Geographers of Mars

Cartographic Inscription and Exploration Narrative in Late Victorian Representations of the Red Planet

By K. Maria D. Lane*

ABSTRACT

Over two decades spanning the turn of the twentieth century, 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. This essay offers a new explanation for the power with which the notion of an inhabited Mars gripped noted scholars and everyday citizens on both sides of the Atlantic. Rather than pointing to a rekindling of age-old philosophical interest in the plurality of worlds, it argues 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. From mapmaking to travelogue-style writing, astronomers borrowed powerful representational strategies from the discipline of geography to legitimize their claims about the red planet. In making the link between geographical and astronomical science more explicit, the essay further suggests that turn-of-the-century representations of Mars could be productively recontextualized alongside geographical works produced in the same period.

THE ERUPTION OF POPULAR ENTHUSIASM for Mars science in the closing decades of the nineteenth century has long interested historians of science, of science fiction, and of science popularization. Over two short decades, from about 1892 to 1910, astronomers' claims about Mars's landscape and climate spurred widespread scientific and popular interest in the possibility that the red planet might be inhabited. Early reports of geometrical lines in the landscape inspired vivid imaginings of an advanced technological society on Mars, eventually producing a full-fledged mania over the "canals," as the lines

* Department of Geography, University of Texas at Austin, 1 University Station, A3100, Austin, Texas, 78712.

The research for this essay was funded by a Mellon Dissertation Fellowship awarded by the Council on Library and Information Resources. I owe special thanks to the Lowell Observatory Library in Flagstaff, Arizona, the Royal Astronomical Society Library in London, and La Biblioteca dell'Osservatorio Astronomico di Brera in Milan, all of which provided outstanding research assistance and allowed me to quote from archival materials. Finally, I would like to thank Roger Hart, Bernard Lightman, Ian Manners, and three *Isis* referees for their helpful comments on early drafts of this essay.

Isis, 2005, 96:477–506

0021-1753/2005/9604-0001$10.00

were then called. Despite a bitter lack of consensus among astronomers over whether the lines actually existed, claims about Mars were reported widely in newspapers, discussed frequently in general interest magazines, and presented regularly to popular audiences on both sides of the Atlantic.

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 profitably 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] Such works helpfully demonstrate 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.

While acknowledging the importance of various individuals—especially the American astronomer Percival Lowell—in flouting scientific norms and courting public audiences, this essay offers a new explanation for how and why Western audiences became so fanatically interested in the science of an inhabited Mars.[2] Rather than pointing to a rekindling of age-old philosophical interest in the plurality of worlds, it argues 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.

From the middle of the nineteenth century, formative early claims about Mars's possible habitability were presented in the quintessential geographical format—the map. The map was the foundation on which truth claims about Mars were built and the primary medium by which knowledge about Mars was communicated.[3] Lengthy discussion and disagreement over an early map showing a geometric (and presumably artificial) landscape on the red planet underscored the power of the map to influence the scientific debate. Much of the power and longevity that the artificial landscape view exerted over both scientific and popular audiences derived from the map's visual authority as a geographical representation.

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 drawn from the ubiquitous travel narratives, explorer accounts, and geographical expeditions of the day. Aligning themselves with the ascendant observational geosciences, astronomers constructed a familiar, Earthlike picture of Mars's geography that contributed to wide-

[1] Steven J. Dick, *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge: Cambridge Univ. Press, 1996); Michael J. Crowe, *The Extraterrestrial Life Debate, 1750–1900: The Idea of a Plurality of Worlds from Kant to Lowell* (Cambridge: Cambridge Univ. Press, 1986); Karl S. Guthke, *The Last Frontier: Imagining Other Worlds, from the Copernican Revolution to Modern Science Fiction,* trans. Helen Atkins (Ithaca, N.Y./London: Cornell Univ. Press, 1983); William Sheehan, *Planets and Perception* (Tucson: Univ. Arizona Press, 1988); Norriss S. Hetherington, "Percival Lowell: Scientist or Interloper?" *Journal of the History of Ideas,* 1981, *42:*159–161; and Hetherington, "Amateur versus Professional: The British Astronomical Association and the Controversy over Canals on Mars," *Journal of the British Astronomical Association,* 1976, *86:*303–308.

[2] David Strauss has written the most comprehensive analysis of Lowell's Mars science: *Percival Lowell: The Culture and Science of a Boston Brahmin* (Cambridge, Mass.: Harvard Univ. Press, 2001) examines Lowell's social maneuvers, his commitment to the Spencerian theory of evolution, and his treatment at the hands of hostile professional astronomers. For Lowell's success as a popularizer see also William Graves Hoyt, *Lowell and Mars* (Tucson: Univ. Arizona Press, 1976).

[3] As will be discussed later, Mars claims were also recorded graphically in the spectrum, which depicted data regarding atmospheric composition; this later proved critical in the scientific debate about Mars's habitability. The map, however, appealed to popular audiences in a way that the spectrum, which was held to be a specialists' tool, never did, and therefore it played a unique role in the popularization of the inhabited-Mars hypothesis.

spread 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 a widespread popular mania.

These strong links between Mars astronomy and geographical science suggest that scientific claims about the red planet should be reexamined and recontextualized as elements of a specifically *geographical* knowledge production process. In this new light, seemingly fantastical and outlandish theories about the geography of an inhabited Mars may prove to have contributed meaningfully to various audiences' understandings of terrestrial landscapes and cultures at the turn of the twentieth century. To illustrate the value of such an approach, this essay briefly compares several Mars-related tropes with contemporaneous geographical descriptions of foreign landscapes and peoples. This analysis finds both alignments with and departures from standard geographical narratives, showing that the production of an imaginative geography for Mars was part of a complex process of knowledge ordering that has yet to be examined in detail.

CARTOGRAPHY AND AREOGRAPHY

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 term used to refer to Martian surface geography in the late nineteenth century), these maps served a complex function in the development of Mars's scientific and cultural meanings.[4] Cartographic conventions lent the red planet a fundamentally geographical identity, induced territorial competition among astronomers, and authorized a view of its landscape as artificial 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.

This section examines the pivotal role of maps in the early Mars debates, showing how astronomers' claims about the geography of the planet rose to prominence or fell into disrepute in tandem with the fortunes of their maps. The triumph of specific maps over others depended on their visual authority, with the inscription of objectivity, certainty, and detail always prevailing over representations of subtlety or simplicity. The unique power of the map thus confounded the emerging segregation of professional and amateur astronomers in the late nineteenth century. Where the authority of early maps had been tied to the status of their makers, later astronomers were able to derive considerable authority in reverse—on the basis of the appearance of their maps.

The Maps of 1877

By the late nineteenth century, maps had become the fundamental unit of knowledge about Mars. Most serious Mars observers regularly produced maps or at least forwarded their sketches to other astronomers who were known to be producing maps. Within the British astronomical community throughout the 1870s, for instance, leading planetary observers distributed standardized sketch sheets to their colleagues, provided detailed instructions on observation and drawing techniques, and then collected contributors' notes and sketches

[4] The term "areography"—which cleverly modified the word "geography" by substituting the Greek name for Mars, "Ares," for the Greek name for Earth, "Geos"—was used as early as 1868 by R. A. Proctor. See Bernard Lightman, "The Visual Theology of Victorian Popularizers of Science: From Reverent Eye to Chemical Retina," *Isis,* 2000, *91:*651–680.

for compilation into lengthy reports and detailed maps at the end of each biennial opposition.[5] (An "opposition" occurs when two planets pass one another in their orbits, forming a line as seen from the sun.) Though this standardization process did not produce any single authoritative map of Mars, it helped establish the new cartographic view of the planet as an impersonal, objective, and authoritative format.

