of rapid modernization," David Strauss, ""Fireflies Flashing in Unison": Percival Lowell, Edward Morse and the Birth of Planetology," *Journal for the History of Astronomy* 24 (1993): 160.

green, and then from green to gold. By his crops we should know him,– a telltale fact of importance because probably the more so on Mars."[217]

Such intuitive geographical analogy obviously appealed to popular audiences, as Morse's and Lowell's comparative statements and imagery were repeated regularly in newspapers and general-interest books and magazines. These non-scientific sources quickly accepted the concept of "artificiality," giving very little attention to the idea that Mars' markings might have some physical explanation.

Arid, Irrigated Mars

In trumping all other explanations of the Martian landscape, Lowell's theory relied on a very specific construction of the red planet's climatic geography. At the same time that he hypothesized a synthetic landscape, Lowell proposed that the red planet was a land of extreme aridity. Though these two interpretations problematically relied on each other for explanation, Lowell managed to roll them into one comprehensive theory that powerfully supported his view that Mars hosted intelligent life. The trope of aridity and the trope of artificiality thus mutually reinforced one another in evoking a desert landscape marked by extensive irrigation infrastructure. In presenting and elaborating on these ideas, Lowell and his followers

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[216] Morse, *Mars and its Mystery*, 118.

[217] Lowell, "Mars: canals," 107.

made liberal use of terrestrial analogies that linked Mars with the geographical issues and stereotypes related to Earth's desert regions.

Early speculative works had painted Mars as a lush, watery landscape. The dark patches on Mars had long been referred to as oceans, and in Schiaparelli's 1878 map, they were actually colored blue to reinforce this convention. French astronomer and popular science writer Flammarion's spectacularly successful 1892 book even depicted Mars as a tropical jungle planet.[218] By the mid-1890s, however, these portrayals had been reversed. The former oceans had been recast as tracts of sparse vegetation,[219] while the "ochre" former continents had been newly reconsidered as "one vast desert waste."[220] The circular "lakes" had become "oases,"[221] and the irregular water's-edge appearance from Schiaparelli's first map had long given way to an increasingly geometric appearance. (Refer to Figure 2.11) The new theme of aridity coincided with Mars' rise in popularity among non-scientific audiences, signaling that the revised representations carried powerful resonance and meaning.

Lowell's first major contribution to the scientific understanding of Mars was his analysis of annual variations in the visibility of the lines/canals, which he equated

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[218] Camille Flammarion, *La Planete Mars, Et Ses Conditions D'Habitabilite. Synthese Generale De Toutes Les Observations. Climatologie, Meteorologie, Areographie, Continents, Mers, Et Rivages, Eaux Et Neiges, Saisons, Variations Observees* (Paris : Gauthier-Villars et Fils, 1892).

[219] Pickering was first to make the vegetation argument in William H. Pickering, "The Seas of Mars," *Astronomy and Astro-Physics* 13 (1894): 553-56.

[220] Percival Lowell, "Mars: seasonal changes on the planet's surface," *Astronomy and Astro-physics* 13 (1894): 821.

[221] Lowell, "Mars: oases."

with seasonal changes in vegetation growth. Though many astronomers had previously reported that the canals did not seem to be equally visible at all times throughout the year, no one had conducted any systematic study or offered a comprehensive analysis of this phenomenon. Lowell's data showed that the changing visibility of the canals followed specific seasonal patterns: canals first began to appear near the Martian pole in Martian spring, then appeared to extend in length toward the Martian equator throughout the summer. In fall/winter, the reverse pattern occurred, as the canals receded in visibility from equator to pole. (See Figure 4.1 for Lowell's graphical display of data related to this phenomenon.) On Earth, Lowell pointed out, the opposite pattern prevails: vegetative growth proceeds from equator to pole on the heels of seasonally warm weather. The inverse relationship on Mars indicated, in his view, that water – not temperature – was the limiting factor in vegetation growth. Based on these observations and analyses, Lowell argued that the water supply on Mars must be seriously constrained.[222]

Lowell also supported his arguments for an arid Mars by pointing to the planet's lack of cloud cover. The dearth of clouds on Mars, in fact, was widely said to be the only reason astronomers enjoyed such detailed views of its surface. Although there were infrequent reports of a thin, veil-like haze from time to time, no one could dispute that virtually all of the Martian landforms were clearly visible at any given time. This was in stark contrast to the situation for Venus, where the

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[222] Percival Lowell, "Mars: the water problem," *Atlantic Monthly* 75 (1895):749-58.

planet's aspect changed so frequently that astronomers determined the entire planet was enshrouded by thick clouds. The remarkable transparency of the Martian atmosphere was compared with Earth's desert regions, which were said to be similarly cloud-free.

Despite the fact that Mars had no noticeable oceans or rain clouds, Lowell pointed to the existence of its polar caps as an indication that the planet was not completely dry. The caps' obvious waxing and waning indicated an active circulation of some water at the surface level. For Lowell, the caps were thus key to understanding the geometric patterns girdling the planet. The geometric lines, in Lowell's hypothesis, comprised an ingenious network of irrigation canals built by intelligent inhabitants to cope with the effects of extreme aridity. In his system, seasonal snowmelt from the polar caps was conveyed by artifice and "gravity"[223] to the "tropic zones,"[224] where it watered a parched landscape, eventually evaporated into suspended water vapor, and was then circulated by light air currents back toward

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[223] It seems that Lowell used the term "gravity" not in its modern sense but rather to refer to the coriolis effect of a sphere's rotation on the flow of its surface waters, as seen in this typical discussion: "No sooner liberated from its winter fetters than it [water] would begin under the pull of gravity to run toward the equator. (It may interest the reader to note that its course would on the spheroidal surface actually be uphill.) Each particle would start due north; but its course would not continue in that direction. For at each mile traveled north it would reach a latitude of greater rotation than the last it left. … The consequence upon the particle would be its northerly motion would be continuously changing with regard to the surface into a more and more westerly one." Percival Lowell, "Mars: Spring Phenomena," *Popular Astronomy* 2 (1894): 98.

[224] Lowell divided Mars into three climatic zones that matched those usually defined for Earth: the arctic zone, the temperate zone, and the tropic zone. Percival Lowell, *Mars and Its Canals* (New York: The Macmillan Co., 1906).

the poles for wintertime deposition as ice.[225] The visible "canals" were said to be not the watercourses themselves but rather 30-mile-wide swaths of vegetation running alongside the ingenious system of waterways. These relatively frail lines on the map were nearly lost in a landscape described as "really one vast Sahara, a waterless waste."[226]

Lowell's discussion of the arid Martian condition regularly used Earth's desert regions as points of comparison. Referring to the uniform stretches of pale Martian surface, for instance, he wrote,

> [T]hey seem to be nothing but ground, or, in other words, deserts. Their color first points them out for such. The pale salmon hue, which best reproduces in drawings the general tint of their surface, is that which our own deserts wear. The Sahara has this look; still more it finds its counterpart in the far aspect of the Painted Desert of northern Arizona. To one standing on the summit of the San Francisco Peaks [in Flagstaff, Ariz.] and gazing off from that isolated height upon this other isolation of aridity, the resemblance of its lambent saffron to the telescopic tints of the Martian globe is strikingly impressive.[227]

Lowell, who traveled to North Africa several times before and during his career as an astronomer, clearly saw a strong parallel between the Saharan landscape and his vision of Mars. Writing to his sister from French Africa in 1896, he included this remarkable comment in his description of the sights:

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[225] These arguments were presented in multiple articles and lectures, which were summarized in his major books: *Mars*, *Mars and Its Canals*, and *Mars as the Abode of Life* (New York: Macmillan Co., 1908).

[226] Percival Lowell, "The Geography of Mars: Lecture to the National Geographic Society, Washington, D.C.," January 3, 1908, handwritten notes, Percival Lowell Unpublished MSS, Lowell Observatory Archives.

[227] Lowell, *Mars and its Canals*, 149.

> And then Arabs everywhere in picturesque squalor and beautiful bronze skins which constitutes so large a part of their clothing. Flowers too sold by the same for love, one may say, for the money paid is next to nothing. Then cafes, also, innumerable in the open air, their little French tables and iron-work chairs setting most contentedly about. Do you know, it is a fancy if you will but I feel as if I were vouchsafed half-visions of the Martians in their perpetually sun-lit planet and oasis-like life.[228]

American Astronomer David Todd, who traveled with Lowell on a solar eclipse expedition to Tripoli in 1900, seems to have been similarly convinced by his own personal travel:

> The more I visit arid regions of the earth, and observe the devices of desert-dwellers to coax the growth of even the sparsest vegetation, the more the truth of Lowell's theory of the Martian canals impresses itself upon me. ... Imagine yourself suspended high about such terrestrial sands, as in a balloon, only hundreds or thousands of miles away, and the likeness of Mars to the earth and the earth to Mars would be compelling.[229]

Although Lowell also used the Arizona landscape around Flagstaff to establish a number of his Mars-related analogies,[230] the general discussion of Mars' deserts and "oases" – the circular markings observed at most canal intersections – seems to have evoked a specifically North African or Middle Eastern landscape for a number of writers who followed him. Many astronomers used the Sahara as the logical point of scientific comparison for Mars: "Mr. Lowell is also right in considering these regions as deserts, for their colour is very much that of yellow sand,

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[228] Percival Lowell to Elizabeth Lowell Putnam, 13 February 1896, Houghton Library, Harvard University: MS Am 2078.

[229] Todd, "Professor Todd's Own Story," 350.

and our Sahara, if not too much dimmed by our dazzling white atmosphere, would show a similar colour viewed from Venus."[231] Popular publications also linked Mars with North Africa, as in the not-so-subtle inclusion of Egypt's sphinx in the illustration for a speculative newspaper article about the red planet. (See Figure 4.2.)[232]

As these astronomers and popular science writers took up the desert chorus, they also embraced Lowell's canal hypothesis as the most likely scenario for an extremely arid planet. This discourse echoed reports from the explorers of their own planet, thus projecting terrestrial water management concerns into the narrative of Mars. As a result, the bizarrely geometrical canal network, which had first defied terrestrial analogy, came to be seen as a familiar landscape, governed by known processes and technologies.

Europeans had long been interested in irrigation in the imperial context. The famous French survey of Egypt during the 1798-1801 invasion campaign had fascinated European readers with its maps, sketches, and descriptions of a waterless landscape in which civilization depended heavily on its irrigation systems.[233] When the British assumed control of Egypt later in the nineteenth century, they brought in

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[230] This is discussed in detail later in this chapter.

[231] E. M. Antoniadi, "Section for the Observation of Mars: Report of the Section, 1896," *Memoirs of the British Astronomical Association* 6 (1898): 100.

[232] "Will the New Year Solve the Riddle of Mars?" *New York Herald*, 30 December 1906.

[233] Godlewska, "Map, text and image."

engineers to rehabilitate the irrigation system from India, where the British colonial administration had established new professional school to train civil engineers in hydraulics and water management. In fact, many of the European nations' imperial efforts in the nineteenth century revolved around water engineering, particularly irrigation.[234] The European publics were therefore accustomed to news about the digging of canals, the constructing of dams, the draining of swamps and the pumping of water, especially in the regions of North Africa and South Asia.

Africa and Asia were not the only relevant comparisons, however. In the frontier territories of Lowell's own country, water management had emerged as a major concern limiting settlement expansion and economic development. John Wesley Powell's explorations of the Grand Canyon and Rocky Mountains had inspired him to make grand pronouncements about the need for water planning in the arid West.[235] His *Report on the Lands of the Arid Region of the United States* not only brought Americans' attention to the benefits of irrigation, but it also directly addressed the need for a large-scale, centralized administration that could survey,

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[234] See, for example, Michael J. Heffernan, "Bringing the Desert to Bloom: French Ambitions in the Sahara Desert During the Late Nineteenth Century - the Strange Case of 'La Mer Intérieure'," in *Water, Engineering and Landscape: Water Control and Landscape Transformation in the Modern Period*, eds. Denis Cosgrove and Geoff Petts (London: Belhaven Press, 1990), 94-114.

[235] Scott Kirsch, "John Wesley Powell and the mapping of the Colorado Plateau, 1869-1879: survey science, geographical solutions, and the economy of environmental values," *Annals of the Association of American Geographers* 92 (2002):548-572; William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York and London: W.W. Norton & Company, 1978).

organize, and manage the nation's arid lands.[236] Although Powell's prescriptions were rejected for the American West, the Martians seem to have followed his advice to the letter.

By cultivating strong analogies with Earth's arid regions, Lowell and his supporters ensured that irrigation became a critical part of the common understanding of Mars' landscape. As one commentator enthused, "to be able to live at all, the Martians have had to develop an elaborate system of irrigation, and only on these irrigated bands does vegetation flourish, the great regions of reddish-ochre tint being dreary wastes of desert land, from which all organic life has long been driven."[237] In a different historical era or cultural setting, perhaps the geometric maps of Mars would have conjured other explanations. For Lowell's popular audiences, however, all attention was fixated on the supposed dearth of Martian water.

Dying Mars

Having argued partly from observational data that Mars was likely a desert planet, Lowell then made a major conceptual leap that his peers and audiences generally accepted without protest. He postulated not only that Mars was arid, but also that it was actually undergoing an unrelenting process of *increasing* aridification. In Lowell's terms, the planet was "dying," slowly losing its water and atmosphere as

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[236] J. W. Powell, *Report on the Lands of the Arid Region of the United States*,2nd ed. (Washington, D.C.: Government Printing Office, 1879).

it aged. Because Lowell's arguments in this vein were integral to the full articulation of his inhabited-Mars hypothesis, the sources of his logical leap and the contexts of its widespread acceptance must be considered fully.

Lowell referred to the long-term climatic processes affecting Mars as "increasing terrestriality," "parching" or "desertism."[238] He argued that the red planet had once hosted oceans as extensive as Earth's, but was well along an irreversible path toward becoming a "dead" world, like Earth's moon. In the intermediate stage, Lowell claimed, Mars had lost its oceans but still retained enough moisture to support limited vegetation.[239] He declared that just as the Martian oceans had gradually vanished with time, Mars' land had begun to lose its water as well, rendering "once fertile fields" into devastated deserts.[240] According to his observations, more than half of the Martian surface "is now an arid waste, unrelieved from sterility by surface moisture or covering of cloud. Bare itself, it is pitilessly held up to a brazen sun, unprotected by any shield of shade."[241] This desert condition was not a temporary or local phenomenon, in Lowell's mind. It was an unalterable process of planetary decay:

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[237] Gregory, "Mars as a World," 24.

[238] All of these terms appear in his lengthy discussion of the Martian climate in *Mars as the Abode of Life,* Chapter 4: "Mars and the Future of the Earth," 111-145.

[239] The planet's minimal water supply was said to be locked up in vapor form in the atmosphere, and in solid form at the frozen polar caps, flowing over the surface as a liquid only infrequently.

[240] Lowell, *Mars as the Abode of Life,* 124.

[241] Ibid., 131.

> To the bodily eye, the aspect of the disk is lovely beyond compare; but to the mind's eye, its import is horrible. That rose-ochre enchantment is but a mind mirage. A vast expanse of arid ground, world-wide in its extent, girdling the planet completely in circumference, and stretching in places almost from pole to pole, is what those opaline glamours signify. All deserts, seen from a safe distance, have something of this charm of tint. ... But this very color, unchanging in its hue, means the extinction of life. Pitilessly persistent, the opal here bears out its attributed sinister intent. … For the cosmic circumstance about them which is most terrible is not that deserts are, but that deserts have begun to be. … They mark the beginning of the end.[242]

Thus the "desertism" of Mars was cast as a sinister process that produced "a world-wide desert where fertile spots are the xception, not the rule, and where water everywhere is scarce."[243]

To understand where this idea of unrelenting aridification came from and why it would have been so palatable, indeed irresistible, to Lowell's audiences, we need look no further than the tropes typically used to characterize Earth's own desert regions at that time. In comparing Mars' landscape to Earth's deserts, Lowell easily assumed the vocabulary that was then widely used to characterize much of the Middle East. Colonial administration throughout the region depended on a narrative of deforestation, aridification, and desert growth to wrest control of natural resources from local populations.[244] Lowell echoed this narrative in declaring that the Earth and Mars were undergoing similar climate change:

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[242]Ibid., 134, 124.