Although a variety of maps were already in circulation, 1877 marked a turning point in the cartography of Mars.[6] On 5 September of that year, Earth and Mars stood in "perihelic opposition," as Earth came into line between Mars and the sun when the two planets were also nearest to the sun and 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 opposition itself but also in the days and weeks leading up to and following the event. Taking advantage of this rare occurrence, the 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 with his 13-inch reflecting telescope all the way to the Portuguese island of Madeira in search of good atmospheric conditions for extended observations. Over two months, Green's effort was rewarded with forty-seven nights suitable for Mars observation, sixteen of which he termed "good," "excellent," or "superb"; this was fewer than expected but "considerably in excess of the average of an English climate." During his expedition he produced a series of exquisite sketches that he later compiled into the most detailed map of Mars to date (see Figure 1). The expedition to Madeira was a major event in Green's avocational career, cementing his status as a serious amateur.[7]

Unfortunately for Green, however, his was not the only interesting map produced in 1877. The professional Milanese astronomer Giovanni Schiaparelli had also taken advantage of Mars's proximity, and in 1878 he published a radical new map that seemed to contradict Green's work. Where Green had used subtle naturalistic shading to represent a surface mottled with barely perceptible "delicate markings," Schiaparelli used hard-edged lines to show a detailed landscape of islands divided by parallel and intersecting straits (see Figure 2).[8] And where Green had used the Anglocentric nomenclature established in

[5] See, e.g., N. E. Green, "Notes on the Coming Opposition of Mars," *Monthly Notices of the Royal Astronomical Society,* 1877, *37:*424; Green, "The Approaching Opposition of Mars," *ibid.,* 1879, *39:*433; E. Walter Maunder, "Mars Section," *J. Brit. Astron. Assoc.,* 1892, *2:*423–427; and Bernard E. Cammell, "Mars Section, 1894," *ibid.,* 1894, *4:*395–397.

[6] The German astronomers Wilhelm Beer and Johann Heinrich Madler produced the first map of Mars in 1840, portraying surface features on a latitude/longitude grid and assigning alphabetical labels to those markings they considered permanent; see William Sheehan, *The Planet Mars: A History of Observation and Discovery* (Tucson: Univ. Arizona Press, 1996). Proctor's 1867 map was the first to introduce proper names for the surface features; see Lightman, "Visual Theology of Victorian Popularizers of Science" (cit. n. 4). Although an opposition occurs every twenty-six months when Earth swings past Mars, a perihelic opposition occurs only once every fifteen years or so.

[7] For Green's description of the observing conditions see "Meeting of the Royal Astronomical Society, November 8, 1877," *Astronomical Register,* 1877, *15:*309–319; for his map see Nathaniel Green, "Chart of Mars from Drawings at Madeira in 1877," map published with "Observations of Mars, at Madeira, in August and September 1877," *Memoirs of the Royal Astronomical Society,* 1879, *44:*123–140. On Green's work and reputation see Richard McKim, "Nathaniel Everett Green: Artist and Astronomer," *J. Brit. Astron. Assoc.,* 2004, *114:*13–23; and "In Memoriam: Nathaniel E. Green, F.R.A.S.," *ibid.,* 1899, *10:*75–77.

[8] Schiaparelli's "Mappa Areographica" was published as Table 3 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,* 1877–1878, *3:*3–136 (hereafter cited as **Schiaparelli, "Osservazioni del 1877"**); for Green's description see Green, "Observations of Mars," p. 123.

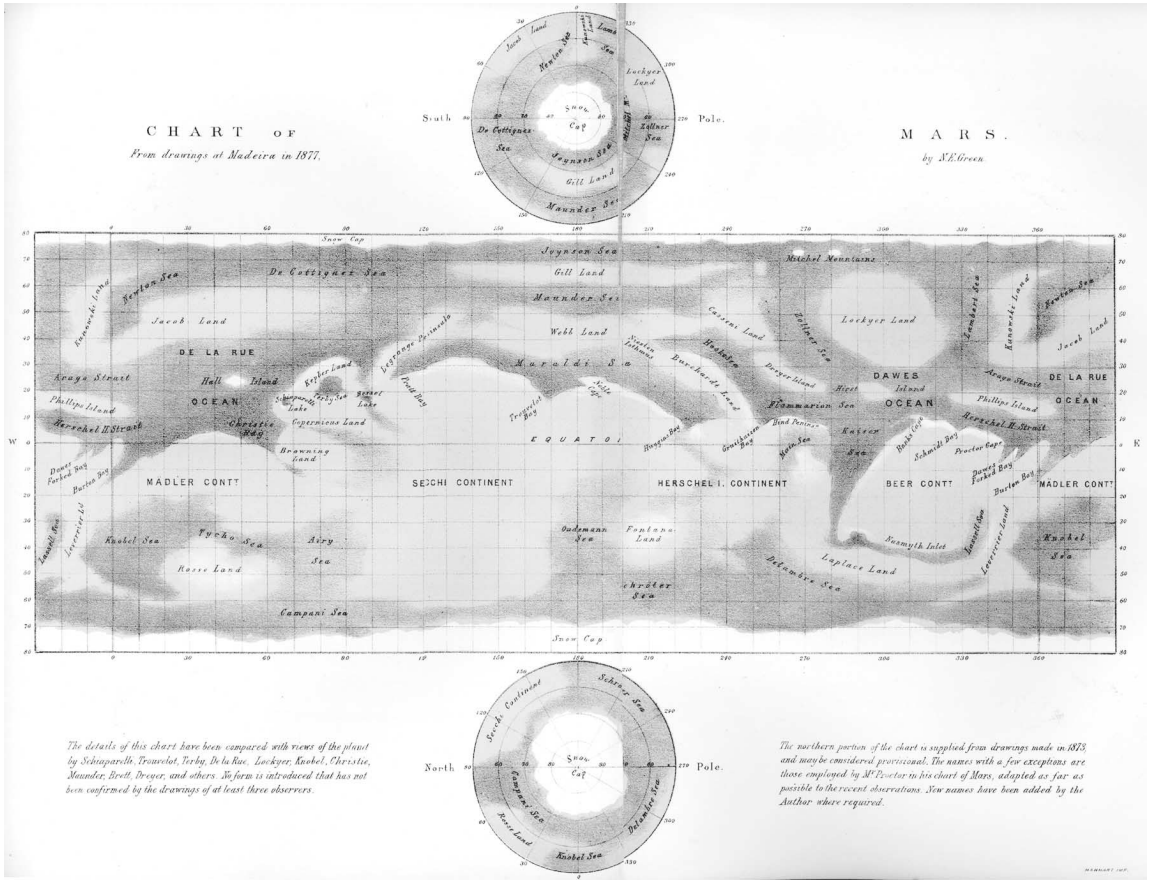

Figure 1. *Mercator and planar projection maps by Nathaniel Green, 1877. Originally published (using reddish-orange color tones) in* Memoirs of the Royal Astronomical Society, 1877–1879, *p. 44.*