[243] Ibid., 124.

[244] Diana K. Davis, "Potential forests: degradation narratives, science, and environmental policy in protectorate Morocco, 1912-1956," *Environmental History* 10 (2005): 212-238; A. T. Grove and

> Upon the southern coast of the Mediterranean, at the edges of the great Sahara, are to be seen to-day the ruins of vast aqueducts stalking silently across the plains. ... At the present day the streams are incompetent to supply the aqueducts, the very presence of which attests that in the past this was not so. The land has parched since times so recent as to be historic, recorded by the monuments of man. … In a startling manner it brings before us the speed with which the desert is gaining on the habitable earth.[245]

> In the same manner streams descend from the cedar-clad range of the Lebanon to lose themselves in the Arabian desert just without the doors of Damascus; and Palestine has desiccated within historic times. Palestine, a land once flowing with milk and honey, can hardly flow poor water now, and furnishes another straw to mark the ebbing of the water supply.[246]

More commonly, however, Lowell used northern Arizona as his primary point of comparison. Noting that Arizona was within a "widening desert-belt" that included "the Sahara, Arabia and the deserts of central Asia" along the same latitude, he presented the Petrified Forest as proof that water had once run through the landscape.[247] Where trees had once stood tall in a dense forest, no moisture remained. Plant life was instead limited to the tops of mesas, such as that on which Flagstaff was perched: "Their lofty oasis is all that is now left of a once fertile

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Oliver Rackham, *The Nature of Mediterranean Europe: an Ecological History* (New Haven: Yale University Press, 2001); Diana K. Davis, "Environmentalism As Social Control? An Exploration of the Transformation of Pastoral Nomadic Societies in French Colonial North Africa," *The Arab World Geographer* 3 (2000): 182-98; Richard H. Grove, "The Evolution of the Colonial Discourse on Deforestation and Climate Change, 1500-1940," in *Ecology, Climate and Empire* (Cambridge: White Horse Press, 1997), 5-36.

[245] Lowell, *Mars as the Abode of Life*, 128-9.

[246] Lowell, *Mars and its Canals*, 153.

[247] Lowell, *Mars as the Abode of Life*, 125.

country; the retreat of the trees up the slopes in consequence of a diminishing rainfall."[248]

In making these analogies between Mars and the Earth, Lowell drew not only on the common geographical narrative of increasing desertism, but also on a powerful trope of the lost paradise. Arising from colonial narratives that painted tropical realms as abnormal (non-European) yet exotic and interesting, a discourse of the tropics as a fallen paradise supported European attempts to "reclaim" or resuscitate landscapes in the Middle East and Africa.[249] Again, these same metaphors surfaced in Lowell's Mars writing, helping to explain how and why it might have conveyed such authority to his readership. He regularly lamented the decline of the great Martian civilization, referring to its "eminently sagacious state"[250] and "supremacy of mind."[251] This paradise of evolutionary advance was said to be sensationally doomed to an exotic climatic demise: "The drying up of the planet is certain to proceed until its surface can support no life at all. Slowly but surely time will snuff it out. When the last ember is thus extinguished, the planet will roll a dead world through space, its evolutionary career forever ended."[252]

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[248] Lowell, *Mars and its Canals*, 152.

[249] Derek Gregory, "(Post)Colonialism and the Production of Nature," in *Social Nature: Theory, Practice and Politics*, eds. Noel Castree and Bruce Braun (Oxford: Blackwell, 2001), 84-111.

[250] Lowell, *Mars and its Canals*, 378.

[251] Lowell, *Mars as the Abode of Life*, 215.

[252] Ibid., 216.

In a departure from the colonial discourse, however, Lowell did not fault Mars' inhabitants for their planet's creeping desertism. Unlike the narratives that described much of the Middle East and Africa, in which local inhabitants were blamed for neglecting their landscapes and squandering the ancient paradise, Lowell explicitly absolved the Martians (and Middle Easterners) of any responsibility: "This making of deserts is not a sporadic, accidental, or local matter, although local causes have abetted or hindered it. On the contrary, it is an inevitable result of planetary evolution."[253] Lowell's focus on the role of natural forces in desert growth, rather than on the agency of desert inhabitants, perhaps stemmed partly from his use of uninhabited stretches of Arizona as a preferred Martian analogy. Unlike North Africa, where there were plenty of locals to blame, Lowell's personal experience in Arizona may have supported his adherence to a purely physical explanation for Mars' climatic decay.

More directly, however, Lowell, drew from Spencer's nebular hypothesis, which was the leading model of cosmic evolution in the mid- to late nineteenth century. The nebular hypothesis held that all planets and heavenly bodies had formed from a common gaseous nebula. Upon formation, the individual planets were thought to begin an irreversible process of cooling and shedding moisture. The smaller the planet, the more quickly this evolutionary process was thought to occur, as small planets were able to cool more quickly on account of their greater surface-area-to-

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[253] Lowell, *Mars and its Canals*, 153.

volume ratio. Earth's tiny moon, for example, was known to be a completely dry and airless world, a perfect example of the end-state of planetary evolution. Mars, also on account of its small size, was likewise considered "an old world, a world well on in years, a world much older relatively than the earth,"[254] though it was not yet dead. Although the nebular hypothesis was somewhat past its prime by the time Lowell used it as the basis for his inhabited-Mars theory,[255] he was thoroughly committed to the Spencerian model of predictable phases of physical evolution.

In his focus on physical processes of landscape change, Lowell also relied heavily on an idea that was then coming to fruition in the discipline of geography: the Davisian cycle. William Morris Davis' conceptualization of landscape as the product of cyclical erosion processes drew extensively on Spencer's application of concepts from organic evolution to other spheres of experience.[256] Just as Davis considered both evolution and erosion as "inevitable, continuous and irreversible process[es] of

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[254] Lowell, "Mars: oases," 234.

[255] The nebular hypothesis was powerfully challenged in 1905 by the planetesimal hypothesis (also called the Chamberlin-Moulton hypothesis), which postulated an accretion model for planetary formation. Rather than condensing from a common gaseous cloud, planets were said to be formed at different times and at different rates by the random accretion of different materials. The planetesimal hypothesis thus rejected both the cooling/drying phases of the nebular hypothesis, as well as its provision for common life forms throughout the universe. See Strauss, *Percival Lowell*, for a full discussion of how the transition between these dominant models affected Lowell's credibility among peers and audiences.

[256] R. J. Chorley, "A Re-Evaluation of the Geomorphic System of W.M. Davis," in *Frontiers in Geographical Teaching*, eds. R. J. Chorley and Peter Haggett (London: Methuen & Co., 1965), 21-28; David N. Livingstone, "The Geographical Experiment: Evolution and Founding of a Discipline," in *The Geographical Tradition* (Oxford: Blackwell, 1993), 177-215.

change producing an orderly sequence of transformations,"[257] Lowell fundamentally viewed Mars' condition as a stage of physical development. He used biological terms to describe the aging of Mars' landscapes in the same manner that Davis personified geology with references to its "life cycles." In Lowell's terms, desiccation was akin to the inevitable decline and death of the body: "Desertism, the state into which every planetary body must eventually come and for which, therefore, it becomes necessary to coin a word, has … made its first appearance upon the Earth. Standing as it does for the approach of age in planetary existence, it may be likened to the first gray hairs in man."[258]

Desert tropes and evolutionary concepts were thus fundamental to Lowell's characterization and conceptualization of Mars as a dying planet. Metaphorical and rhetorical devices allowed him to establish firm analogies with known terrestrial regions and also helped him paint a startling picture of accelerated landscape change. By imagining Mars as a growing desert, Lowell set the stage for his sensational inhabited-Mars theory: "To let one's thoughts dwell on these Martian Saharas is gradually to enter into the spirit of the spot, and so to gain comprehension of what the essence of Mars consists."[259]

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[257] Chorley, "A Re-Evaluation," 30.

[258] Lowell, *Mars and its Canals*, 16.

[259] Lowell, *Mars as the Abode of Life*, 134.

Inhabited Mars

Though the appearance of Mars' physical geography was said to be generally analogous with Earth's own arid and irrigated regions, Lowell focused on an important dissimilarity. The irrigation systems astronomers reported seeing on Mars were far more extensive than any known infrastructure on Earth. The complexity of the Martian landscape geometry, in fact, convinced Lowell that the planet hosted intelligent life. Essentially, the landscape itself provided the evidence for beings he did not claim to see. Furthermore, it provided the primary clues as to what the beings must be like.

Briefly, Lowell argued that the severe environmental stress of climate change had led to significant evolutionary advances of Martian beings and Martian society. His evidence for this, of course, was the canal network, which he praised as an ingenious global irrigation scheme, constructed to bring seasonal polar snowmelt to those equatorial regions suffering from increasing aridification:

> The evidence of handicraft, if such it be, points to a highly intelligent mind behind it. Irrigation, unscientifically conducted, would not give us such truly wonderful mathematical fitness in the several parts to the whole as we there behold. A mind of no mean order would seem to have presided over the system we see,– a mind certainly of considerably more comprehensiveness than that which presides over the various departments of our own public works.[260]

As Lowell's continued researches and observations added more and more detail to the map, he became more and more convinced not only that Mars hosted intelligent life,

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[260] Lowell, *Mars*, 208-9.

but that it was organized in a highly advanced civilization. When trying to explain the apparent alternation of water flow between two major Martian canals, for example, Lowell concluded that the canals were regulated by a sophisticated water-sharing arrangement implemented by peacefully organized regional neighbors: "It is easily conceivable that a limited water supply should involve a necessity of the sort. It may well be that after one district has enjoyed the water and its results for a certain period, the supply should then be turned for a time into a neighboring one to be turned back again after a while."[261] Lowell offered this apparently high level of cooperation among neighboring regions as further evidence of the Martians' impressive social organization and advancement, lauding their civilization as an example of the highest level attainable in a Spencerian hierarchy of cultures.[262]

> The struggle for existence in their planet's decrepitude and decay would tend to evolve intelligence to cope with circumstances growing momentarily more and more adverse. But, furthermore, the solidarity that the conditions prescribed would conduce to a breadth of understanding sufficient to utilize it. Intercommunication over the whole globe is made not only possible, but obligatory.[263]

Lowell's speculative hypotheses and explanations, though often criticized by many of his peer astronomers, nonetheless intrigued the publishers, editors and writers who brought his work to the attention of broad audiences in North America and Europe.

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[261] Percival Lowell, "Bulletin No. 8 The Thoth and the Amenthes," *Bulletins of the Lowell Observatory, 1903-1911* (Lowell Observatory: 1911), 1:43.

[262] Lowell, *Mars and its Canals.*

[263] Lowell, *Mars as the Abode of Life,* 143.

In crafting what became this best-known and most popular explanation for the appearance of Mars, we can now see that Lowell's claims echoed trends in contemporary geographical thought. First, his equation of the complexity of a landscape with the advancement of its civilization employed geographers' basic method of using landscape analysis to determine cultural level. Several of the men who helped establish geography as a discipline in the late-nineteenth-century, including Halford Mackinder, Friedrich Ratzel, and William Morris Davis, had by Lowell's time begun to assert critical links between landscape and society.[264] Although Lowell cannot be shown to have known or corresponded with any of these scholars, he clearly employed similar concepts in his own work. In his 1906 book, *Mars and its Canals*, for instance, Lowell included a brief chronicle of "man's history," which highlighted landscape activity as the best indicator of evolutionary progress:

> While [man] still remained of savage simplicity, a mere child of nature, he might come and go unmarked by an outsider, but so soon as he started in to possess the earth his handicraft would reveal him. … It began with agriculture. Deforestation with its subsequent quartering of crops signalized his acquisition of real estate. His impress at first was sporadic and irregular, and in so far followed that of nature itself; but as it advanced it took on a methodism of plan. … Regularity rules to-day, to the lament of art. The railroad is straighter than the turnpike, as that is straighter than the trail. Communication is now too urgent in its demands to know anything but law and take other than the shortest path to its destination. Tillage has undergone a like rectification. To one used to the patchwork quilting of the crops in older lands the methodological rectangles of the farms of the Great

[264] Livingstone, "The geographical experiment."

> West are painfully exact. Yet it is more than probable that these material manifestations would be the first signs of intelligence to one considering the earth from far.[265]

Just like the geographers, then, Lowell assumed a fundamental and systematic connection between the natural and social worlds.

Furthermore, as will be discussed in more detail in the next chapter, Lowell's explanation of Martian civilization as read through Martian landscape relied on (and reinforced) the environmentally deterministic viewpoint that early geographers used to describe the non-Western world. Ratzel was perhaps most influential in his elaboration of the role of environment in affecting a people's progress through the evolutionary "stages" of civilization. As articulated in his *History of Mankind*, the "less favourable conditions" of the temperate zones had led to greater evolutionary progress and higher forms of civilization because man there "had to look after himself with more care than in the soft cradle of the tropics."[266] The new generation of geographers after Ratzel, particularly Ellsworth Huntington and Ellen Semple in the United States, accordingly attempted to "read history through environmental spectacles,"[267] arguing that climate and landscape morphology were the primary determinants of cultural development. This theory (which conveniently justified most Western imperial activity by portraying tropical peoples as helplessly backward,

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[265] Lowell, *Mars and its Canals*, 362-3.

[266] Friedrich Ratzel, *History of Mankind [Völkerkunde]*, trans. A. J. Butler, 2nd ed (London: Macmillan and Co., 1896), 1:27.

[267] Livingstone, *The Geographical Tradition*, 210.

inferior, or immoral) found expression in travel writing, exploration accounts, imperial maps, and scientific studies.[268] Lowell himself had of course trafficked in such deterministic analysis in his own early writing about the Far East, saying of the Japanese:

> The torpor of the East, like some paralyzing poison, stole into their souls, and they fell into a drowsy slumber only to dream in the land they had formerly wrested from its possessors. Their birthright passed with their cousins into the West.. … Artistic attractive people that they are, their civilization is like their own tree flowers, beautiful blossoms destined never to bear fruit.[269]

Lowell clearly carried this environmentally deterministic perspective and the concepts of cultural evolution from his Orientalist studies to his Martian studies, thus imbuing the dominant Martian landscape narrative with strong conceptual links to the emerging discipline of geography. It was precisely those geographical elements of its representations that elevated Mars above other astronomical subjects and prompted the fascination of both the European and North American publics.

Mars and the Future of the Earth

As shown throughout this chapter, astronomers frequently used terrestrial metaphors to explain the physical geography of the Martian world. From Arizona to Africa, the comparisons were frequent and numerous, establishing a powerful rhetoric

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[268] For a detailed treatment of this phase in geography's history, see Livingston, *The Geographical Tradition,* Ch. 7, "A 'sternly practical' pursuit: geography, race and empire."

[269] Lowell, *The Soul of the Far East,* 223-4, 225-6.

of analogy and familiarity between the two planets. Putting the analogies in context, we see that representations of Mars reflected in many ways the scenery well-known explorers and geographers had reported encountering in Egypt, India, and the American West. Lowell's and Todd's comments indicate that personal travel directly influenced scientists' beliefs about Mars. Even for those who had not traveled the world, however, the newsworthy exploits of irrigation engineers in imperial regions were common knowledge, easing audiences' acceptance of claims regarding an irrigated Mars.