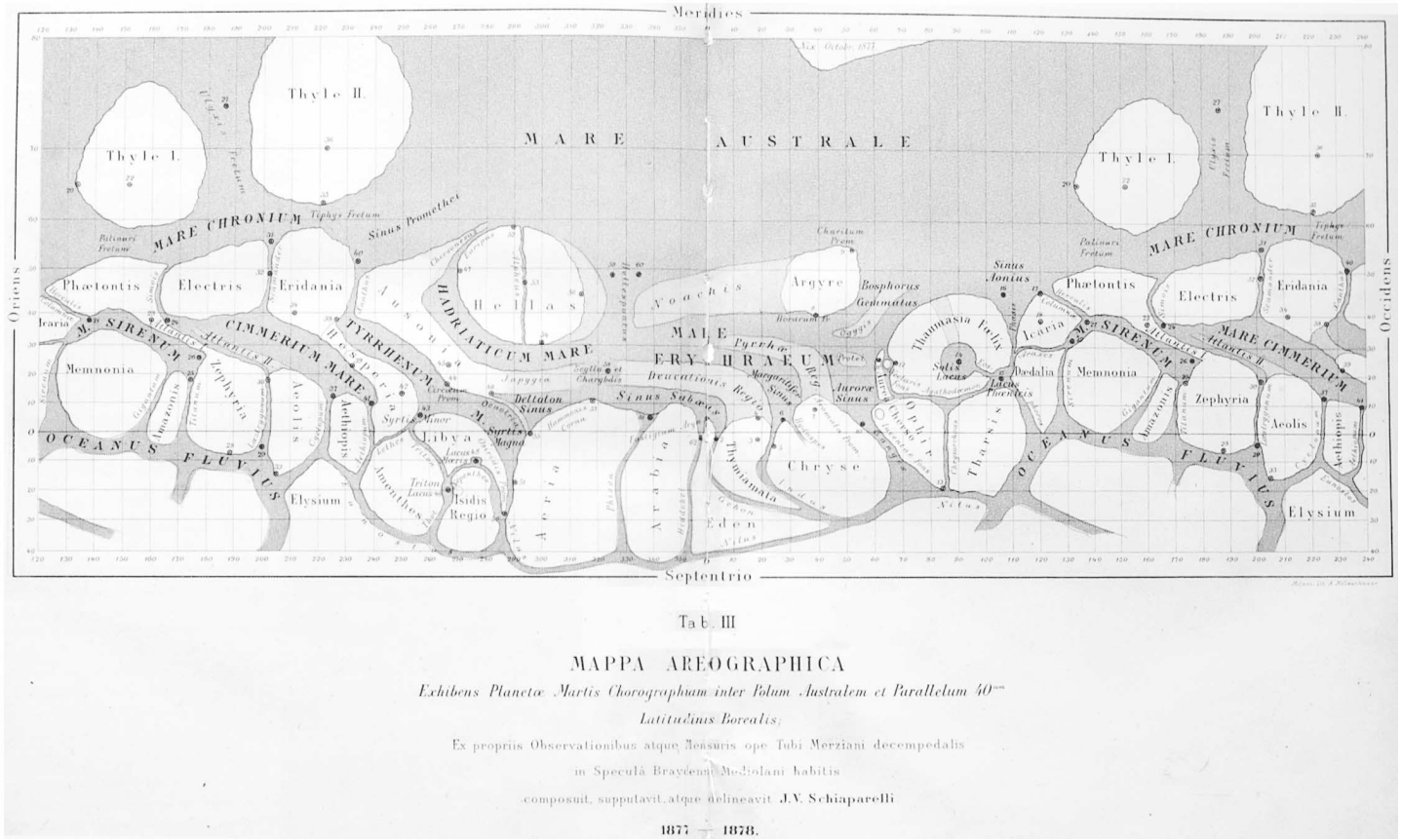

Figure 2. *Mercator projection map by Giovanni Schiaparelli, 1878. Originally published (using blue tone in the darker areas) in* Atti della Reale Accademia dei Lincei: Memorie della Classe di Scienze Fisiche, Matematiche e Naturali, 1877–1878, *p. 3.*

an earlier map by Richard Proctor, Schiaparelli had endowed Mars with a set of completely new place-names based on the classical and mythological geography of the ancient Mediterranean world.

Green was surprised by Schiaparelli's map, as he claimed to have seen no such prominent lines 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 sketches that Schiaparelli had sent to him, saying that 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." 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." Schiaparelli did not respond in print but expressed private displeasure at what he perceived as Green's "thoughtless" initiation of a controversy.[9]

In truth, it was not only draftsmanship that distinguished Schiaparelli's and Green's mapmaking methods. Green was a longtime Mars observer with a large network of British colleagues who were themselves active Mars observers throughout the 1870s. His 1877 map was a compilation of his own and his colleagues' observations over the years, and it drew heavily on the work of other Englishmen. Not only did Green use the nomenclature that had already been established by the English science writer Proctor; he also drew heavily from observations by the English astronomer William Dawes, whose work had served as the basis for Proctor's map. Green claimed to have put no marking on the published 1877 map that was not definitively seen by at least three observers, even leaving out prominent items that some of his colleagues insisted should have been included. His personal contribution to the map—apart from its rendering—was an augmentation of the detail visible in Mars's southern latitudes, which he recorded in careful color sketches made while he sat at the telescope in Madeira. During the Madeira expedition, Green completed forty-one sketches, each of which took approximately two hours to prepare (see, e.g., Frontispiece).[10] Twelve of these sketches were published with his lengthy observation memoir, along with the Mercator and planar projection maps shown in Figure 1. Although the northern latitudes of Mars were not visible from Earth in 1877, Green's Mercator map covered all latitudes from 80° south to 80° north, using data 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, his detailed map included only his own observational data. Despite recording almost no detail north of 40° latitude (owing to its invisibility from Earth in 1877), Schiaparelli conducted a study of unprece-

[9] "Meeting of the Royal Astronomical Society, April 12, 1878," *Astron. Reg.,* 1878, *16:*115–123; Nathaniel E. Green to G. V. Schiaparelli, 15 Mar. 1878, Corrispondenza Scientifica, Archivo dell'Osservatorio de Brera; and Schiaparelli to Otto Struve, 6 July 1878, in Osservatorio Astronomico di Brera, *Corrispondenza su Marte di Giovanni Virginio Schiaparelli,* 2 vols., Vol. 1: *1877–1889* (Pisa: Domus Galilaeana, 1963), pp. 14–18.

[10] See Lightman, "Visual Theology of Victorian Popularizers of Science" (cit. n. 4), for a discussion of Proctor's reliance on Dawes. Regarding features that Green omitted despite his colleagues' views see "Meeting of the Royal Astronomical Society, April 12, 1878"; and "Meeting of the Royal Astronomical Society, December 13, 1878," *Astron. Reg.,* 1879, *17:*1–20. On Green's contacts with other Mars astronomers and his sketching and mapping practices see McKim, "Nathaniel Everett Green" (cit. n. 7); and Green, "Observations of Mars" (cit. n. 7).

dented 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 with an 8-inch Merz refractor on the roof of Milan's stately Palazzo di Brera, Schiaparelli observed Mars from August 1877 to April 1878. His logbooks include thirty-one complete drawings of Mars's face and more than a hundred detailed sketches of various regions that he recorded during fleeting instants of "excellent air" (see, e.g., Figure 3). Many of these pencil sketches were later tidied into composite drawings that Schiaparelli sent to colleagues, including Green, for comment. The full report of Schiaparelli's 1877 observations—including the Mercator projection map shown in Figure