The captivating and enduring construction of Mars as a dying desert world likewise drew from popular accounts of terrestrial landscapes.[270] Citing the geographer Huntington, Lowell linked his hypothesis regarding Mars' lost oceans to evidence about Earth's own desiccation: "The Caspian is disappearing before our eyes, as the remains, some distance from its edge, of what once were ports mutely inform us. Even so is it with the Great Salt Lake, the very rate of its subsidence being known and measured."[271] In arguing that Mars' continents had also begun losing their moisture, Lowell continued to echo Huntington's work on climate change, in which the geographer argued that many of the Earth's driest regions had once been much wetter, showing a trajectory of desiccation on Earth.[272] Not until 1924 did Huntington revise his hypothesis to acknowledge fluctuations or "pulses" in climatic

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[270] Markley's *Dying Planet* traces the trope of Mars as a dying planet up to the present day.

[271] Lowell, *Mars as the Abode of Life*, 122.

history, thus abandoning the idea that the process of climate change was linear in the direction of desiccation. The story of Mars thus intersected perfectly with a broad contemporary discourse regarding landscape and climate change on Earth.

Within this context, Mars functioned as a conceptual site of projection for existing geographical concerns. In Lowell's formulation, Mars essentially became a type of futuristic looking-glass, an indicator of Earth's destiny on its evolutionary trajectory.[273] Lowell's prediction that Earth was "going the way of Mars" and would eventually "roll a parched orb through space"[274] drew from and amplified a certain terror regarding aridification. In Huntington's hypothesis, several of Earth's great ancient civilizations had fallen when their climates began to shift toward aridity. If Mars was any example, the Earth could expect continued change, bringing a significant increase in the extent of the desert regions and, presumably, continued challenges to civilization. As Lowell wrote, in typically colorful prose, "Deserts already exist on the earth, and the nameless horror that attaches to the word in the thoughts of all who have had experience of them, or are gifted with imagination to conceive, is in truth greater than we commonly suppose."[275] The greater terror, of course, was the prospect that Earth's deserts would enlarge and increase their

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[272] Ellsworth Huntington, *Civilization and Climate,* 1st ed. (New Haven: Yale University Press, 1915).

[273] Lowell addressed this implication most directly in his last major book, *The evolution of worlds* (New York: The Macmillan Co., 1909). Strauss argues in *Percival Lowell* that Lowell saw this book and its argument as the culmination of his life's work.

[274] Lowell, *Mars as the Abode of Life,* 122, 124.

[275] Lowell, *Mars as the Abode of Life,* 124.

influence on the globe until Earth was as dry as Mars: "Pitiless as our deserts are, they are but faint forecasts of the state of things existent on Mars at the present time. Only those who as travelers have had experience of our own Saharas can adequately picture what Mars is like and what so waterless a condition means."[276] Mars thus inspired some dread. As American sociologist Lester Frank Ward put it,

> On Mars we can, as it were, see with our own eyes a race of vast antiquity and supreme wisdom, clinging desperately to the orb that bore it, half gasping for breath and hoarding every drop of its precious water, but doomed in the relatively near future to face the lingering death of a dying world. This is indeed sad, and it is perhaps still sadder to reflect that such is the fate of all life including that of our own globe and our own race.[277]

At the same time, however, Lowell's Mars was held up as an optimistic example of how to cope with landscape and climate change. For their part, the Martians had reportedly responded to their environmental crisis in the noblest, most ancient manner: by redirecting their limited water supply to its most efficient use through irrigation. In so doing, they had spurred their civilization to even greater advances, thus turning environmental challenges into evolutionary boosts. The story of dying Mars thus supported the view that civilization could be sustained in arid landscapes via science, technology, and organization, despite any cosmic inevitability of planetary demise. In this regard, the discussion about Mars more closely echoed the work of George Perkins Marsh, who rejected Huntington's climatic determinism

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[276] Lowell, *Mars and its Canals*, 157.

[277] Lester Frank Ward, "Mars and Its Lesson," *The Brown Alumni Monthly* 7 (1907): 164.

and insisted that man was an active agent in the modification of the Earth. His 1864 catalog of man's destructive impacts on the Earth, which inspired the first wave of conservation activism, highlighted especially the ways that man's technology could effect massive hydrological change.[278] Marsh's worry, then, was the Martians' supposed salvation.

Conclusion

As this brief discussion shows, the dominant constructions of Mars' physical geography played an important role in reflecting and reinforcing beliefs regarding landscape change around the turn of the twentieth century. The success of the Mars narrative put forward by Percival Lowell and his followers was largely based on its geographical characteristics. It is therefore appropriate to examine not only the character of its geographical-style representations, but also the significance of its geographical themes. At its most basic level, the astronomical story of Mars rested on the construction of analogies between its landscape and Earth's. In developing these comparisons, successful scientists and writers gave rise to the view of Mars as a miniature version of the Earth, complete with deserts, irrigation systems, and inhabitants. In so doing, they also allowed the red planet to become a powerful site of projection for existing concerns about Earth's own evolution and future.

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[278] George Perkins Marsh, *Man and Nature; or, Physical Geography As Modified by Human Action*, ed. David Lowenthal (Seattle and London: University of Washington Press, 2003 [1864]).

The fundamental construction of the Martian landscape in the 1890s as "artificial," or patterned by the activities of intelligent beings, altered long-standing analogies to include Earth's manmade structures as a point of comparison between the two planets. Where the inexplicably geometric appearance of the Martian surface had once defied analogy, Lowell successfully introduced the idea that Mars' physical geography could be equated with Earth's engineered or cultivated landscapes. In advancing this hypothesis, he gained the attention of popular audiences who quickly accepted the idea of an inhabited Mars. At the same time, Lowell managed to overpower most other explanations for Mars' physical appearance, thus constraining the scientific discourse.

Lowell's most powerful construction of the Martian landscape painted the planet as a site of tremendous aridity, nourished only by an extensive irrigation system. This representation of Mars as a desert planet relied on frequent and specific comparisons to individual deserts in Africa and Arizona, quickly introducing climatic stereotypes that circulated in much geographical literature at the time. The focus on irrigation, especially, concentrated on a theme that was then a staple of geographic interest in both Europe and North America. Lowell thus presided over a shift in the Martian narrative that saw strangeness converted to familiarity, as the planet's puzzling landscape geometry was said to reveal one of the oldest technologies known to man.

Intimately linked with the discussion of Mars' aridity was the commentary on its continually increasing aridification. Though there was no observational evidence whatsoever to support this claim, Lowell succeeded in painting the red planet as a lost paradise that was suffering the late stages of water loss and desert growth. Writers and audiences responded to this portrayal with very little hesitation, probably because it drew from the standard tropes of desiccation, despoliation, and mismanagement used to represent Earth's arid regions.

Although the dominant Lowellian narrative did not hold Martian inhabitants responsible for their planet's imminent demise, it nonetheless exhibited many of the same elements present in geographers' linking of terrestrial landscape with human culture. Following in the environmentally deterministic footsteps of the day's leading geographers, Lowell's assumptions about Martian climate led him to even greater assumptions about the probable intelligence and advancement of the supposed Martian inhabitants. Rather than being seen as dangerous leaps of logic, assertions in this vein were enthusiastically accepted by his readers. Similarly, Lowell used visible Martian landscape patterns to support his broad assumptions about Martian civilization, arguing that the complexity of the landscape indicated a certain level of sophistication for the invisible inhabitants.

All of these maneuvers employed standard geographical tropes that built on one another, quickly creating an unassailable portrait of the Martian landscape as familiar and Earth-like. In the process, these tropes also allowed Mars to become a

site of projection for terrestrial concerns. Terrors regarding Earth's aridification and dreams about human technological progress, for instance, were expressed and negotiated in arguments and speculations about Mars. As these hopes and fears regarding Earth's geographical change were projected onto Mars, the planet became sensationally popular, thus underscoring the relevance and significance of the Mars narrative well beyond the confines of disciplinary astronomy.

Outside the pages of the scientific journals and even outside the Sunday papers, fiction writers also began to use arid Mars as an allegorical setting for Western civilization's environmental challenges in the early 1900s. Though Lowell had depicted the Martians as responding to their crisis calmly and rationally, by increasing their social organization and developing fantastic new technologies, some fiction writers told a different story. In alternative scenarios, such as the well-known series written by Edgar Rice Burroughs, the planet was said to be plunged into global mayhem, with warfare, contests for resource control, and anxieties about possible catastrophe governing daily life.[279] H.G.Wells' characterization of the Martians as immoral parasites, happy to destroy their own planet and others in the quest for food, was equally dystopian.[280] First presented by scientists, soon sensationalized for presentation to popular audiences, and later modified by social commentators and

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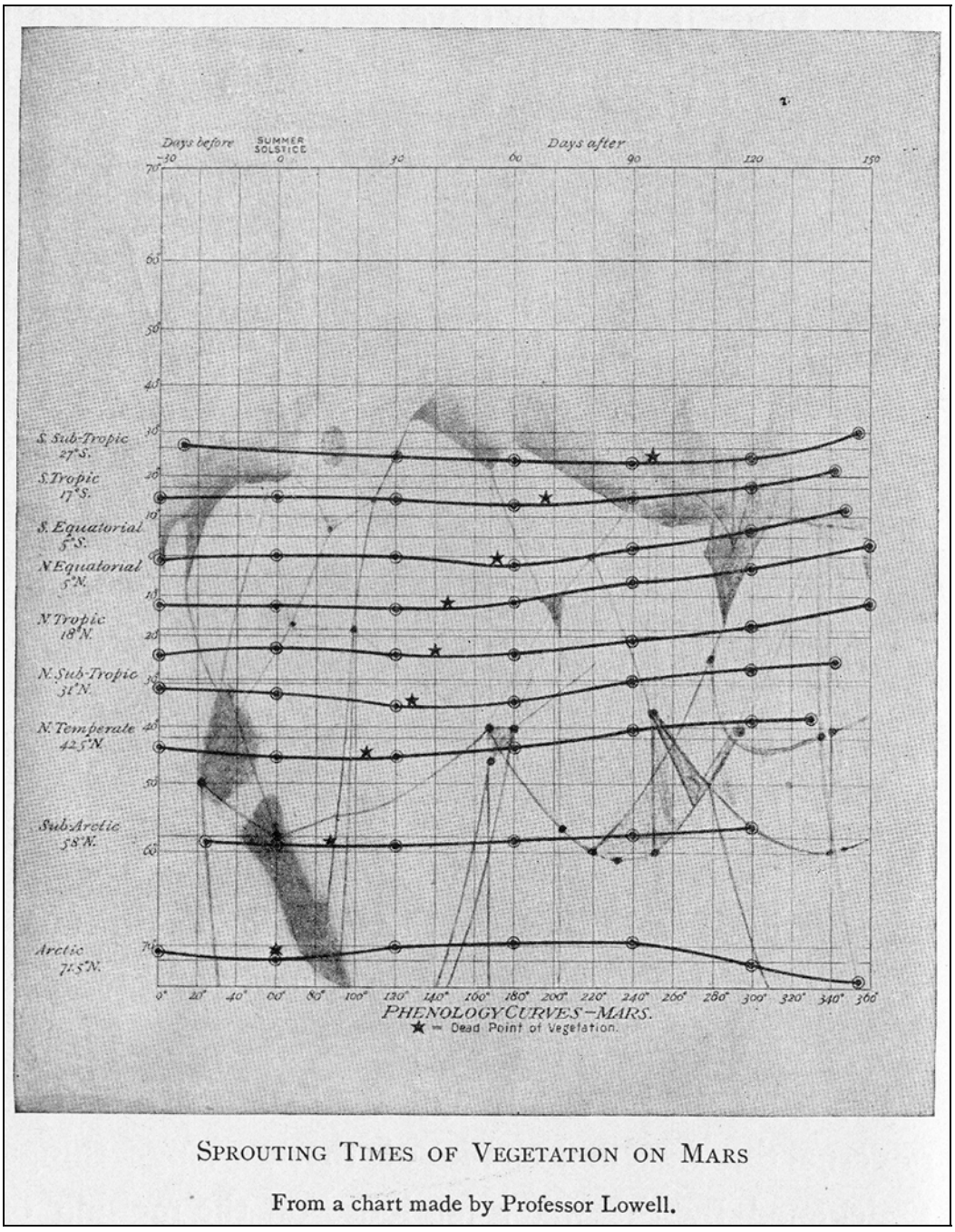
[279] Edgar Rice Burroughs, *A princess of Mars* (New York: Dover Publications, Inc., 1964 [1917]). (First serialized in *All-Story Magazine* in 1912.)

[280] H. G. Wells, *The War of the Worlds* (New York: Buccaneer Books, 1983 [1898]).

fiction authors, the tropes of landscape familiarity – of Mars as Earth – thus provoked a certain disquiet.

Figure 4.1 Data showing seasonal canal visibility, 1908



SPROUTING TIMES OF VEGETATION ON MARS

From a chart made by Professor Lowell.

Figure 4.2 Article from the *New York Herald*, 1906

NEW YORK HERALD, SUNDAY, DECEMBER 30, 1906.—MAGAZINE SECTION.

WILL the NEW YEAR SOLVE the RIDDLE of MARS?

Positive Assertion by Professor Lowell, Based on His Latest Discoveries, Indicate That Our Nearest Planetary Neighbor Is Peopled by a Race Superior to Mankind.

TWENTY-FOUR INCH TELESCOPE OF THE LOWELL OBSERVATORY, FLAGSTAFF, ARIZONA

DOME OF THE LOWELL OBSERVATORY, FLAGSTAFF, ARIZONA

PROF. PERCIVAL LOWELL

NATURAL LINES (CRACKS, RIVERS, ETC.)

ARTIFICIAL LINES (RAILWAYS, STREAMS, ETC.)

CHAPTER 5. A NEW MARTIAN CULTURAL GEOGRAPHY

Once the topic of Mars had been brought to the attention of mainstream audiences, popular texts increasingly began to speculate on the supposed Martians' appearance, nature, and customs, generally focusing on the ways they were expected to differ from humans. As the focus turned from Martian landscape to culture, dominant representations began to deviate further and further from accepted scientific knowledge, and Mars became a powerful pop culture topic. Just as was the case for the representations of Mars' landscape, the popularized representations of Martian culture also carried a geographical significance.

This chapter focuses on the Mars narrative that began to emerge in the early 1890s and continued through the first decade of the twentieth century. It shows that dominant representations of the unseen Martian culture, though they varied widely, were influenced by Social Darwinist philosophy and the Orientalist tradition of geographical writing about the non-Western Other. These undertones not only reflected the intellectual context in which astronomers and science writers were working, but they also invited and shaped popular interest in the subject of Mars as an inhabited planet. At the same time, the construction of a superior Martian in both scientific and popular texts and images indicates that the discourse surrounding Mars departed in significant ways from typical writing about the non-Western world. Though Martians were clearly presented as an essentialized Other (rather than some

utopian vision of the Western Self), their imagined supremacy over humans transcended the traditional narrative. Capable of transforming Mars through global engineering, gathering information about Earth through a powerful gaze, and sending signals across millions of miles of space, the superior Martian had no Earthly analogy.

Based on a comparison of audience responses to the new discourse, I argue that national context influenced the production and consumption of Mars geographies. While British audiences were rather cautious in their acceptance of the inhabited-Mars theory, American audiences enthusiastically embraced the extraterrestrial portrait painted by American astronomer Percival Lowell. The American willingness to consider the hypothetical Martian as a non-dangerous mentor indicates a broader reframing of the Western encounter with the Other. The Martian discourse thus reflects an American Orientalism that differed from the European construction in its lack of fear, prevalence of optimism, and focus on science and technology as cultural mediators.