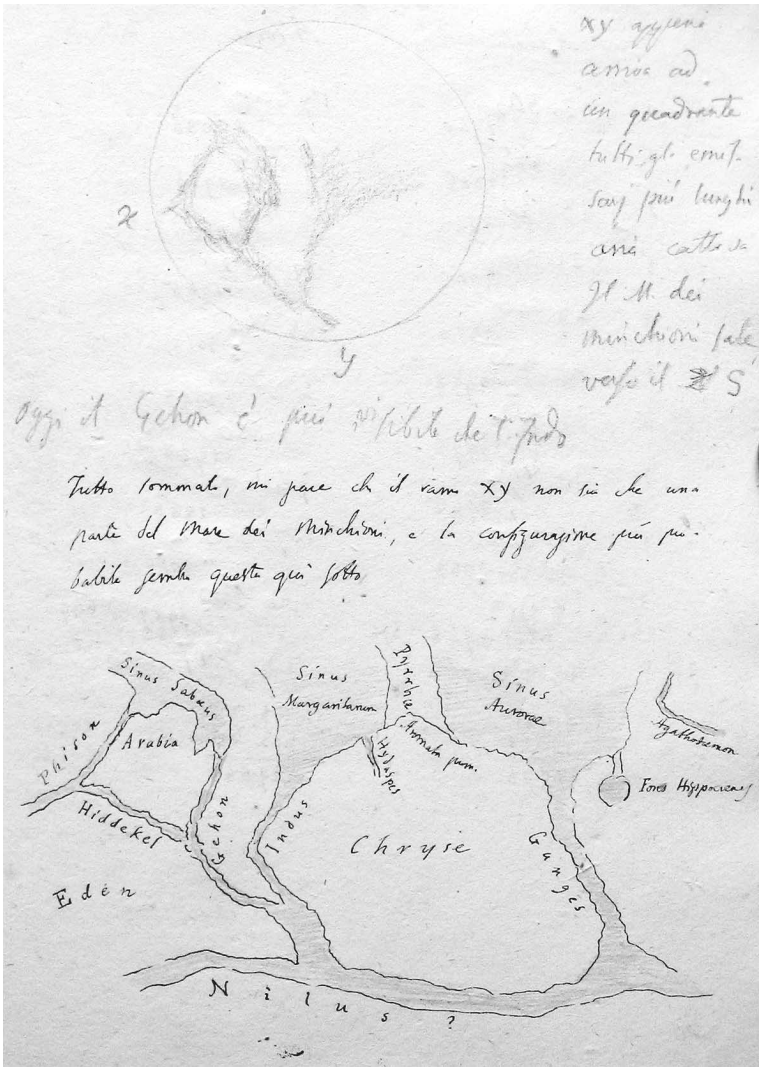

Figure 3. *Page from the unpublished observation logbook of Giovanni Schiaparelli, 28 February 1878. Courtesy INAF—Osservatorio Astronomico di Brera, Milan, Italy.*

2 as well as a planar projection map of Mars's south pole—was published by the leading Italian scientific society.[11]

Authorizing a New Martian Landscape

In their published observation reports, 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 firsthand "eyewitness" quality of their observations, and the essential agreement of their own sketches with the work of earlier observers. Despite such similarities in argument and structure, however, Schiaparelli's representations of Mars clearly won out over Green's. In the ensuing three decades, most Mars maps produced in Europe and North America followed the Italian's nomenclature and artistic style.

Schiaparelli's map was able to achieve this prominence in part because the perceived objectivity of the cartographic format obscured the substantial procedural differences in the production of his map and of Green's. At another level, Schiaparelli's map trumped Green's by establishing a greater visual authority through the use of definitive markings and new place-names. This visual authority, augmented by Schiaparelli's personal authority as a leading European astronomer, powerfully established the new view of Mars as a potentially inhabited landscape.

As the previous section 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 an objective scientific authority separate from the identities of the mapmakers. Once the landscape of Mars had been projected onto a latitude/longitude grid, the only differences that mattered were those that could be seen in the visual format.

Since both of the 1877 maps were presented as objective and unbiased representations of the Martian surface, then, only one of them could be "right," given the visual discrepancy between the two. Green's map appeared hazy and indistinct, while Schiaparelli's was detailed and definitive. Furthermore, Schiaparelli had added a significant amount of new detail and had depicted an intriguing landscape of islands surrounded by blue water. Visually, 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. 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 professional astronomer. Although Schiaparelli had not been known previously as a planetary observer (his

[11] For Schiaparelli's communications with his colleagues during the 1877 observations see esp. Schiaparelli to François Terby, 20 Nov. 1877, and Schiaparelli to Struve, 23 Nov. 1877, 4 Jan. 1878, 6 July 1878, in *Corrispondenza su Marte,* Vol. 1 (cit. n. 9), pp. 5–6, 6–7, 10–14, 14–18. His observations are recorded in Giovanni Schiaparelli, "Refrattore di Merz, Tomo I, Minute Originali delle Osservazioni dal 14 Agosto 1875 al 31 Agosto 1877," and "Rifrattore 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. For the full report see Schiaparelli, "Osservazioni del 1877."

major career discovery was the theoretical prediction and observational confirmation of links between meteor showers and comet orbits), 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. Thus even those who were skeptical of his unorthodox map and its visual implication that Mars might have an artificial landscape generally treated him with deference and respect.[12] Essentially, Schiaparelli's personal authority bolstered the visual authority of his map to win scientific acceptance of the possibility of an inhabited Mars.

In society meetings and publications throughout the 1880s, for example, the European astronomical community revealed a willingness to entertain all manner of explanations for Schiaparelli's canals—except for accusations that the Italian astronomer was untruthful or deficient in observational skills. Green thought the dark streaks might be artistic misrepresentations; E. Walter Maunder considered it most likely that they were the boundaries of differently shaded regions; and a writer for the *Observatory* suggested that Schiaparelli might have been using too high a magnifying power for his telescope.[13] Green himself was at pains to make clear, however, that his critique of Schiaparelli's mapping style was not meant to impugn his talent as an observer.

Although he enjoyed a significant reputation in Britain, Green was an amateur observer who certainly did not outrank Schiaparelli within the discipline as a whole. Despite the fact that he had a strong network behind him and had observed Mars with a more powerful telescope from a more advantageous location, Green habitually deferred to Schiaparelli.[14] Referring to the Italian deferentially and sincerely as "the learned and exact professor," he justified his limited criticisms of Schiaparelli's map only on the basis of his own status as a professional portrait artist and drawing master and restricted his critique to matters of artistic style. For instance, 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.

Lord Lindsay commented similarly that "Professor Schiaparelli was not likely to be led away by imagination. There might be something peculiar in his telescope, or in his eyes, but he was not likely to publish observations or drawings without being fully persuaded that the appearances actually existed."[15]

By the early 1890s, the scientific, visual, and personal authority of Schiaparelli's 1877

[12] *All'astronomo G. V. Schiaparelli: Omaggio, 30 giugno 1860–30 giugno 1900* (Milan: Osservatorio Astronomico di Brera, 1900). Crowe argues in *The Extraterrestrial Life Debate* (cit. n. 1) that Schiaparelli was a pluralist, despite his oft-stated (and oft-cited) neutrality on the issue of Mars's habitability. Although Crowe does not argue that Schiaparelli *intended* to portray Mars as having an inhabited landscape, he shows that throughout his career Schiaparelli generally aligned himself with the position of the pluralists.

[13] Green, "Observations of Mars" (cit. n. 7); "Meeting of the Royal Astronomical Society, April 14, 1882," *Astron. Reg.,* 1882, *20:*101–111; and "Schiaparelli's Observations of Mars," *Observatory,* 1882, *5:*138–143.

[14] Green's deference here notwithstanding, relations between amateurs and professionals were rarely so uncomplicated during the Mars debates. As will be discussed later, many of those who observed Mars regularly were amateurs who used telescopes substantially weaker than those of their professional counterparts.

[15] Green, "Observations of Mars" (cit. n. 7), p. 130; "Report on the Meeting of the Association held December 31, 1890," *J. Brit. Astron. Assoc.,* 1890, *1:*110–114, on pp. 110–111; and "Meeting of the Royal Astronomical Society, April 12, 1878" (cit. n. 9), p. 123 (James Ludovic Lindsay served as president of the Royal Astronomical Society in 1878 and 1879). For a full discussion of Green's identity as a professional artist see McKim, "Nathaniel Everett Green" (cit. n. 7).

map (and a series of others that he produced at subsequent oppositions) had largely 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 place-names 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.[16]

It seems, however, 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 map of 1877 was never challenged. Initial critiques of Schiaparelli's artistic style were soon followed by an assault on his distinctive place-names. 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. As Schiaparelli eventually emerged victorious from these nationalistic contests, he maintained control of the intellectual territory of Mars. His inclination to represent it as Earthlike, with oceans, islands, and canals, would have substantial consequences for the future of knowledge production about the planet.