Lowell's Evolved Martians

Percival Lowell's influential inhabited-Mars hypothesis relied in large measure on a widely-accepted theory of planetary evolution. By arguing that the red planet was physically older than Earth, Lowell established the basis for his interpretation that it was a dried-out desert world. At the same time, his reliance on

evolutionary theory introduced the idea that any Martian inhabitants must be more advanced than humans. According to Lowell, Mars' physical advancement would have produced a life-sustaining environment much earlier than the Earth. Any Martian civilization, then, would have had the benefit of extra eons in which to evolve, far outdistancing the evolutionary progress of Earth's own cultures. At the same time, the red planet's desiccation, presumed to be a geologically recent phenomenon, was said to have provided an extra evolutionary boost for the already-advanced Martians. The environmental challenge of water scarcity, Lowell argued, would have spurred natural selection of higher and better traits in the surviving Martians, thereby producing a deterministically evolved being unlike any on Earth: "In an aging world where the conditions of life have grown more difficult, mentality must characterize more and more its beings in order for them to survive, and would in consequence tend to be evolved. To find, therefore, upon Mars highly intelligent life is what the planet's state would lead one to expect."[281]

Lowell's assumptions about the evolution of an unseen Martian civilization were intertwined with the "proof" visible on the Martian landscape. The canals' straightness, global extent, perfect intersections, and regular variations led Lowell and others to accept that the Martians must be both organized and intelligent. In terms of intelligence, the geometry of the canals was considered verification of advanced mathematical understanding, the pinnacle of knowledge.

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[281] Lowell, *Mars and its Canals*, 382.

> There is little doubt now that Mars possesses vegetable, and perhaps animal life; but the question that interests humanity is, Are there intelligent beings there? The only important argument in favor of their existence is the presence of the canals. These canals are so long and narrow, straight and uniform, that they look artificial. If they are artificial, it is certain that their constructors possess a knowledge of spherical trigonometry, and considerable skill in the mechanical construction of surveying instruments, implying greater intelligence than that possessed by our ancestors a thousand years ago. It is doubtful if our progenitors in the year 900 A.D. could have built a perfectly straight road three thousand miles long, directed to a definite point, even if it had been across level country.[282]

Though no mention was usually made of Martian literature or arts, the red planet's technologies and engineering prowess were imagined to be unfathomably sophisticated: "Quite possibly, such Martian folk are possessed of inventions of which we have not dreamed, and with them electrophones and kinetoscopes are things of a bygone past, preserved with veneration in museums as relics of the clumsy contrivances of the simple childhood of the race. Certainly what we see hints at the existence of beings who are in advance of, not behind us, in the journey of life."[283]

In terms of societal organization, Lowell suggested the Martians had advanced beyond the need for petty squabbling and warfare. Upon the evidence of the global canal network, he pronounced that the red planet must be a utopia of sorts:

> Apart from the general fact of intelligence implied by the geometric character of their constructions, is the evidence as to its degree afforded by the cosmopolitan extent of the action. Girdling their globe and stretching from pole to pole, the Martian canal system not only embraces their whole world, but is an organized entity. … The first

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[282] Pickering, "The Planet Mars," 469.

[283] Lowell, *Mars*, 208-9.

> thing that is forced on us in conclusion is the necessarily intelligent and non-bellicose character of the community which could thus act as a unit throughout its globe.[284]

With each successive publication, Lowell seemed to become more and more certain of this pronouncement. In 1903, for instance, he reported a peculiar phenomenon in his observational data. Having regularly mapped a certain canal since 1894, he discovered that it actually seemed to show up in one of two slightly different positions, depending on the year in which his observations had been conducted. On this data, Lowell determined that he must actually be observing two separate, adjacent canals. The importance of this observation, he claimed, was the fact that the two neighboring canals never appeared simultaneously; meaning that one must always be dry while the other was supplied with water. Given that such phenomena could not be explained by simple meteorology, Lowell hailed this as an example of peaceful water-sharing.[285] This interpretation fit perfectly with his theory that climate change and water crisis were the source of societal advancement on Mars.

As an evolutionary wonderland of advanced technology and peaceful social relations, then, Lowell's Mars stood as an example and beacon for the Western world. Providing an example of Earth's likely future, Lowell argued that Mars should provide hope for those distressed by contemporary concerns such as the management of finite natural resources, the intricacies of American entry into global trade, and

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[284] Lowell, *Mars and its Canals*, 376-377.

[285] Lowell, "Bulletin No. 8."

domestic class warfare.[286] "In the Martian mind," he commented, "there would be one question perpetually paramount to all the local labor, women's suffrage, and Eastern questions put together – the water question. How to procure water enough to support life would be the great communal problem of the day."[287] As the importance of resource concerns began to outweigh political affairs, Lowell said, the evolutionary process would spur worldwide peace:

> War is a survival among us from savage times and affects now chiefly the boyish and unthinking element of the nation. The wisest realize that there are better ways for practicing heroism and other and more certain ends of insuring the survival of the fittest. ... Whether increasing common sense or increasing necessity was the spur that drove the Martians to this eminently sagacious state we cannot say, but it is certain that reached it they have, and equally certain that if they had not they must all die. When a planet has attained to the age of advancing decrepitude, and the remnant of its water supply resides simply in its polar caps, these can only be effectively tapped for the benefit of the inhabitants when arctic and equatorial peoples are at one. Difference of policy on the question of the all-important water supply means nothing short of death. Isolated communities cannot there be sufficient unto themselves; they must combine to solidarity or perish.[288]

Lowell posited that the looming environmental challenges of Earth's own desiccation would spur welcome advances in scientific knowledge and technological mastery. As Earth's environment went the way of Mars, so would its technological abilities. He encouraged his audiences to see in Mars' difficulties inevitable progress,

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[286] See Dolan, David Sutton, "Percival Lowell: the Sage As Astronomer" (Ph.D. Diss., University of Wollongong, 1992) on the subject of Lowell's political alignment with Roosevelt and the Progressive Party on these issues.

[287] Lowell, *Mars*, 129.

thus validating and reinforcing his support for technologically driven systems, global resource networks, and centralized social organization. While predicting these evolutionary advances, Lowell optimistically suggested they could be achieved even before a crisis point was reached, mainly by virtue of the lessons learned from Mars observation: "One of the things that makes Mars of such transcendent interest to man is the foresight it affords of the course earthly evolution is to pursue."[289]

Lowell's view of an evolutionarily advanced red planet became the dominant popular view of Mars, largely fueling the mania that spurred non-scientists to address the planet in mainstream genres like newspaper, magazines, general-interest books, encyclopedias, cartoons, and even songs, poems, and theatrical productions. Although many astronomers rejected Lowell's speculations about an advanced Martian civilization as unfounded, unproven, or illogical, many carefully refrained from dismissing the idea of Martian life altogether. Prominent American astronomer Newcomb, who insisted he was not convinced by Lowell's arguments, nonetheless admitted, "Life not wholly unlike that on the earth may therefore exist upon Mars for anything we know to the contrary."[290] Similarly, the Irish astronomer and writer Ball tried to dismiss sensational reports that regularly appeared in the newspapers, but stopped short of rejecting the possibility of Martian life: "though there may once have been, or though there may yet be, intelligent life on Mars, the laws of probability

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[288] Lowell, *Mars and its Canals*, 377-8.

[289] Lowell, *Mars and its Canals*, 383-4.

would seem against the supposition that there is such life there at this moment."[291] In these measured critiques, doubtful scientists found it difficult to temper the enthusiasm Lowell generated in the popular press.[292] By the time leading American astronomers started making more direct criticisms of Lowell in 1905 and 1907, it was too late to rescue the red planet from rampant speculation. Newspaper headlines touted the "vast engineering works"[293] completed by a Martian "race superior to mankind;"[294] magazine writers discussed "the things that live on Mars;"[295] and cartoons poked fun at the backward society Martians would presumably see when looking down at the Earth. (See Figures 5.1 and 5.2.)

The Martian Gaze

One of the primary tropes regarding Martian intelligence concerned the ability of the red planet's inhabitants to view and understand the Earth. This trope first began to take shape in early scientific descriptions of Mars' features. In considering

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[290] Cited in epigraph of Morse, *Mars and its Mystery.*

[291] Ball, "Mars," 205.

[292] For a discussion of the role of popularizers in both making and interpreting science for Victorian publics, see Bernard Lightman, "'The voices of nature': popularizing Victorian science," in *Victorian Science in Context* (Chicago and London: University of Chicago Press, 1997).

[293] Mary Proctor, "Martians Build Two Immense Canals in Two Years," *New York Times*, 27 August 1911.

[294] "Will the New Year Solve the Riddle of Mars?"

[295] H. G. Wells, "The Things That Live on Mars: a Description, Based Upon Scientific Reasoning, of the Flora and Fauna or Our Neighboring Planet, in Conformity With the Very Latest Astronomical Revelations," *Cosmopolitan Magazine* 44 (1908): 335-42.

the extent to which terrestrial analogy might be used to explain various characteristics of Mars – from its colorful shading to the changes in its white polar caps – astronomers adopted a habit of comparing their own view of Mars with the hypothetical view a Martian would have of the Earth. The famous English astronomer Herschel noted, for instance, that "the [Martian continents] are distinguished by that ruddy colour which characterizes the light of this planet (which always appears red and fiery), and indicates, no doubt, an ochrey tinge in the general soil, like what the red sandstone districts on the Earth may possibly offer to the inhabitants of Mars, only more decided."[296] Schiaparelli likewise remarked that the colors on Mars might be due to vegetation, but cautioned that it was difficult to be sure about this speculation: "In such a manner also would the flowers of the plants of the great steppes of Europe and Asia be rendered visible at the distance of Mars, – by a variety of coloring. ... But how difficult for the Lunarians and the Areans to be able to imagine the true causes of such changes of appearance, without having first at least some superficial knowledge of terrestrial nature!"[297]

This rhetoric of Earth's visibility from Mars was used in many arguments, including even those that argued *against* the similarity of the two planets. Despite often harboring opposition to the newly popular theory of Martian habitability, in fact, many astronomers nonetheless described a rhetorical Martian inhabitant in their

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[296] John F. W. Herschel, *Outlines of Astronomy*, 10th ed. (London: Longmans, Green, and Co., 1875), 338-9.

own writing. American astronomer Holden, for instance, was consistently antagonistic to Lowell's observation reports as well as his general hypothesis, once remarking that the extensive changes astronomers reported seeing on Mars had absolutely no comparison on Earth. In so doing, however, he asked sarcastically, "Is it conceivable that an observer on Mars, examining the earth in any part of its recent history, would have seen any such amazing topographic changes as we have this year observed?"[298] His use of phrasing that evoked the hypothetical Martian, of course, undermined his stated rejection of Lowell's ideas. Many other astronomers fell into this trap as well.

In its many variations, this powerful trope usually painted the hypothetical Martian as an intelligent, scientific astronomer, capable of casting a penetrating reverse gaze toward the Earth. Popular audiences seized on this image, embracing the idea that the Martians might know much more about humans than Earth's own astronomers knew about Mars. Such interest can be seen in one writer's comment in an astronomy journal targeted toward popular audiences:

> These facts … lead us to speculate as to the kind of inhabitants there may be upon that far-away world, and what they are doing; whether they are like ourselves. Are they devoted to science? Are they constructing immense telescopes and gazing at us, making maps of the Atlantic and Pacific Oceans and the eastern and western continents? Do they know whether, at the north pole of the earth, there is an open polar sea, or whether there is an undiscovered continent near the south

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[297] Schiaparelli, "The planet Mars," 723.

[298] Holden, "Note on the Mount Hamilton observations," 668.

> pole? Are they a race of great engineers, and do they construct public works on a gigantic scale?[299]

By the turn of the century, the trope of the watchful Martian had become so prevalent that it was regularly used as a lampoon device. Cartoons sometimes speculated on the wild images of Earth that would appear in a Martian telescope, as already shown in Figures 5.1 and 5.2. Newspapers filled extra space on their pages with quips about Martians astronomers, such as this example: "A telegram from Prof Lowell at the Flagstaff observatory says that the canals of Mars have been photographed by Lampland. We wonder if Mars is photographing our Panama Canal."[300] Even the more scientifically oriented astronomy journals occasionally participated in such humor. After an unseasonably late snowfall in England in 1908, for instance, *The Observatory* included a spoof story supposedly reprinted from the fictitious *Mars Wireless Intelligencer:* "Professor Highell, of Bannerpole, has observed on Terra a brightening of the tiny spot known as Albion, suggesting a fall of snow."[301] These amusements not only poked fun at the uncertainty astronomers expressed in their differing interpretations of Mars, but also reflected growing comfort with the idea that the red planet might host intelligent beings. It seems to have been commonly

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[299] H.C. Wilson, "Mars and his canals," *Sidereal Messenger* 8 (1889):14.

[300] Unlabeled newspaper clipping, 1905, in Percival Lowell MSS, Clipping Files 1894-1916, Lowell Observatory Archives.

[301] "Notes," *The Observatory* 31 (1908): 221. The reference to "Highell, of Bannerpole" is, of course, an allegorical reference to Lowell, who worked at Flagstaff.

accepted that if such beings existed, they must surely be looking at the Earth. (See also Figure 5.3.)

From the prevalence of gazing-Martian rhetoric came a fascination with the idea that inhabitants on Mars might also be trying to signal the Earth. One of the astronomical topics most quickly picked up by the popular press was the report of "projections" on the surface of Mars. Starting in the 1890s, astronomers occasionally claimed to see small bright markings on the dark side of Mars. These always occurred very near the line where sunset was falling on the Martian surface (called the "terminator" edge), leading astronomers to suggest that the islands of light might be high clouds or mountaintops illuminated by the lingering twilight sun.[302] Astronomers' initial uncertainty about this interpretation, however, allowed the newspapers to speculate that the fleeting bright markings were instead light-beams deliberately flashed as signals to the Earth. Astronomers' telegrams to the newspapers about their discovery of projections in 1892, in fact, launched the first explosion of popular interest in Mars in the United States. Though some astronomers lamented the sensationalism with which the story gathered pace, there was little they could do to stop the resulting mania. A note in the *Journal for the British Astronomical Association* could barely contain its disgust:

> If one may judge from the telegrams and articles which have appeared in the newspapers with regard to the present Opposition of Mars,

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[302] This explanation would account geometrically for the appearance of a bright light surrounded by darkness.

> astronomy is making great progress in popular interest, though much that has been written shows that the public still require further education. To begin with, it was evidently expected that Mars would do something extraordinary, – flash a congratulatory communication by the Morse code at least – to celebrate his coming successfully out of opposition. Then our American colleagues suffered many things of many reporters, and it is to be feared (or rather hoped) were grievously slandered by them. … [T]he leading idea in several papers seemed to be the prospect of starting an interplanetary telegraph.[303]

Despite British astronomers' protests, the damage had already been done. The Mars craze had officially opened in America, spurred by the idea that an intelligent race of Martians was trying to communicate with humans.

By century's end, newspapers and popular magazines were regularly reporting on Mars, including a broadened discussion of the possibilities of signaling between the two planets. Regular reports of "terminator projections," especially from Lowell Observatory, continued to fire speculations about the Martians' use of electrical light-beams. Though Lowell himself classified the projection phenomena as clouds,[304] his insistence that Mars hosted intelligent life certainly contributed to a popular willingness to believe them to be signals. The famous engineer and inventor Nicola Tesla fanned the flames in 1900 by claiming that he had detected an odd electrical transmission in his Colorado mountaintop laboratory. Claiming it could not be explained by the well-known effects of the sun, the aurora borealis, or the Earth, he determined it had likely come from Mars. The supposed message – "one, two, three"

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[303] "Notes: the Opposition of Mars," *Journal of the British Astronomical Association* 2 (1892): 477.