Various features of Mars had received their first proper names only ten years earlier, when Proctor had casually applied astronomers' surnames to a map he intended for publication in 1867. Since that time, various names had been added, changed, or reshuffled on maps published throughout Europe. The well-known French astronomer and popular science writer Camille Flammarion famously adjusted Proctor's scheme for his own maps to give the nomenclature a more Continental flavor, presumably because the Englishman had unduly favored his countrymen in his initial choices. 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." 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. On Schiaparelli's Mars, "Lockyer Land" was renamed "Hellas," while "Fontana Land" became "Elysium."[17]

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 nomenclature of Mars, one British astronomer lamented that Schiaparelli's contribution had served only "to create wholly needless con-

[16] David Gill, "The Nomenclature of Markings on Mars," *Astron. Reg.,* 1879, *17*:95.

[17] "Mappa Areographica," published as Table 3 in Schiaparelli, "Osservazioni del 1877." See Lightman, "Visual Theology of Victorian Popularizers of Science" (cit. n. 4), for a complete discussion of Proctor's maps. For Flammarion's adjustments see Jürgen Blunck, *Mars and Its Satellites: A Detailed Commentary on the Nomenclature* (Hicksville, N.Y.: Exposition, 1977).

fusion," while another dismissed the Latin names as "useless rubbish." Despite the utilitarian value of preserving a nomenclature that was already in wide use, however, Proctor's surname labels were admitted to be problematic in prioritizing some 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." 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."[18]

In addition to concerns about convenience, priority, and prestige, there were also important territorial 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, another countered that "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 made." He implied that the discoverer of a scientific object should be free to assign whatever names he liked and that scientists of other nationalities should then accept that decision, without resorting to 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."[19]

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, some British astronomers conducted a war of words that functioned in many ways like a classic contest for territorial control. 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's 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 the objections to 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.

In addition to provoking deep-seated territorialism, the newly inscribed names and canals conveyed a sense of place and intrigue that Mars had not previously enjoyed. Although the planet's 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 it as a familiar, Earthlike 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.

The Power of the Map

Despite the early debates, Schiaparelli's 1877 map ushered in a new era of Mars cartography, as professional and amateur astronomers across Europe and North America worked

[18] William Noble, "Names of Markings on Mars," *Astron. Reg.,* 1879, *17:*95–96, on p. 96; A. Marth, "Nomenclature of Markings Visible upon the Planet Mars," *ibid.,* pp. 24–25, on p. 24; E. B. Fennessy, "Nomenclature of Markings on Mars," *ibid.,* p. 90; and Herbert Sadler, "Nomenclature of Markings Visible upon the Planet Mars," *ibid.,* p. 25.

[19] Noble, "Names of Markings on Mars," p. 96.

to confirm the existence of the canals. At the end of each biennial opposition results were compared, discoveries were announced, and newly sighted canals were added to the network. Green himself wrote before the 1879 opposition that "a careful search should be made for the remarkable dark canals figured by Professor Schiaparelli" 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, his observations were finally confirmed by the Belgian astronomer François Terby and the French astronomer Joseph Perrotin in 1886.[20] 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.

Within an established competitive and territorial framework, those astronomers who added the most detail to the map became its most authoritative interpreters. Once established, the new map of Mars was thus able to bolster the personal authority of individual astronomers, allowing even amateurs to become prominent theorists about the landscape and culture of Mars. The American astronomer Percival Lowell, for instance, began his Mars research in 1894 with no professional pedigree but quickly became one of the best-known Mars astronomers by producing extremely detailed maps. Whereas others' wild theories about the red planet could be dismissed as sensationalist nonsense, Lowell's inhabited-Mars hypothesis had to be taken seriously because he had added significant detail to the map. In his first year of observation he confirmed all but two of Schiaparelli's canals and added 116 of his own discovery.[21] Before the year was out he had begun publishing a series of popular articles in the *Atlantic Monthly* arguing that the canals were evidence of a civilization on Mars.

Although most professional astronomers rejected Lowell's theory-driven methods, his speculative hypothesis, and his targeting of popular publications, they grudgingly admitted that he deserved respect for his continued contributions to the Martian map. Simon Newcomb, director of the 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." 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 known to that science"—though in fact Payne's appreciation probably owed more to the detailed appearance of Lowell's maps than to the actual process he used in making them.[22]

[20] Green, "Approaching Opposition of Mars" (cit. n. 5), p. 433; 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 Reale Accad. Lincei,* 1880–1881, *3:*3–109; 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)," *ibid.,* 1886, *4:*281–373; 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 (Opposizione 1883–1884)," *ibid.,* 1895–1896, *5:*183–240; "The Canals on Mars," *Astron. Reg.,* 1886, *24:*268 (reporting Terby's findings); and J. Perrotin, "Observation des Canaux de Mars Faite a l'Observatoire de Nice," *Observatory,* 1886, *9:*364–365.

[21] Hoyt, *Lowell and Mars* (cit. n. 2).

[22] Simon Newcomb to Percival Lowell, 30 Oct. 1905, Simon Newcomb Papers, United States Library of Congress Manuscript Division, Washington, D.C.; and W. W. Payne, "The 'Canals' of Mars," *Popular Astronomy,* 1904, *12:*365–375, on p. 366.

In the popular press the 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." Whereas Schiaparelli's professional reputation had helped establish the authority of his canal map, Lowell's legitimacy was produced by the opposite process: the unrivaled detail of his authoritative canal maps won him significant personal authority of a sort not available to other amateurs. Even after his unorthodox methods and views brought the astronomical community to ostracize him, popular audiences continued to treat Lowell as a celebrity, embracing his theories about Martian civilization.[23] This enduring authority derived in large measure from the appearance of his unrivaled maps.

Just as was true for many of the terrestrial expeditions of the day, then, 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. Those whose expeditions failed to turn up anything new, on the other hand, were branded failures and had difficulty finding sponsors for subsequent travels. This blending of the authority of map and maker explains how the infamous—nonexistent—"Kong Mountains" could have appeared on commercial maps of West Africa for over a hundred years.[24] Just as in the case of Mars, terrestrial explorers felt the need to include details from earlier maps in order to assert their legitimacy, even when those features could not be independently confirmed.

In the same way that explorers' maps of Australia allowed Europeans conceptually to erase aboriginal peoples from the landscape and maps from the Great Trigonometrical Survey allowed the British to rationalize their control of India, Schiaparelli's 1877 map—a limited perspective from a single year, as opposed to Green's compilation of many astronomers' work over many years—came to set the standard for the next three decades of mapping Mars as a world or geographical place. Lowell built his career and reputation on the basis of his contributions to the Schiaparellian map, claiming significant powers of landscape interpretation in the process. It was only after 1907, when planetary photography began to supplant cartography as the standard of proof, that the power of the map began to wane.[25]

[23] "French Clergyman Combats Theory of Prof. Lowell as to Presence of Some Sort of Intelligent Life on Planet Mars," *Boston Sunday Herald,* 4 Aug. 1907, magazine section. See Strauss, *Percival Lowell* (cit. n. 2), for a detailed discussion of how American and British astronomers acted in concert to isolate Lowell.