– not only confirmed a Martian knowledge of mathematics, he said, but also called for a response from humans. "Absolute certitude as to the receipt and interchange of messages would be reached as soon as we could respond with the number 'four,'" he claimed. "The Martians, or the inhabitants of whatever planet had signalled to us, would understand at once that we had caught their message across the gulf of space and sent back a response."[305]

Indeed, the public seems to have been captivated by the idea of sending a return signal to Mars, though it was hard to conceive of a technology or procedure that could produce a disturbance big enough to be visible from Mars. The idea of raising a huge flag or carving an enormous message into the Saharan landscape to reply to the incoming signals, first suggested in 1892,[306] fascinated audiences well into the first decade of the 1900s. As might be expected, astronomers actively rejected most of this speculation as sensational and impossible.[307] Astronomers' repeated dismissals, however, did not diminish popular writers' and audiences' enthusiastic projection of an active, scientific consciousness onto Mars.

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[304] Percival Lowell, "Explanation of the supposed signals from Mars of December 7, and 8, 1900," *Popular Astronomy* 10 (1902):185-94.

[305] Nikola Tesla, "Talking with planets," *Collier's Weekly*, 9 February 1901, 4-5.

[306] Ball, "Mars."

[307] Ball, Robert, "Signalling to Mars," *Living Age* 229 (1901):277-84.

Social Darwinism and Martian Determinism

In addressing the probable nature of these Martian signalers and gazers, Lowell linked his Mars hypothesis with a thinly veiled political viewpoint that added to its credibility. As Dolan has argued, Lowell saw it as his role as a scientist and intellectual not only to investigate the natural world but also to interpret and communicate its meanings to a wider audience.[308] His increasing alienation from the American scientific establishment and his diminishing professional reputation do not seem to have deterred Lowell in the slightest from continuing his observatory's work and his popular writing about Mars. To the contrary, he simply became more outspoken, more critical of his opponents, and more calculating in his claims, viciously dismissing those who could not conclusively "prove" that his theories were untrue. Pointing the finger at his critics, Lowell argued that those who did *not* write for nonscientific audiences actually committed the worst public disservice: "To set forth science in a popular, that is, in a generally understandable, form is as obligatory as to present it in a more technical manner. If men are to benefit by it, it must be expressed to their comprehension."[309] If we view Lowell's message and importance as primarily political, this behavior appears quite rational, as does his continued fame and popularity outside the disciplinary bounds of academic astronomy.

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[308] Dolan, *Percival Lowell*.

[309] Lowell, *Mars and its Canals*, viii.

We must investigate, then, the politics or worldview that lay behind Lowell's Mars claims. Painting desert Mars and its environmentally-determined culture as a futuristic vision of Earth, Lowell was heavily influenced by his belief in Spencerian philosophy and its concomitant theories of the unity of natural and social laws. Strauss's excellent biography of Lowell treats his commitment to Spencerian theory in great detail, identifying Lowell as "one of the last and most audacious exemplars of a characteristically nineteenth-century mode of inquiry. Among his predecessors were Alexander von Humboldt, whose five-volume *Cosmos* sought to explain the operation of the universe."[310] From Asia to Arizona, Strauss shows, Lowell was principally concerned with expanding upon Spencer's theory of evolution and the unity of the cosmos, as elaborated by Huxley, Fiske and Haeckel. For Japan, he attempted to characterize Asian development levels on a hierarchical scale "from savage to civilized;"[311] while for Mars, he turned to the nebular hypothesis to explain the planet's evolutionary progress, as described in Chapter 4.

Though Spencerian philosophy was then somewhat outdated as an explanation of the physical laws of the universe, its political utility lingered in a Social Darwinist vision – of racial hierarchy as natural law – that continued to resonate in geographical writing about non-Western cultures. Lowell's early East Asian travel writings clearly expressed a belief in environmental determinism that paralleled Ratzel's explanations

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[310] Strauss, *Percival Lowell*, 101.

[311] Ibid., 109.

of the geographic and climatic roots of cultural development.[312] Less well known, however, are Lowell's later lectures on the topic of American progress, which further developed these themes. In his view, American superiority was no less environmentally determined than Japanese cultural stagnation:

> That upon which we most pride ourselves, our shrewdness and our inventiveness is thoroughly climatic. We are quick because our nerves are tense through forces outside of ourselves. We are kept keyed up to our capacities, if not beyond them. Endeavor is of the very breath of our nostrils. There never, indeed, was a clearer case of adaptation to new conditions.[313]

Lowell thus characterized America's climatic debt exactly as did American geographer Semple: "[T]he Temperate Zones, whose climate avoids both these extremes and abounds in contrasts, whose summers are productive enough to supply food for the winter, and whose winters give both motive and energy for the summer's work, are richer in cultural possibilities and hence in historical importance."[314] In order to best serve the interests of the greater society, Lowell further argued in these lectures, the naturally best and the brightest must be allowed to maximize their talents

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[312] For a detailed discussion of the links made between climate and culture, see David N. Livingstone, "Tropical Climate and Moral Hygiene: The Anatomy of a Victorian Debate," *British Journal for the History of Science* 32 (1999): 93-110.

[313] Percival Lowell, "Oration on the Fourth of July at Flagstaff, Arizona," 1901, Percival Lowell Unpublished MSS, Lowell Observatory Archives. The converse implication of this praise for Americans, commonly expressed in this time period, was that peoples living in tropical or humid regions were sluggish, insipid, and incapable of higher social organization. See David N. Livingstone, "Climate's Moral Economy: Science, Race and Place in Post-Darwinian British and American Geography," in *Geography and Empire*, eds. Anne Godlewska and Neil Smith (Oxford and Cambridge: Blackwell, 1994), 132-54.

[314] Ellen Churchill Semple, *Influences on the Geographic Environment on the Basis of Ratzel's System of Anthropo-Geography* (New York: Henry Holt and Company, 1911), 629.

and wealth. He vigorously opposed immigration, the unionization of American labor, and the advance of socialism on the grounds that they would delay the natural evolution of a superior American "race," increase violence, suppress individualism, and reduce American society to its lowest common denominator.[315]

Such lectures clearly expressed the deterministic Social Darwinist stance that is embedded in Lowell's Mars writing. In his vision of Mars, every individual accepted his place (class) in society, acceded to the power of the state, and appreciated the societal leadership role of the upper classes. As impending environmental crisis was sure to hasten the competitive selection process, he further believed that those societies at the upper end of the racial hierarchy were destined to come out on top by virtue of their natural superiority.[316] Throughout Lowell's writing, noble high-class Martian civilization served as a laudable example of resource management and peaceful social organization: Lowell's prescribed remedy for the Western world's own ills. Lowell's representations of Mars thus served to validate a specifically Progressive political view. This political significance of Lowell's work perhaps clarifies what many historians have seen as his irrational devotion to speculative claims in defiance of the accepted professional standards of

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[315] See especially Percival Lowell, "Immigration Versus the United States: an Address Delivered at Phoenix, Arizona," 1916, Percival Lowell Unpublished MSS, Lowell Observatory Archives; Percival Lowell, "On the Portents of Socialism," 1910, Percival Lowell Unpublished MSS, Lowell Observatory Archives.

[316] Dolan, *Percival Lowell*.

scientific writing. It also justifies his use of moralistic and prescriptive writing styles – the same voice he had adopted for his books about Japanese and Korean culture.

If we re-evaluate Lowell's "message" about inhabited Mars in this context, we can better understand the reasons it appealed to widespread audiences, despite public skepticism from leading astronomers. Because of its deterministic and evolutionary significance, the story about Martian geography could be conceptually integrated into ongoing discussions about the nature of racial difference, the difficulties of cultural contact, the justifications for imperialism, and the role of science in guiding continued Western expansion.

Not only do we see these topics prioritized in sciences like the newly established discipline of geography, but we know they became subjects of public dialogue as well. It was not uncommon at this time for leading intellectuals to offer opinions on topics of such general interest, and Lowell's decision to cast the Mars news in these themes would not have been out of the ordinary in any way. Re-examination of the historical record, in fact, shows that it was these very geographical concerns that featured most prominently in popular representations of Mars. While most astronomers were engrossed by scientific questions such as the composition of Mars' atmosphere, the public was much more interested in social questions, such as whether Martian and human cultures could possibly communicate.

Beyond Lowell, several well-known figures in the United States and Britain also addressed Mars from these non-astronomical perspectives, helping reinforce a

nonscientific view of Mars' significance. British naturalist Alfred Russel Wallace, for instance, was so provoked by Lowell's theory that he was moved to write several essays and a book describing his objections.[317] In these, he vented most of his wrath on Lowell's assumptions about the ways civilizations respond to aridity. Though Wallace certainly addressed Lowell's scientific data in the process, he argued that environmental crisis leads to regional isolation, not to cooperation. Furthermore, he disputed that advanced technology can be produced by societies that do not have secure food surpluses and significant leisure time. American sociologist Lester Frank Ward, by contrast, seems to have accepted Lowell's hypothesis unreservedly. He commented that the eventual demise of the planet Earth, as foretold by Mars, nonetheless left room for hope: "the contrast with that old decadent orb that is now telling us its story, instead of depressing us, should inspire us with thankfulness that we are young, with faith in an unlimited future, and with buoyant aspirations for the progress of humanity."[318] British historian and writer H.G. Wells took up the subject of Mars in both fiction and nonfiction, addressing the many ways in which Martians could be expected to differ from humans. Though his nonfiction work dealt mainly with issues of how the planets' different environments would determine divergent

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[317] Alfred Russel Wallace, *Is Mars Habitable? A Critical Examination of Professor Percival Lowell's Book "Mars and Its Canals," With an Alternative Explanation* (London: Macmillan and Co., 1983); Alfred Russel Wallace, "Astronomy--the Solar System," in *The Wonderful Century*: *the Age of New Ideas in Science and Invention*,2nd ed. (London: Swan Sonnenschein & Co., 1903), 226-64.

[318] Ward, "Mars and its Lesson, 165.

physiology,[319] his famously chilling novel *War of the Worlds*[320] squarely confronted the possibility that the Martians' supposed technological superiority might actually mask an abject moral inferiority.[321] Other fiction writers likewise explored the possibility of Martian-human interactions, with American Edgar Rice Burroughs' serial adventure stories quickly becoming the most widely read. On Burroughs' Mars, the Martian environmental crisis had led to crippling inter-racial and inter-urban warfare on the red planet. Burroughs' hero, a "gentleman of Virginia" and Confederate soldier who had been unexplainably transported to Mars for ten years, helped save the planet with some good old-fashioned American valor.[322]

Overall, this influential writing primarily concerned itself with topics showing little or no congruence with astronomers' interest in the red planet. These works addressed instead the climatic determination of culture, the evolutionary roots of cultural progress, and the role of science in controlling or even preventing a Martian scenario on Earth.

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[319] Wells, "The Things that Live on Mars."

[320] Wells, *The War of the Worlds.*

[321] For more detail on how this anxiety was expressed in British fiction, see David Schroeder, "A Message From Mars: Astronomy and Late-Victorian Culture" (Ph.D. Diss., Indiana University, 2002).

[322] Burroughs' stories were first serialized in *All-Story Weekly* beginning in 1912. They were later collected into several novels, starting with *A Princess of Mars*.

Reframing the Encounter with the Other

The fervor of popular and intellectual response to Lowell's determinist vision of a technological, advanced, and politically Progressive Mars indicates that the planet's non-scientific meanings should be taken seriously. At a minimum, the popularized Mars narrative reframed geographical imaginations of the Western encounter with the Other, conjuring a variety of alternatives. The extent to which various authors and audiences engaged with these alternative imaginations suggests, furthermore, that national context influenced the production and consumption of Mars geographies.

The typical European construction of the non-Westerner, or the "Other," has long been characterized by Edward Said's concept of "Orientalism." In Said's formulation, Orientalism is a style of thought, representation, and engagement: "a way of coming to terms with the Orient that is based on the Orient's special place in the European Western experience."[323] Said originally focused on Europeans scholars' portrayal of the Middle East as similar, but inferior, to Europe in a multitude of ways. By rhetorically converting the unknown to the known, he argued, writers made the Orient understandable to their Western audiences at the same time they asserted their superiority and dominance over unfamiliar peoples, thus providing an epistemological mandate for imperialism and colonialism. Post-Said, other scholars have noted that Orientalist-style representation – the discursive construction of

geographical knowledge through uncritical repetition of simplistic yet powerful tropes and analogies – was not limited to the subject of the Islamic world nor to the texts of classical scholars.[324]

The powerful discursive constructions of Orientalism permeated even the geographic representations of inhabited Mars, despite the red planet's acknowledged physical separation from the terrestrial spheres of European influence. In terms of both procedure and content, astronomers and science popularizers clearly assimilated some Orientalist habits. As has already been noted, astronomers regularly employed simplistic terrestrial analogies to label phenomena they did not fully understand. The uncritical use of terrestrial vocabulary such as "polar caps," "canals," and "oases" began innocuously enough in reference to purely visual similarities. By the time the public began to take interest in the topic of Mars, however, such terms had already begun to produce a powerful imaginative geography of the red planet. Although astronomers had little concrete evidence regarding Mars' atmospheric composition or the nature of its surface features, the vocabulary that was already in place contributed strongly to Lowell's vision of a desert world with limited water sources. As one early

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[323] Said, *Orientalism*, 1.

[324] See, for example, Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992); Lisa Lowe, *Critical Terrains: French and British Orientalisms* (Ithaca, NY : Cornell University Press, 1991); Peter Bishop, *The Myth of Shangri-La: Tibet, Travel Writing and the Western Creation of Sacred Landscape* (London: The Athlone Press, 1989); Patrick Brantlinger, "Victorians and Africans: the Genealogy of the Myth of the Dark Continent," *Critical Inquiry* 12 (1985): 166-202.

opponent of the inhabited-Mars hypothesis pointed out, the word "canal" itself powerfully conjured images that could not necessarily be proven.

> It has been previously remarked that the name of 'canals' as applied to the dark streaks on Mars … does not really matter, the term being merely used in a technical way, and not as implying that the so-called canals are artificial productions or even water at all, and that the terms seas and bays are merely convenient ways of referring to these details, and do not in any way prejudge the question. I am afraid the explanation does not suffice to remove the impression. You cannot constantly allude to a man as 'that nigger,' however much you explain that you do not mean to imply anything about his colour, without creating an impression that he lacks something of desirable whiteness. … I fear the direction given to observation and deduction by the tacit assumption that the phenomena of Mars are due to water, all water and nothing but water, is somewhat injurious.[325]

Such simplifications of terminology, then, allowed audiences to conceive of Mars as a familiar world while also promoting a very specific view of its geography.

The creation of a geography for Mars also exhibited Orientalist traits in that it produced an image of the planet as being alien and impenetrable while at the same time open to a scientific gaze. Newspapers were fond of pointing out how strange a place Mars would seem to any human who managed to visit, as in this list of things "men of the earth might do on Mars": "A baseball player could knock a baseball the distance from the Battery to City Hall. A gunner handling a 16-inch gun could shoot the distance from New York to Poughkeepsie. … Men could run almost as fast as horses run on the earth. In case of fires men might jump from third-story windows

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[325] Holmes, "The canals of Mars," 301-2.

without injury."[326] The editor of *Harper's New Monthly Magazine* also wrote of Martian strangeness: "[The Martian] may, indeed, have four dimensions instead of three, and instead of five senses a dozen, and among them common sense. … All his conditions are probably totally different from ours. Our vices may be his virtues."[327] In these terms, Mars sounds like the classic antipode – a place of utter opposites in every dimension. Just as in the essentialist descriptions of the Islamic world that Said analyzed, Mars was said to be fascinatingly strange.

At the same time, however, the frequent descriptions of Mars implied that astronomers had conceptual control of it. Every scientific report – even those emphasizing its perplexing strangeness – indicated that Mars was open to scrutiny. Much was made of the fact that Mars had no significant clouds and was therefore visible in its entirety, unlike cloudy Earth, which would appear shrouded to a hypothetical outside observer. According to Lowell, "one of the striking things about the planet's features is their patent exposure to our sight. Except in the winter time of its hemisphere or in the spring after the greatest melting of the polar cap, nothing seems to stand in our way of an uninterrupted view of the surface, whether in the arctic, temperate, or tropic zones."[328] Again, this exhibits one of the hallmarks of Orientalist writing: use of a rhetoric that emphasizes the visibility of the region in

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[326] Edward S. Morse, "My 34 Nights on Mars: How Prof. Edward S. Morse Has Been Studying the Great Planet Through the Lowell Observatory Telescope and His Own Interesting Account of What He Discovered There," *The World Magazine*, 7 October 1906, 9.

[327] Charles Dudley Warner, "Editor's Study," *Harper's New Monthly Magazine* 93 (1896): 639.

question. Laid bare for the outside observer, the place is presented as if it is completely accessible, despite its mesmerizing peculiarities. The fact that astronomers used impressive telescopes to effect a quintessential all-seeing scientific gaze only served to reinforce the power of this rhetoric. In the sensationalist language of the Sunday papers, the gaze was reported thus: "Mars stands in imminent danger of becoming known. The great telescopes of the earth have been focussed on the red star in the southeastern sky uninterruptedly for the past two months and delicate photographic apparatus has made many new exposures."[329] The creation of an imaginative geography of Mars – through the uncritical repetition of simplistic tropes implying both familiarity and difference and through the use of a rhetoric of scientific objectivity – then, surely drew on Orientalist discursive practice to some extent.

Despite its many similarities with writing in the Orientalist tradition, however, the scientific and popular narratives regarding Mars also differed in significant ways that served to fundamentally reframe the Western encounter with the Other. Unlike the Orientalist propensity to discursively *erase* existing cultures from a foreign landscape,[330] the Mars narrative paradoxically *projected* unseen inhabitants. The map of Mars, in fact, was once said to be "too full" – with "none of the tantalizing

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[328] Lowell, Mars and its Canals, 85.

[329] "French clergyman combats theory."

blank spaces" that exist on Earth's map.[331] Regardless of the fact that Western astronomers had actually constructed the "fullness" of this map in a blatantly territorial struggle (see Chapter 2), the post-1900 discourse indicates that Mars was no longer considered a conquerable or available territory. Astronomers built their prestige by over-acknowledging the perceived Martian presence in their canal-filled maps, not by conceptually minimizing it.

Even more significantly, the Martians filling the map were widely said to be superior to humans. Lowell's emphasis on Mars' evolutionary advancement, as discussed earlier in this chapter, had painted a colorful picture of the advanced Martian. Popular writers seized on his suggestions, regularly characterizing Martians in terms of their advantages over humans. Wells claimed, for instance, "The Martians are probably far more intellectual than men and more scientific, and beside their history the civilization of humanity is a thing of yesterday."[332] Such statements were ubiquitous in the popular press, providing a sharp contrast to the discourses that traditionally characterized "savages" or "natives." Though typical Western writing sometimes praised the civilizations of the Other, any compliments were generally focused on a mere exotic charm or on a long-lost, glorious classical past. Present-day

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[330] Simon Ryan, "Inscribing the Emptiness: Cartography, Exploration and the Construction of Australia," in *De-Scribing Empire: Post-Colonialism and Textuality*, eds. Chris Tiffin and Alan Lawson (London: Routledge, 1994), 115-30.

[331] Brewster, "The earth and the heavens," 262.

[332] Wells, "The things that live on Mars," 342.

occupants of the land were simply never characterized as "far more intellectual and scientific" than Westerners in any Orientalist writing.

In addition, the imagination of a reverse gaze attributed remarkable abilities of self-representation to the supposed Martians. As compared to the supposed lack of subjectivity afforded to the Other in most Orientalist writing, the Martians' representational ability was remarkable. The signal-sending inhabitants of the red planet not only knew beyond a shadow of a doubt that Earth hosted intelligent beings, but had also devised a way of making their presence known across millions of miles of space. The laughable observers on the Earth, on the other hand, could not even agree as to whether they were witnessing signals or natural phenomena. And even if they *were* signals, humans could not envision a plausible way to send a response or determine what to say in reply to the incomprehensible incoming signals.[333] The Martian Other thus outranked the Western astronomer and his audiences in terms of subjectivity, technology, intelligence and organization.

Mars and the American Geographical Imagination

Part of the significance of this reframing of the non-Western Other can be read through audience response. By far, the most enthusiastic reaction to Lowell's inhabited-Mars hypothesis came from popular audiences within the United States.

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[333] Nikola Tesla, "Signalling to Mars – a problem of electrical engineering," *Harvard Illustrated*, 1907.

That is not to say that European newspapers, journals, and book publishers were not also interested in his work, but he never achieved similar levels of acclaim outside his home country, despite publicity efforts. A German publisher, for instance, declined to undertake translation of Lowell's books because his theories were "amongst some German astronomers considered to be not on a scientific basis."[334] This sentiment seems to have prevailed in other European nations as well, particularly Britain. The British astronomical establishment had long denied the existence of canals or inhabitants on Mars, starting with the Schiaparelli-Green debates of the 1870s. By the time Lowell entered the scene, he found a number of British astronomers to be his most vocal critics and accordingly spent much effort trying to convince them to accept his findings.[335] The British newspapers were just as interested in Lowell's discoveries as the American papers, as evidenced by their attempts to gain exclusive publication rights,[336] but more often than not printed his reports with a critical spin that acknowledged British astronomers' vigorous skepticism.

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[334] Herman Zeiger to Percival Lowell, 13 April 1909, Percival Lowell Correspondence, Lowell Observatory Archives.

[335] Lowell corresponded actively with E.W. Maunder, of Greenwich Observatory, and E.M. Antoniadi, of the British Astronomical Association, directly engaging them in debates over his work. He also presented lectures to London's scientific societies on several occasions, usually to a hostile or lukewarm reception.

[336] London's *Daily Mail* tried without success to get an exclusive on Lowell's 1907 photographs, probably prompting his remark in a personal letter that "The world, to judge from the English and American papers, is on the qui vive about the expedition as well as about Mars. They send me cables at their own extravagant expense and mention vague but huge (or they won't get 'em) sums for exclusive magazine publication of the photographs." Percival Lowell to David Todd, 26 July 1907, Percival Lowell Corresondence, Lowell Observatory Archives.

In the United States, on the other hand, sensationalism ran rampant. On the basis of his theory's popular success, Lowell regularly spoke to packed lecture halls across the East Coast, received praise-filled reviews, enjoyed hearty book sales, and became a minor celebrity. His obituaries all noted this popular success, praising Lowell's ability to reach American audiences: "While it is true that his astronomical theories scandalized staid old scientists, at the same time they attained a hold on the popular imagination which has never been loosened. … They did more to popularize the study of astronomy than all the college courses could have done in a hundred years."[337] American newspapers printed Lowell's circulars without criticism, ran speculative stories about the Martians and published Mars-related illustrations and maps in full-page formats to catch readers' attention. American highbrow magazines took the inhabited-Mars hypothesis seriously, and American fiction established a new genre to explore its imaginations of distant Mars. This outpouring of enthusiasm for Lowell and the Martians shows that the Mars mania was primarily an American affair. Although sensational news stories and popular enthusiasm occurred elsewhere, the phenomenon of American popularization was unmatched.

Since Lowell was driving the discourse primarily on the basis of American audiences' support, the reframed Martian Other should be contextualized as a specifically Lowellian, American construction. For Lowell's part, it cannot be

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[337] "The Man Who Explored Mars," 2 December 1916, unlabeled obituary, Clipping Files 1894-1916, Lowell Observatory Archives.

ignored that he carried his Orientalist experience into his science. His own encounter with the Japanese and Korean Other, while certainly conditioned by an essentialist, deterministic perspective, was nonetheless free of the fear that encumbered European encounters with Africa and the Middle East. In this regard, Lowell's views reflected a broader, westward-facing American Orientalism that Said identified as fundamentally different from the European case: "Americans will not feel quite the same about the Orient, which for them is much more likely to be associated very differently with the Far East. … To speak of Orientalism therefore is to speak mainly, although not exclusively, of a British and French cultural enterprise."[338]

American Orientalism, if it can even be properly termed as such, was concerned much less with maintaining "the pattern of relative strength between East and West"[339] than with using science and technology "to define and contain a world in which the American presence was rapidly expanding."[340] As Susan Schulten has argued, the discipline of American geography saw its turn-of-the-century mission as the application of scientific expertise to questions of commerce and politics. Modifying the environmental determinism they had first adopted from European geographers, American academics began to treat cultural difference as the product not of climate and race, but as the product of climate and commerce: "This was a world

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[338] Said, *Orientalism*, 1 4.

[339] Ibid., 6.

[340] Susan Schulten, *The Geographical Imagination in America, 1880-1950* (Chicago and London: University of Chicago Press, 2001), 13.

organized around commercial potential rather than racial difference."[341] In the Philippines, for example, geographers helped cast the American imperial effort as an essentially commercial enterprise. The moral imperative of confronting, reforming, or even understanding the racialized Filipino Other was accordingly presented to the public as a secondary benefit of commercial activity, rather than a point of focus.[342]

The American encounter with the Other was thus more optimistic and less fearful than Europe's, perhaps explaining why the Mars mania resonated so much more powerfully with American audiences. In merging a calm scientific curiosity with his Progressive political view, Lowell created a Martian Other that implied an enormous power imbalance yet inspired no real panic. A prolific popular astronomy writer, Garrett Serviss, captured the excitement of American audiences in this characterization of Martian superiority:

> The Martian intelligences might look upon us as we look upon monkeys in a menagerie, and their learned doctors might say: 'See what we were like once! These creatures have a gleam of our intelligence, and their limbs and sense organs indicate the line of evolution that ours have followed. They even show the germ of some of our most wonderful organs in their growing sensitiveness to electric forces. Give them time, and place them amid our surroundings, and who knows but that they might develop electro-magnetic vision, electro-magnetic hearing and electro-magnetic muscular control?

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[341] Schulten, *The Geographical Imagination*, 13.

[342] Julie A. Tuason, "The Ideology of Empire in National Geographic Magazine's Coverage of the Philippines, 1898-1908," *Geographical Review* 89 (1999): 34-53.

> They might even discover the secret of using inter-atomic energy, which has saved us.'[343]

In the American construction of Mars, the Other's technological superiority was a trait to look up to, to emulate, and to use as a guide. This was of course very different from the British construction, perhaps best exemplified by Wells' terrifying depiction of Martian techno-droids laying indiscriminate waste to the English countryside during their march on London in *War of the Worlds.*[344]

As expressed in the American enthusiasm for superior Martians, science and technology were constructed as devices of unification and progress, rather than conflict or domination. The Lowellians saw the Martians as role models for environmental and social control. At the same time, they uncomplicatedly acknowledged that the Martian behind the telescope knew more about Earth than the American or British astronomer could claim to know about Mars, that the Martian canal engineer had achieved unthinkable levels of earth-moving and water-controlling, and that the Martian signal-makers had harnessed technologies that were still in their infancy on Earth. Driven by the latest science, the Lowellian narrative was considered no less "real" than the speculative reports from the Philippines or from the Caribbean, thus reframing the Other as a benign fellow in the universal goal of economic and technological progress.

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[343] Garrett P. Serviss, "Professor Lowell's Last Conclusions About Life on Mars," *New York City American*, 10 December 1916.

[344] For examples of the way these anxieties were expressed in British fiction, see Schroeder, "A message from Mars."

Conclusion

Just as was true for representations of the Martian landscape, significant meaning was carried in the portrayal of Mars' cultural characteristics. As a dominant narrative emerged to represent the red planet at the turn of the century, its non-scientific themes provoked the most sustained reaction from intellectuals, general-interest writers, and popular audiences. Driven by Lowell's hypothesis, the primary relevance of this narrative can be found in its underlying political commentary on geographical topics.

The evolved Martians, as described by Lowell and embraced by the public, were said to have coupled their natural biological evolution with impressive social advancement. As their world aged and their climate suffered, these highly developed beings had supposedly learned the secrets of global organization, world peace and technological supremacy. Not coincidentally, these characteristics perfectly matched the ambitions of Lowell's own Progressive politics. He thus can be shown to have developed his scientific claims about Mars in sympathy with his own political beliefs, finding support from audiences that shared those same views.

Just as the Lowellian vision of Mars communicated a political ideal, it also encapsulated some of the leading ideas from the geographic philosophies of their time. The application of environmentally deterministic concepts and climatic explanation, particularly, were central to Lowell's arguments about the probable cultural scenario on Mars. These themes were also addressed directly by many of the

non-scientific commentators who entered into the speculative discussion over Mars. The importance of this link cannot be overstated. The advancement of Martian beings made sense to general audiences only because they accepted deterministic philosophy and Social Darwinist politics. Thus re-contextualized, the dominant Mars narrative can be seen to have operated on multiple levels, most of which had nothing to do with the technical or evidentiary concerns of astronomical science.

The greater importance of Mars' cultural representations lay in their ability to reframe the Western encounter with its cultural Other. The projection of intelligent beings onto Mars clearly drew in some ways from the Orientalist tradition of representing the Middle East as Europe's polar opposite. In establishing a powerful imaginative geography for Mars, however, many writers enthusiastically reframed the comparison, casting the Martian civilization as superior to the Earth's Western cultures. The trope of the reverse gaze, which posited a Martian observer possessed of the scientific desire and technical ability to observe Earth from afar, was only one of the ways in which the imagined Martians were represented as superior. The assumed facts of Martian evolution were also said to have endowed them with physical, social, intellectual, and technological gifts that far outstripped any known to exist on Earth.

Different audiences, however, reacted to these constructions with differing levels of enthusiasm and skepticism. By far, the most passionate response to the Lowellian narrative came from American audiences, who took to the deterministic

representation of an incredibly superior Martian with very little of the fear that was expressed in other national contexts, such as Britain. This phenomenon can be explained partially by examining the ways that Lowell's specifically American view of Orientalism and the Other was communicated in his claims about Mars. The American interest in commerce and technology as guides to cultural contact, for instance, differed significantly from the European model of racial separation. As Lowell took up themes of cultural contact that he had already considered during Orientalist travels to the Far East, he automatically made them palatable for American audiences in ways that never quite appealed to their European counterparts. The construction of a cultural geography for Mars, steered by the American Orientalism of Lowell and sensationalized by the reaction of his American audiences, thus reframed the cultural encounter with the Other in significant ways.