[24] Felix Driver, "Exploration by Warfare: Henry Morton Stanley and His Critics," in *Geography Militant: Cultures of Exploration and Empire* (Oxford: Blackwell, 2001), pp. 117–145; and Thomas J. Bassett and Philip W. Porter, "'From the Best Authorities': The Mountains of Kong in the Cartography of West Africa," *Journal of African History,* 1991, *32:*367–413. 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/London: Johns Hopkins Univ. Press, 2001).

[25] Simon Ryan, *The Cartographic Eye: How Explorers Saw Australia* (Cambridge: Cambridge Univ. Press, 1996); and Matthew H. Edney, *Mapping an Empire: The Geographical Construction of British India, 1765–1843* (Chicago/London: Univ. Chicago Press, 1997). For a detailed discussion of the way, beginning in 1905, photographic evidence altered the debates over Mars see Jennifer Tucker, "Science Illustrated: Photographic Evidence and Social Practice in England, 1870–1920" (Ph.D. diss., Johns Hopkins Univ., 1996), Ch. 4.

ASTRONOMY AS GEOGRAPHY

Mapmaking was not the only powerful convention astronomers adopted from the discipline of geography. During the Mars canal debates, geography played an important role both in how astronomers conducted their observations and in how they established legitimacy for their claims. Most notably, new attention to the variations in "seeing" conditions at different geographical points 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 publications. They thus portrayed their science as similar to the popular field sciences of the day, like geography or botany.

Astronomy's stated similarity to field science was not merely rhetorical, however. Astronomers also borrowed methodological and evidentiary standards from disciplines like geography. Calling attention to their "eyewitness" views of the Martian surface, observers relied on a geographical gaze to make sense of what they were seeing.[26] Rather than trusting theoretical predictions or worrying over the shortcomings of their instruments, that is, astronomers made sense of Mars by looking at its landscape and using visual intuition to explain its characteristics.

As the inhabited-Mars hypothesis gained notoriety 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 in consciously comparing themselves to well-known explorers or in subconsciously adopting rhetoric from the observational sciences, astronomers established a link between their Mars work and the ascendant discipline of geography. They claimed to be practicing a new kind of geography and to be doing it more skillfully than the well-known explorers of the day. This representational hybridity not only propelled Mars science into the consciousness of geographically literate audiences; it also reinforced a view that the geography of Mars was familiar and Earthlike—and that the planet was perhaps inhabited.

The Geography of "Seeing" Mars

As others have noted, the issue of telescope size was a significant point of debate in the disagreements over Mars. Most of the observers who claimed to see the canals used telescopes that were considerably smaller than those used by the professional staff at large institutional observatories. When the most powerful telescopes of the day failed to show canals, the small-glass proponents were subjected to charges of optical deficiency and even willful imaginative leaps. Such charges, however, were unable to establish conclusively that the canals did not exist. This failure can be ascribed in part to a successful counterargument that played off variations in the "seeing" at different locations. At times and in locations of atmospheric disturbance, it was said, small telescopes actually suffered less distortion (owing to their lesser magnification) than large ones.[27] The atmospheric clarity

[26] For a discussion of the geographic "gaze" 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 Rose (Research Series, 28) (Bristol: Historical Geography Research Group, 1992), pp. 8–18.

[27] The definitive account of the debate over telescope size is John Lankford, "Amateurs versus Professionals: The Controversy over Telescope Size in Late Victorian Science," *Isis,* 1981, *72:*11–28. See also Strauss, *Percival Lowell* (cit. n. 2); Crowe, *Extraterrestrial Life Debate* (cit. n. 1); Hoyt, *Lowell and Mars* (cit. n. 2); and Simon

and stillness of a given observation site, then, was frequently said to be more important than telescope size, allowing canal advocates to resist critiques that branded their equipment as inferior.

Whereas seeing had previously been considered to vary from night to night at a given location, depending on atmospheric conditions, 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 constraints, then, it became preferable to change one's location in pursuit of better atmospheric conditions. The British astronomer Green reportedly chose the Portuguese island of Madeira for his 1877 Mars-observing expedition "for its southern position, 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." Similarly, the Harvard Observatory sent a Mars-observing expedition all the way to Arequipa, Peru, in search of steady air. Writing from Peru in 1892, the 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.[28]

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 prompt an expedition to northern Africa, or East Asia, or India.[29] Though similar in style (and levels of publicity) to the eclipse expeditions, the new expeditions to observe Mars were oriented around getting a better view, not a unique view. Mars could be observed from the London suburbs, of course, but reports from a mountaintop station in Peru or Argentina were automatically considered more credible owing to the superior seeing conditions there. Travel to remote locations thus became an important factor in legitimizing Mars observations.

Another way an astronomer might gain access to a location blessed with good seeing was to be fortunate enough to live there. The British amateur astronomer P. B. Molesworth, for instance, was stationed with the British 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. The sketches that accompanied his reports were repeatedly commended as "remarkable," and Molesworth himself pointed to 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."[30]

Schaffer, "Astronomers Mark Time: Discipline and the Personal Equation," *Science in Context,* 1988, *2:*115–145. See Lankford, "Amateurs versus Professionals," and Strauss, *Percival Lowell,* for detailed analyses of how individual astronomers maneuvered during these arguments.

[28] Green, "Observations of Mars" (cit. n. 7), p. 38; and William H. Pickering, "Changes and Floods on Mars," in *Mars* (1892; Boston: Gorham, 1921), pp. 42–55, on p. 55.

[29] See Alex Soojung-Kim Pang, *Empire and the Sun: Victorian Solar Eclipse Expeditions* (Stanford, Calif.: Stanford Univ. Press, 2002), for a thorough overview of the practices and representations of solar eclipse expeditions.

[30] P. B. Molesworth, "Observations of Mars, 1903," *Monthly Not. Roy. Astron. Soc.,* 1905, *65:*825–841, on p. 839. Praise for Molesworth's reports appears in Eugene Antoniadi, "Mars Section, First Interim Report for 1898–1899," *J. Brit. Astron. Assoc.,* 1899, *9:*156–158; and Antoniadi, "Section for the Observation of Mars: Report of the Section, 1900–1901," *Memoirs of the British Astronomical Association,* 1903, *11:*85–142.

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 uncommon route chosen by Percival Lowell, who had famously selected the location for his Mars-focused observatory only after sending an associate to assess the atmospheric conditions at a variety of sites throughout Arizona. Eventually situated on an elevated mesa in the frontier lands of arid Flagstaff, the Lowell Observatory suffered few of the disturbances common to metropolitan observatories: light pollution, smog, lake or coastal breezes, and cloudy weather. Lowell and his associates took every opportunity to assert the superiority of their Flagstaff location as a means of securing legitimacy for their claims about Mars. In his first major publication about the planet, 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."[31]

The establishment of several major observatories in the remote American West, in fact, coupled with a number of high-profile Mars-related expeditions to the tropics, changed the standards for astronomical claims-making. Even the Lowell Observatory, with its celebrated pure atmosphere, eventually sent expeditions farther south in search of even better views. Whatever criticisms other astronomers might make of Lowell's claims, they generally admitted the advantages of his location. Simon Newcomb, who never accepted Lowell's theory about the canals of Mars, nonetheless wrote of the Flagstaff observatory that "its situation is believed to be one of the best as regards atmospheric conditions."[32] Such comments indicate the extent to which geographical location had achieved parity with the other factors, such as professional rank and power of instrument, that defined an astronomer's credibility.

In the face of nonmetropolitan and tropical astronomers' rising prestige, in fact, city-based or weather-bound astronomers were forced to admit the inferiority of their own results. The Irish astronomer C. E. 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." Even those who resisted such self-flagellation nonetheless faced charges of inadequacy from outside, as 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]."[33]

Geographical movement and the representation thereof thus became ways for Mars

[31] Percival Lowell, *Mars* (Boston/New York: Houghton, Mifflin, 1895), p. v. See also A. E. Douglass, "The Lowell Observatory and Its Work," *Pop. Astron.,* 1895, *2:*395–402.

[32] 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* (Edinburgh/London: Black, 1902), Vol. 25, pp. 728–756, on p. 728. The Lick Observatory, situated atop California's Mount Hamilton, was completed in 1888. On Mars-related tropical expeditions see, e.g., Green, "Observations of Mars" (cit. n. 7); David Gill, "Mr. David Gill's Expedition to Ascension: Correspondence and Reports," *Month. Not. Roy. Astron. Soc.,* 1877, *38:*1–10; Percival Lowell, "On the Climatic Causes of the Removal of the Lowell Observatory to and from Mexico," *Observatory,* 1897, *20:*401–404; and "Lowell Expedition to the Andes," *ibid.,* 1907, *30:*429.

[33] C. E. Burton, "Notes on the Aspects of Mars in 1882," *Scientific Transactions of the Royal Dublin Society,* 1883, *1:*301–305, on p. 304; and Lowell to E. Walter Maunder, 28 Nov. 1903, Lowell Observatory Archives, Flagstaff, Arizona.

astronomers to achieve legitimacy. In terms familiar to the competing terrestrial geographical expeditions, remote and tropical observatories and observers claimed more authority than their urban counterparts based on their ability to "see" the Martian landscape without interference from polluted air. Those in nonremote positions lost some credibility and even admitted the inferiority of their situation, compared to the vantage points enjoyed by their expedition-going colleagues. These discussions essentially cast astronomy as a field science, where instrumentation was secondary to the location of study. For Mars as for Earth, it seems, the only credible way to investigate foreign geography was to mount an expedition and get out of town.

Gazing on the Martian Landscape

Not only did astronomers regularly go into "the field" to get results that would count as legitimate; they also adopted interpretive strategies from field scientists. Given the wide disparity in findings and the fundamental unverifiability of astronomical observations—made at different times in different locations with different instruments—Mars work was legitimized through a rhetoric of individual perception and intuition. At its core, then, the rhetorical maneuvering of the Mars astronomers drew on a prevailing view in the observational geosciences: that a landscape had to be seen to be understood.

With regard to Mars's temperature, for instance, visual observations of landscape change were held to be more authoritative than estimates based on computational analysis of the planet's mass and distance from the sun. According to theoretical calculations, Mars should be considerably colder than Earth—probably never above freezing—given that it is smaller and farther 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.[34] This visual evidence, equated with the behavior of polar snow and ice on Earth, seemed to suggest a seasonal melting of ice that would confirm Mars's average temperature to be considerably above freezing, at least during the summer.

Despite some protests that unproven hypotheses about the white patches should not be allowed to negate sound theoretical predictions about extreme cold on Mars, the "melting" of the "polar snows" was widely accepted as conclusive observational evidence that Mars had a temperature comparable to that of Earth. During the height of the discussion over the planet's hospitability to life forms, this conclusion about its temperature strongly contributed to the arguments of those who favored the view that Mars could support life. Even Schiaparelli, who was neutral on the issue, offered the opinion that "as far as 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."[35]

Another debate, closely related to the temperature question, also emphasized the observational characteristics of Mars science. Given that the polar caps were believed to melt, many observers logically assumed that the planet must have liquid water on its surface at

[34] John F. W. Herschel, *Outlines of Astronomy,* 10th ed. (London: Longmans, Green, 1875).

[35] Giovanni Schiaparelli, "The Planet Mars [Pt. 1]," *Astronomy and Astro-Physics,* 1894, *13:*635–640, on p. 640 (emphasis added). That Mars's "polar snows" "melted" was presented as common knowledge in general publications such as *Reynolds's Universal Atlas of Astronomy, Geology, Physical Geography, the Vegetable Kingdom, and Natural Philosophy* (London: Reynolds, 1876); George F. Chambers, *A Handbook of Descriptive Astronomy,* 3rd ed. (Oxford: Clarendon, 1877); and Simon Newcomb and Edward S. Holden, *Astronomy for Schools and Colleges* (New York: Holt, 1879). For an objection to this assumption see Marsden Manson, "The Climate of Mars," *Pop. Astron.,* 1895, *2:*371–374.

various times during the year. When tests failed to show any polarized light reflecting from dark areas of Mars's surface and the expected "flash" of sunlight glinting off water was never seen, however, Pickering proposed that the dark areas could be vegetation rather than oceans. This theory, which shortly became central to Lowell's inhabited-Mars hypothesis, rested on a detailed analysis of the visible patchiness and variability in the colors of Mars's surface. Although spectroscopic analyses were inconclusive in determining whether the water vapor necessary for vegetative growth existed in Mars's atmosphere, 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 thus explained: "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."[36] Once again, landscape-level observational analysis trumped theoretical or experimental findings.

Despite the difficulties of actually "seeing" the red planet from—at best—35 million miles away, 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, the optical characteristics of various instruments, or the atmospheric clarity of various locations—paramount issues for claims based on personal observation.[37] Astronomers thus used the evidence, rhetoric, and methods of observational field scientists, employing the geographical gaze to powerful effect. Just like the landscapes of central Africa or south Asia, Mars became knowable when it became visible. Likewise, Mars astronomers became credible when they claimed to have seen its landscape directly, with their own eyes.

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, astronomers successfully cultivated a reputation as adventurers. They associated with geographers, claimed that their true study was geography, borrowed imagery from geographers, and wrote popular works in the style of travel narratives. All of these practices contributed to the rise of popular interest in Mars and deepened the acceptance of a fundamental analogy between Earth and Mars.

[36] William H. Pickering, "Mars," *Astron. Astro-Phys.,* 1892, *11:*668–675; Pickering, "Colors Exhibited by the Planet Mars," *ibid.,* pp. 449–453; and Robert S. Ball, *In the High Heavens* (London: Isbister, 1893), p. 145. On the absence of polarized light reflections see G. H. Lepper, "An Examination of the Modern Views as to the Real Nature of the Markings of Mars," *J. Brit. Astron. Assoc.,* 1905, *15:*133–137. On the missing glint of sunlight on water see J. R. Holt, "The Solar Image Reflected in the Seas of Mars," *Astron. Astro-Phys.,* 1894, *13:*257–258; and "An Image of the Sun on the Martian Seas," *J. Brit. Astron. Assoc.,* 1894, *4:*260–261. For a detailed discussion of the heated debates over the spectrum of Mars see David H. DeVorkin, "W. W. Campbell's Spectroscopic Study of the Martian Atmosphere," *Quarterly Journal of the Royal Astronomical Society,* 1977, *18:*37–53.

[37] On matters of eyesight or perception see Simon Newcomb, "The Optical and Psychological Principles Involved in the Interpretation of the So-Called Canals of Mars," *Astrophysical Journal,* 1907, *26:*1–17; 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," *J. Brit. Astron. Assoc.,* 1903, *13:*344–351; and Percival Lowell, "On the Kind of Eye Needed for the Detection of Planetary Detail," *Pop. Astron.,* 1905, *13:*92–94. See also Sheehan, *Planets and Perception* (cit. n. 1). On the characteristics of various instruments see Lowell, "Double Canals and the Separative Powers of Glasses," *Pop. Astron.,* 1904, *12:*575–579.

From the start, Mars astronomers conceived of and labeled their activity as a geographical exercise, essentially giving themselves a new identity by association. Schiaparelli explicitly referred to geographical work in his influential observation report from 1877:

> 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.
>
> The 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.

Others were less direct but nonetheless emphasized the central importance of mapmaking to the study of other worlds. Edward Holden, for example, wrote, "There is certainly no more important question in planetary astronomy than to determine whether our neighboring planets are or are not inhabited. . . . 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."[38] Such comments suggested a fundamental connection between astronomical work and geography.