Figure 5.1: Cartoon from *Eastern Utah Advocate*, 1908

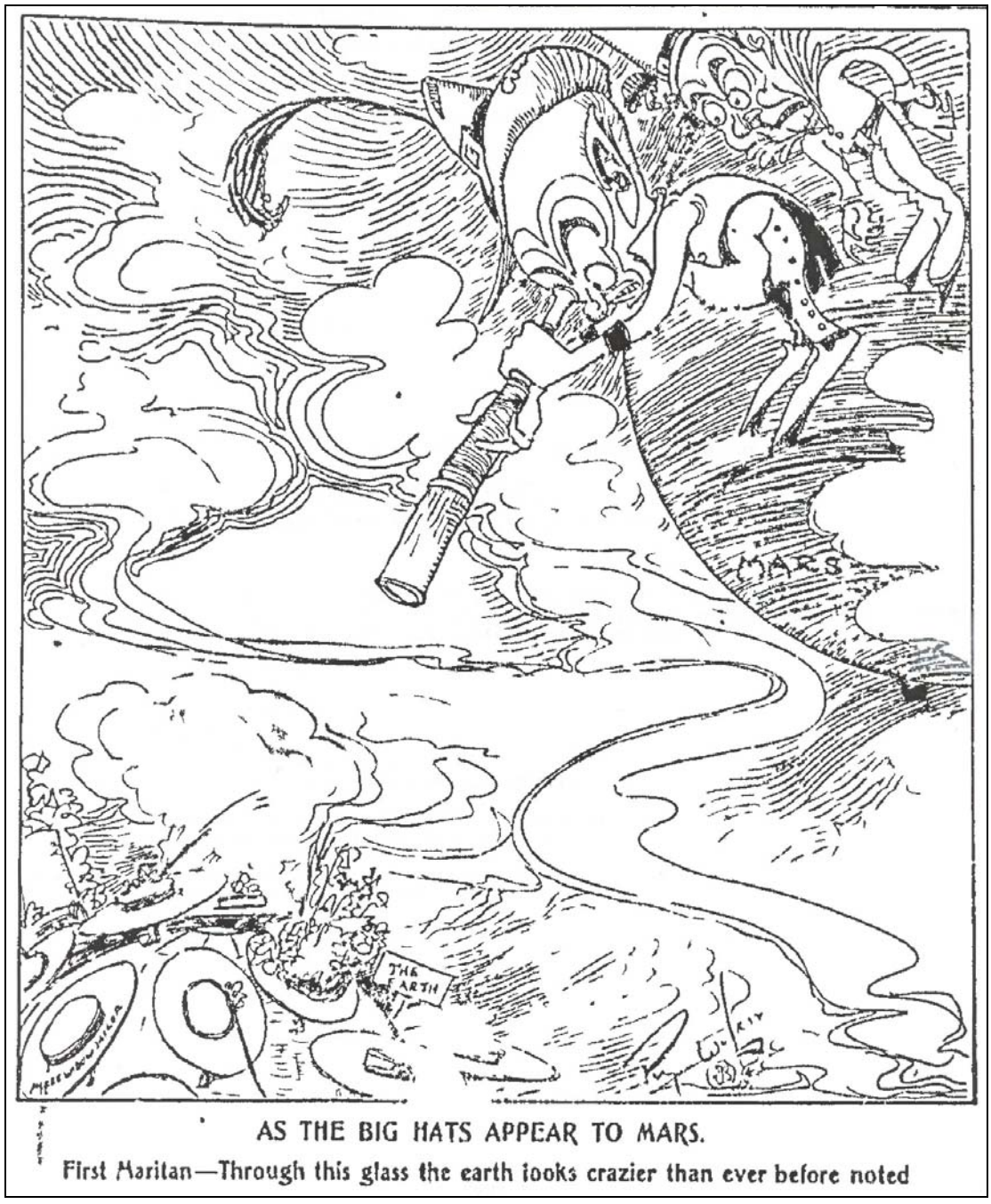


Figure 5.2 Cartoon from San Francisco Examiner, 1892

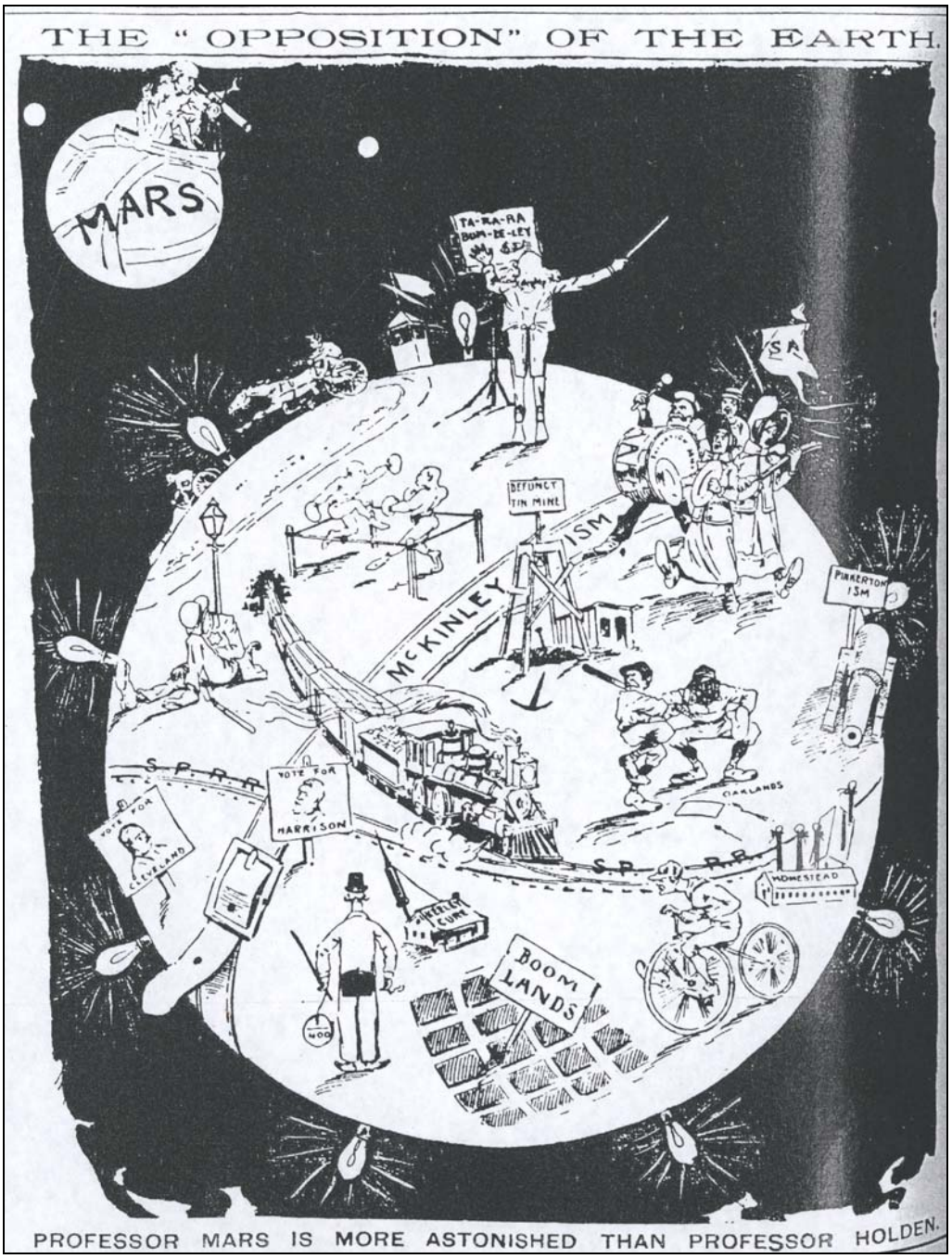
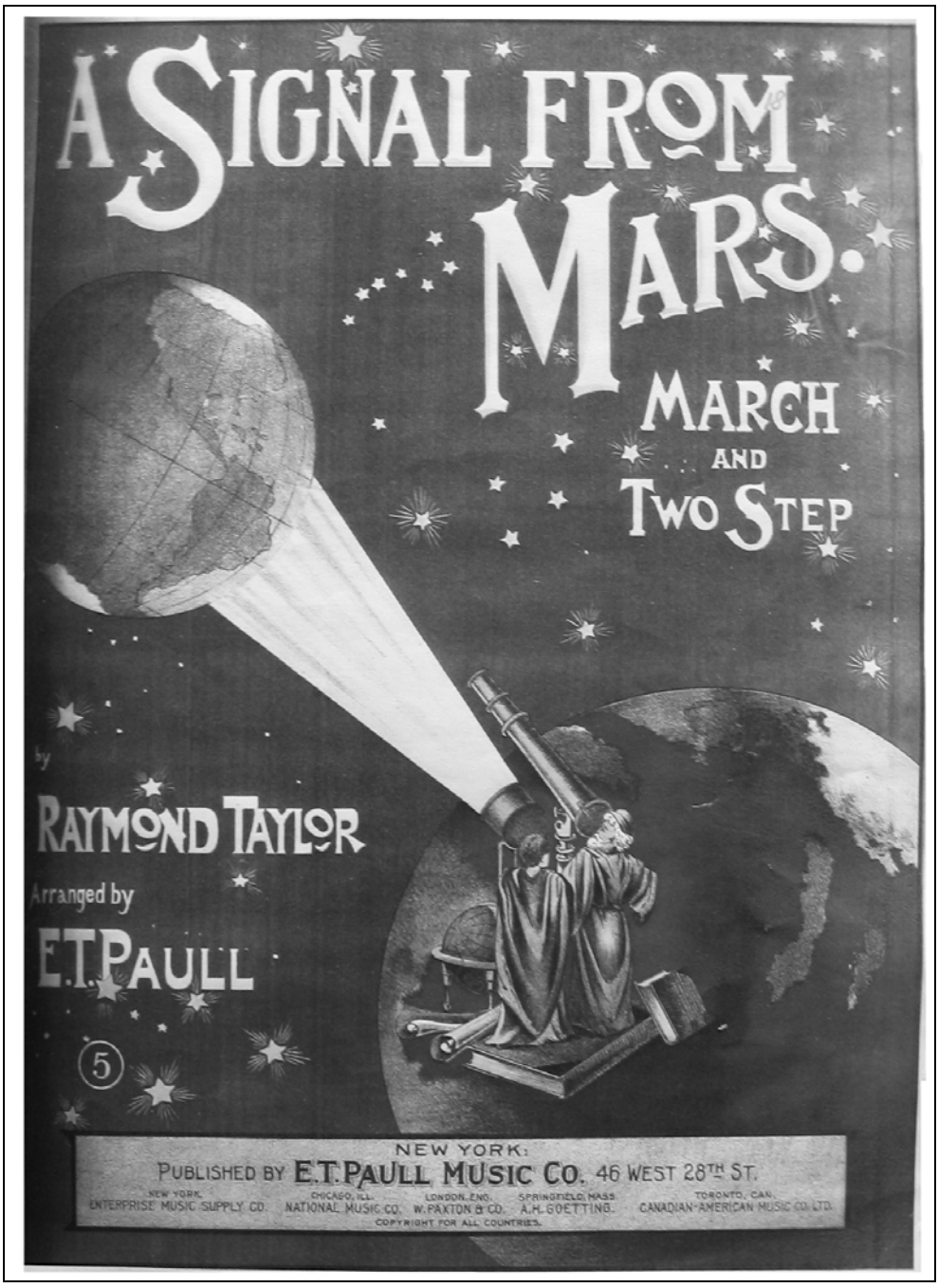


Figure 5.3 Sheet music cover, 1901



CHAPTER 6. CONCLUSION

The planet Mars has fascinated sky-watchers for centuries. Its unusual red color and seemingly erratic motion in the night sky have inspired superstitious explanations and mythological interpretations since ancient times. Even with the introduction of increasingly powerful optical devices like the telescope, early modern astronomers still struggled to explain why Mars occasionally appeared to stop and then move temporarily backward in its otherwise fixed path through the stars. Kepler finally decoded these movements in the seventeenth century, showing that they proved the elliptical nature of planetary orbits and validating Copernicus' theories with a certainty that helped overthrow the old Ptolemaic paradigm. Mars thus played an important role in the ascendancy of mathematical geometry as one of the basic pillars of the "scientific revolution" as well as of the reopening of ancient metaphysical debates concerning the plurality of worlds and the uniqueness of man.

Against this scientific and cultural backdrop, the astronomers of the nineteenth century pursued the red planet relentlessly, using ever-more sophisticated equipment and techniques to view and characterize its fundamental physical qualities. The process by which their endeavors eventually launched a powerful Mars mania is a complex story, in which scientists, popular audiences, and media outlets were engaged in the production of geographic knowledge for a planet so distant that no human could seriously consider visiting. This complicated geography of Mars, established by astronomers and their audiences, took place entirely beyond the

bounds of disciplinary geography. As the preceding chapters have shown, however, the development of the Mars mania was integrally tied to the development of more conventional forms of geographic knowledge during the same time period. By identifying and interpreting these links, I have illuminated an imaginative geography for Mars that engaged critically with geographical ideas, expectations, and knowledge about Earth.

Producing a Geography for Mars

Just a few decades after the consensus Western scientific view had determined that Mars was not a cloudy planet with a continually changing aspect, Schiaparelli reported his observations of the Martian "canali" in 1878. His radical augmentation of the planet's known surface features had two significant impacts on the study of Mars. First, it defined a new class of linear markings as the most prominent features of the Martian surface. Second, it introduced the possibility that Martian geography was extensively similar to terrestrial geography. The first impact induced numerous professional and amateur astronomers to begin looking for Martian canals over the next several decades. The second impact attracted the attention both of scholars outside the discipline of astronomy and of popular audiences that were fascinated by the possibility that Mars could be inhabited. Schiaparelli's revised Martian geography thus injected new momentum into the quest to view and know Mars. After 1878, astronomers set themselves to the task of producing new knowledge about Mars; popular writers quickly interpreted their findings for the benefit of non-

scientific audiences; and the reading public then eagerly consumed these interpretations within the broader cultural, intellectual and political contexts of late nineteenth century life.

The linear waterways that dominated Schiaparelli's map had not appeared on any previous maps of Mars, and they quickly became the subject of significant attention and controversy. Though Green and his British supporters argued they were probably representational artifacts caused by the artistic misuse of dark lines, a much more intriguing interpretation held them to be narrow canals that had never before been seen. This interpretation was widely credible because Mars was in fact very difficult to observe. When scrutinizing the red planet, astronomers were usually working at the limits of vision and were hard pressed to say with any certainty how many permanent surface features they were actually seeing, if any. To complicate matters, the variability of weather conditions, equipment quality, and individual eyesight made it impossible for two observers to report the same results, even when they were working at the same time or in the same location. These circumstances made it easy for many astronomers to accept the possibility that Schiaparelli's southern location, powerful telescope, and acute vision had allowed him to see features invisible to most others.

The simple geometric shapes – both lines and circles – that began to cover the post-Schiaparellian Mars maps are now thought to have been produced by the human eye's tendency to simplify imperfectly seen complex shapes. The pre-existing convention of recording Mars observations in cartographic format, however, ensured

that these shapes would persist in the scientific record, despite the difficulties of seeing them in the first place as well as the inconsistencies of their visibility to different observers. Mars maps provided a ready guide for future astronomers, who used them to confirm their own blurry views of the planet and reinforce their certainty that the hazy shapes they perceived were most likely lines or circles. If an astronomer found he could not see a given feature that appeared on existing maps, for instance, he quickly assumed that his weather, telescope, or eyesight had compromised his ability to view it clearly. The visual authority of the cartographic format prevented the conclusion that the feature in question did not exist. In this sense, the canals were essentially artifacts of the observation and recording process.

The cartographic process was also instrumental in shaping the widely accepted assumption that the lines or canals formed an extensive geometric network. In order to make a contribution to the study of Mars after 1878, it was no longer sufficient for an astronomer to report his own observations of the planet from a given night and location. To match and build upon the comprehensiveness of Schiaparelli's effort, it became desirable for astronomers to work in coalition to build composite views of the planet's features. The British astronomical community, as an example, efficiently organized and compiled the work of multiple astronomers into a single view of the Martian surface after each period of planetary opposition. Within this cooperative process, individual astronomers could not gain prestige other than by adding new features to the map. There was no incentive for reducing detail or removing features from the existing maps.

As individual features were observed, reported, and then projected onto the map's graticule, a detailed geometric network of interconnected lines took shape. Although no astronomer ever reported observing this network as a whole through the telescope, the network nonetheless came to be seen as the definitive reality of Martian geography. The process of cartographic projection, whereby numerous individual lines and circles – themselves the artifacts of visual observation – were conjoined in a convincing visual display, created a powerful cartographic artifact that fueled scientific and popular imaginations alike. The visual authority of maps in general induced a ready acceptance of this artifact, with most scientific attention focused on identifying the location and nature of various canals. Little effort was spent investigating the question of whether the network existed in the first place. It appeared on every map of Mars after all; therefore, it must certainly exist. The map's power to condition acceptance of the canal network is underscored by the fact that belief in the canals began to subside at exactly the same time the map began to lose its perceived objectivity alongside astronomical photography.

The race to add features to the Mars map also induced a territorial scientific competition among European astronomers, laying a foundation for the extent to which Martian geography would be seen as similar to Earth's. Criticism of the de-Anglicized nomenclature and high-contrast coloration in Schiaparelli's 1878 map took a decidedly nationalistic tone, with English astronomers acting swiftly to protect the prestige of their compatriot Green. Lowell later brought American astronomers into the fray by adding unprecedented numbers of canals to the map and then

criticizing English astronomers for their inability to see these new features. Such territorial wrangling over what was essentially an un-viewable landscape that took all of its meaning from observational and representational artifacts had a decisive impact on audiences' perceptions of Martian geography. As far as the map of Mars was subject to competition among nations, it could be imagined as a real physical landscape, analogous to Earth's own.

Through cartographic projection and scientific competition, then, the canal network grew and became more complicated, begging explanation. In interpreting and presenting the meanings of their observations to curious and attentive audiences, astronomers and popular science writers turned to geographic reasoning and geographic representational modes to cultivate legitimacy. Drawing evidentiary standards and analytical methods from the observational sciences, astronomers and science writers established unshakable analogies between Martian and terrestrial geographies. Most importantly, astronomers employed an explicit geographical gaze to observe Mars, claiming to see the planet with a direct, unimpeded view and then making sense of that view through intuition and analogy. Rather than working to confirm the existence, nature, and function of individual elements of the Martian landscape, the interpreters of Mars were much more likely to consider the planet as a whole. Offering comprehensive theories that ignored the workings of any individual feature, astronomers like Lowell engaged in landscape-level analysis that could not be definitely proved or disproved. The best test of these intuitive analyses and theories was a comparison with known landscape processes on Earth. The extensive

discussion of Martian elements' similarity to Earth's topographical features and geographical processes was a rhetorical staple not only of the inhabited-Mars proponents, but also of their critics. Specific terrestrial landscapes, cities, and countries were repeatedly invoked in discussions over distant Mars. In developing these comparisons, successful scientists and writers gave rise to the view of Mars as a miniature version of the Earth, complete with deserts, irrigation systems, and inhabitants.

Mars astronomers further ingrained these connections by rhetorically aligning themselves and their methods with the discipline of geography. Presenting themselves in their publications and comments as field scientists, planetary scientists negotiated their legitimacy as observers on the basis of their geographical remoteness, regularly emphasizing the necessity of secluding themselves in distant and pristine landscapes to conduct accurate observations of Mars. In images and texts, advocates of the inhabited-Mars theory portrayed their scientific activities as rigorous, strenuous, and adventurous, thus asserting superiority over their critics in the metropolitan centers. Not only did these representational maneuvers have a significant positive impact on the credibility of astronomers such as Lowell and Schiaparelli, but they also captured the interest of non-specialist audiences who might otherwise have been uninterested in astronomical news.

Given that astronomers' observations, representations, and analyses of Mars were conducted in a manner so similar to geographical science, audiences predictably responded most strongly to those elements of the Mars narrative that were overtly

geographical. Popular interest, as reflected in mainstream newspaper and magazine coverage as well as widely distributed works of fiction, gravitated toward questions regarding the relationships among Martian landscape, culture, and climate. Although astronomers may not originally have shared the same enthusiasm for these topics, the strength of popular response induced scientists' participation in what they often considered somewhat speculative debates over the possibility and nature of life on Mars.

The fervor with which popular media focused on these themes, in fact, became an important driver of scientific work. Astronomers such as Lowell, who were willing to address or guide the rampant speculation that emerged in mainstream media, achieved a popular legitimacy that made up for many deficiencies in their scientific work. Even though Lowell was roundly criticized in astronomical circles, for example, his theories regarding Martian habitability were taken so seriously by wider audiences that established astronomers found it extremely difficult to discredit him on the basis of his science. Those scientists who would have preferred to ignore Lowell's ideas found themselves forced to engage in increasingly exasperated attempts to set the record straight for the public. In the process, they found themselves dragged into a war of words that did little to salvage the professional reputation of their discipline, as leading astronomers in both Europe and North America had intended. The production of geographical knowledge for Mars thus involved a complex interplay of elite science and popular interest.

Projecting a Terrestrial Geography

At a basic level, the analogy-laden story of inhabited Mars functioned powerfully to project Western concerns about Earth's own evolution and future onto the countenance of the red planet. The use of analogies attracted the attention of popular audiences and helped them accept the idea of an inhabited Mars. At the same time, analogical reasoning managed to overpower most other explanations for Mars' physical appearance, thus constraining the scientific discourse.

The fundamental construction of the Martian landscape in the 1890s as "artificial," or patterned by the activities of intelligent beings, altered long-standing analogies to include Earth's manmade structures as a point of comparison between the two planets. Where the inexplicably geometric appearance of the Martian surface had once defied analogy, Lowell successfully introduced the idea that Mars' physical geography could be equated with Earth's engineered or cultivated landscapes. Lowell's most powerful construction of the Martian landscape painted the planet as a site of tremendous aridity, nourished only by an extensive irrigation system. This representation of Mars as a desert planet relied on frequent and specific comparisons to individual deserts in Africa and Arizona, quickly introducing climatic stereotypes that circulated in much geographical literature at the time. The focus on irrigation, especially, concentrated on a theme that was then a staple of geographic interest in both Europe and North America. Lowell thus presided over a shift in the Martian narrative that saw strangeness converted to familiarity, as the planet's puzzling landscape geometry was said to reveal one of the oldest technologies known to man.

Intimately linked with the discussion of Mars' aridity was the commentary on its continually increasing aridification. Though there was no observational evidence whatsoever to support this claim, Lowell succeeded in painting the red planet as a lost paradise that was suffering the late stages of water loss and desert growth. Writers and audiences responded to this portrayal with very little hesitation, probably because it drew from the standard tropes of desiccation, despoliation, and mismanagement used to represent Earth's arid regions.

Although the dominant Lowellian narrative did not hold Martian inhabitants responsible for their planet's imminent demise, it nonetheless exhibited many of the same elements present in geographers' linking of terrestrial landscape with human culture. Following in the environmentally deterministic footsteps of the day's leading geographers, Lowell's assumptions about Martian climate led him to even greater assumptions about the probable intelligence and advancement of the supposed Martian inhabitants. Rather than being seen as dangerous leaps of logic, assertions in this vein were enthusiastically accepted by his readers. Similarly, Lowell used visible Martian landscape patterns to support his broad assumptions about Martian civilization, arguing that the complexity of the landscape indicated a certain level of sophistication for the invisible inhabitants.

All of these maneuvers employed standard geographical tropes that built on one another, quickly creating an unassailable portrait of the Martian landscape as familiar and Earth-like. In the process, these tropes also allowed Mars to become a site of projection for terrestrial concerns. Anxieties regarding Earth's aridification

and dreams about human technological progress, for instance, were expressed and negotiated in arguments and speculations about Mars. As these hopes and fears regarding Earth's geographical change were projected onto Mars, the planet became sensationally popular, thus underscoring the relevance and significance of the Mars narrative well beyond the confines of disciplinary astronomy.

Just as was true for representations of the Martian landscape, significant meaning was also carried in the portrayal of Mars' cultural characteristics. The evolved Martians, as described by Lowell and embraced by the public, were said to have coupled their natural biological evolution with impressive social advancement. As their world aged and their climate suffered, these highly developed beings had supposedly learned the secrets of global organization, world peace and technological supremacy. Not coincidentally, these characteristics perfectly matched the ambitions of Lowell's own Progressive politics. He thus can be shown to have developed his scientific claims about Mars in sympathy with his own political beliefs, finding support from audiences that shared those same views.

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of Orientalism and the Other was communicated in his claims about Mars. The American interest in commerce and technology as guides to cultural contact, for instance, differed significantly from the European model of racial separation. As Lowell took up themes of cultural contact that he had already considered during Orientalist travels to the Far East, he automatically made them palatable for American audiences in ways that never quite appealed to their European counterparts.

Lessons from the Red Planet

The development of a widespread mania over Mars in the late nineteenth and early twentieth centuries has intrigued contemporary historians of science for several decades. Recent research has chronicled the ways individual scientists engaged in social and rhetorical maneuvers to establish credibility for what are now often seen as spurious knowledge claims about the landscape and culture of the red planet. This dissertation adds a new dimension to such scholarship by showing that the knowledge artifacts astronomers produced through their observations, representations, and analyses of Mars were inherently geographical. Mars astronomers fashioned their legitimacy by focusing on issues of geographical interest, employing geographical representational modes, and emphasizing the applicability of geographical analytical methods to Earth's distant neighbor. These same processes also helped Mars news achieve its widespread appeal among Western audiences that in turn influenced scientific directions and launched cultural interpretations of Mars science.

In reviewing the historical record to expose these connections, we also find a rich geographical narrative that has yet to be examined by historical geographers. The production of geographical knowledge for Mars depended on geographical assumptions and representations that appealed to wide audiences. Examination of these elements, therefore, provides a new lens on the geographical ideas that carried cultural weight at the turn of the twentieth century. The use of desert tropes to characterize Mars, for instance, shows the extent to which arid-landscape narratives had infiltrated the geographical understanding of Western, metropolitan audiences. At the same time, the Mars narrative critically questioned the standard presentation of deserts by projecting intelligent beings onto the surface of Mars. Rather than following the trope of evolutionary decay usually applied to the landscapes and inhabitants of Earth's tropical deserts, cool Martian deserts were cast as sites of evolutionary honing. This reconfiguration of established tropes can also be seen in the troubled acknowledgement of a superior Martian Other.

The projection of terrestrial geographical concerns onto Mars thus suggests a rich topic for historical scholarship. The identification of such strong intellectual interaction between two disparate sciences also reinforces the need for historians of science, especially historians of geography, to look beyond academic boundaries when assessing the progress of knowledge production. In this case, astronomers' discussions over Martian features served as important loci of geographical knowledge production, despite their disciplinary distance from the formal centers of geographic scholarship and education. Similarly, the influence of popular audiences on

scientists' interests, credibility, and claims illuminates the potential pitfalls of focusing solely on elite science as a driver of knowledge production. Audience response to the inhabited-Mars theory clearly altered the social and professional status of astronomers like Lowell, thus disrupting established efforts to achieve a greater professionalization and specialization within the discipline of astronomy.

It should also be noted that the complex processes of geographical knowledge production for Mars did not end in 1910. Although Lowell's professional stature had been weakened and the canal theory had become less convincing, there was no empirical disproof of the canals until the Mariner 4 mission produced close-range photographs of the barren planet in 1964. Until that time, various scientists continued to investigate the possibilities for Martian life, striving to produce hard data that would settle the arguments Lowell had incited. Although most astronomers had accepted by the mid-1930s that Mars was extremely arid, the broader narrative of Mars as a dying world subject to evolutionary forces held its sway. By the 1940s and 1950s, attention had turned to the possibility that Mars might host lower lifeforms, such as lichens, that could survive in an extreme environment that had suffered evolutionary decay. These discussions did not completely overturn Lowellian assumptions about planetary evolution and terrestrial analogy, allowing the inhabited-Mars narrative to continue in the absence of hard data to the contrary.

At mid-century, the United States National Aeronautical and Space Agency's (NASA) decision to send probes to Mars during the Cold War space race was guided by canal-covered mission-planning maps, an indication that the discredited canals still

held some sway over scientific imaginations of the planet as well. Ironically, the first successful Mariner missions of the 1960s transmitted images of a barren, moonlike landscape on Mars, providing the first confirmation that Mars was a dead world. At the same time, however, they revived a fascination with the red planet's geography. When concerns emerged regarding the degradation of Earth's environment in the 1970s, Mars was painted as a possible escape hatch for desperate humans. Scientists and fiction writers alike began to investigate the technological and ethical constraints surrounding "terraforming" – the intentional initiation of a global warming scenario on Mars to alter its climate such that terrestrial life could be implanted in a colonization bid.

Even today, the investigation of conditions that might sustain life on Mars continues to drive research funding for both the American and European space agencies, as reflected in the journal Science's announcement that the most significant scientific advance in 2004 was the discovery that Mars once had water. This recent finding confirms some of Lowell's old arguments, although it has not reinstated the canals nor brought the planet to life. In a sense, however, the Mars mania never really ended. It has merely been recycled, extended, and altered as it encounters new historical contexts. To understand today's fascination with Martian geography and with the possibility of using it as a future home for humans, we must begin with the tropes and ideas produced a century ago.

To understand today's fascination with Mars and with the possibility of using it as a future home for humans, contemporary cultural geographers would do well to

examine the extent to which today's scientific practices rely on old geographical narratives in the production of new geographical knowledge. A brief review of the continued intersections of Mars science and geographical knowledge through the 1920s, 1960s, 1990s, and the present day suggests a number of potentially productive questions: To what extent has the development of space faring technology allowed Mars to be cast as a new American "frontier," either for settlement or science? Since the Space Age, what tropes and themes have accompanied the characterization of Mars as a site of potential human colonization? How has Mars functioned as a tool of reverse analogical investigation – a way of learning about Earth? How have the analogies between Mars and Earth's polar regions been extended by the establishment of Mars research stations in Antarctica and northern Canada? To what extent have the old tropes regarding global Martian irrigation persisted or been adapted in newer proposals for large-scale environmental modification, such as planetary terraforming and full-blown human colonization? All of these questions address the larger theme of how imaginative geographies of Mars have functioned in their contexts to reflect and modify existing geographical ideas and knowledge. It is clear that Mars has already become a site of landscape-culture interaction at the imaginative level, and it cannot be long before humans set foot on the physical planet as well. In anticipation of this event, cultural geographers may need to become cultural "areographers" as well.

As a historical geographer, my research on this topic has in fact been motivated by a desire to identify historical antecedents for the mindset that guides

recent American and European initiatives to study and visit Mars. My analysis has thus necessarily ignored the role of non-Western scientists' and audiences' interest in Mars, as the historical record does not show it to have influenced the European and North American publications of the time. My study has also focused heavily on scientific publications that would have been consumed by literate audiences, thus exploiting rich archival collections yet overlooking the way nonliterate audiences would have gained knowledge about Mars.

As a result, the work presented here provides a clear picture of the nature and significance of conflicting knowledge claims produced for Mars. The production and consumption of a Martian geographical narrative – as read through scientific publications, scientists' personal papers and correspondence, letters to the editors, newspaper, magazines, science fiction, and other mainstream literary sources – was a complex and interlinked process, in which scientific claims and popular excitement mutually influenced one another. The construction of Mars as an inhabited, advanced desert planet became sensationally powerful and influential because it relied on observational methods, representational tropes, and analytical modes drawn from the discipline of geography. These elements captured Western audiences' interest and ignited a cultural mania that hinged on the assumed geographical similarity of Mars and the Earth. The narratives surrounding this areographical doppelganger thus serve as a unique lens for viewing the progress of geographical knowledge, ideas, audiences, and tropes at the turn of the twentieth century.

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