Those astronomers who were most successful in attracting the attention of broad popular audiences also cultivated personas as adventurers or geographers, directly comparing themselves with the famous polar explorers of the day. Lowell often reported on Martian polar changes and surface features as if he had actually visited the planet and witnessed them firsthand. He claimed, for instance, "Areography is a true geography, as real as our own. 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 the Martian globe." More directly, he reported that "there turns out to be at the south pole at the proper season, that dream of arctic explorers, an open 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."[39]

Thanks to what he insisted was an unimpeded view of the Martian poles, Lowell was able to claim that he had achieved a long-sought terrestrial triumph—discovery of an open polar sea—thus cultivating legitimacy in the public eye. He frequently said of Mars's poles, in fact, that they were more visible and better known than Earth's: "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." In discussing his map of one of Mars's polar regions, he 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."[40]

[38] 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 (1878; Springfield, Ill.: Association of Lunar and Planetary Observers, 1996), pp. 3, 1; and Edward S. Holden, "What We Really Know about Mars," *Forum,* 1892, *14:*359–368, on p. 359.

[39] Lowell, *Mars* (cit. n. 31), p. 93; and Percival Lowell, "Mars: The Polar Snows," *Pop. Astron.,* 1894, *2:*52–56, on p. 55.

[40] Lowell, "Mars: The Polar Snows," p. 54; and Percival Lowell, "Mars: The Water Problem," *Atlantic Monthly: A Magazine of Literature, Science, Art, and Politics,* 1895, *75:*749–758.

As this rhetoric reveals, astronomers' comparisons of themselves to the polar explorers were no accident. Astronomers clearly conceived the importance of their work to be in some sense geographical and rhetorically positioned themselves so that their successes contrasted with the difficulties and failures of a string of polar expeditions that had captured public attention and support. When Schiaparelli stated that "the same divisions and movements of these icy fields present themselves to us, at a glance, that occur during the summer of our own arctic regions, according to the descriptions of explorers," he was not only commenting on the appearance of the red planet but also making an implicit argument for the importance of continued Mars study. Similarly, 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," he was making a bid for public attention that would legitimize his Mars work.[41]

The strategy worked, as popular writers accepted the comparison without reservation. A writer for the *National Review* introduced the topic 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." The popular science writer E. T. Brewster opened his *Atlantic Monthly* review article, "The Earth and the 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.[42]

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, information about Mars acquired a sense of everyday relevance that eluded most other astronomical topics.

Given these connections between astronomy and geography, it is not surprising that quite a few of the more prominent Mars astronomers were intimately associated with geographical work and participated in social networks that included geographers. Schiaparelli, for instance, published on the meteorology and topography of Milan, and his personal papers show that he corresponded extensively with Italian and other European geographers. The draft for his second major memoir on 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

[41] Schiaparelli, "Planet Mars" (cit. n. 35), p. 636; and Lowell, *Mars* (cit. n. 31), p. 88. For a detailed discussion of the Victorian fascination with all things polar see Robert G. David, *The Arctic in the British Imagination, 1818–1914* (Manchester: Manchester Univ. Press, 2000).

[42] R. A. Gregory, "Mars as a World," *Living Age,* 1900, *225:*21–28, on p. 22 (rpt. from the *National Review*); and E. T. Brewster, "The Earth and the Heavens," *Atlantic Month.,* 1907, *100:*260–265, on p. 262.

Association. Similarly, Newcomb, the director of the Nautical Almanac Office, who became involved in the Mars debate as a proponent of the optical illusion theory, corresponded with American geographers and even served as an advisor to President Theodore Roosevelt on a proposed expedition to the Philippines.[43]

Lowell—the most active and influential advocate of the inhabited-Mars theory at the turn of the century—boasted professional geographical credentials as well. Before he founded his observatory in 1894, and long before he lectured on "The Geography of Mars" to the National Geographic Society in 1908, 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, he became fluent in the language of popular geographical writing and developed an understanding of the public appetite for sensational information about exotic foreign cultures.[44]

Lowell's writing—which combined descriptions of physical and cultural landscapes with the moralistic championing of Western culture—was characteristic of much popular geographical writing at the time, and he was very good at it. Against the backdrop of wide public interest in exploration accounts from Africa, expedition reports from the North and South Pole expeditions, and newspaper coverage from the emerging American imperial spheres in Central America, the Caribbean, and the Pacific, Lowell's views on how Japanese and Korean peoples fit into a global spectrum of socioracial development resonated with his American readers.[45]

Mars in the Image of Earth

It was not merely Lowell's identity and reputation as an esteemed travel writer that positioned him for success as a popular astronomy writer, however. His command of the conventions of popular geographical writing and his understanding of its appeal also served him well in promoting his views of Mars as a civilized world. Lowell typically employed the standard geographer's convention of constructing analogies to help readers understand foreign subjects in familiar (if simplistic) terms. For instance, he compared the size and

[43] G. V. Schiaparelli, "Topografia e clima di Milano," in *Le opere di G. V. Schiaparelli,* 11 vols., Vol. 11 (1881; Milan: Hoepli, 1943), pp. 355–396; Schiaparelli, draft copy of *Marte,* Ch. 3: "Osservazioni sull'aspetto presentato dalle vari regioni del pianeta durante l'opposizione 1879," Fondo Schiaparelli, Archivo Storico, Osservatorio Astronomico di Brera; and Theodore Roosevelt to Alexander Agassiz, 26 Dec. 1902, Newcomb Papers (cit. n. 22).

[44] Percival Lowell, "The Geography of Mars: Lecture to the National Geographic Society, Washington, D.C.," 3 Jan. 1908, unpublished lecture notes, Lowell Observatory Archives (cit. n. 33); Lowell, *Chosön: The Land of the Morning Calm: A Sketch of Korea* (Boston: Ticknor, 1886); Lowell, *Noto: An Unexplored Corner of Japan* (Boston: Houghton, Mifflin, 1891); and Lowell, *Occult Japan; or, The Way of the Gods: An Esoteric Study of Japanese Personality and Possession* (Boston: Houghton, Mifflin, 1894).

[45] Percival Lowell, *The Soul of the Far East* (Boston/New York: Houghton, Mifflin, 1888). Strauss shows in *Percival Lowell* (cit. n. 2) that Lowell attempted to characterize Asian development levels on a Spencerian hierarchical scale "from savage to civilized." Noting the advancement of Japanese art and the flaws of Western industrialism, Lowell developed a view of individuality as the pinnacle of human societal evolution in order to "validate something truly valuable in East Asian culture [i.e., art] that was, nonetheless, not the equal of Western achievement in science" (p. 129). He similarly relied on Spencer in his study of Mars, Strauss shows, basing his proofs of extraterrestrial life on a modified version of Spencer's nebular hypothesis (originally posited by Pierre Simon Laplace) that claimed the inevitable development of the solar system, a common origin for all planets, and the necessary evolution of life on all planets. On the popular geographical writing of the period see David Spurr, *The Rhetoric of Empire: Colonial Discourse in Journalism, Travel Writing, and Imperial Administration* (Durham, N.C.: Duke Univ. Press, 1992); Tim Youngs, "'My Footsteps on These Pages': The Inscription of Self and 'Race' in H. M. Stanley's *How I Found Livingstone,*" *Prose Studies,* 1990, *13:*230–249; and Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 1992).

probable operation of the Martian canals to the well-known waterway at Suez and contrasted their geometric appearance with the winding Mississippi River. He 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." Many other Mars observers followed 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, the South African veldt, and so forth. Lowell's rhetorical style also carefully separated what he termed "fact" (what he saw) from "speculation" (what he deduced), reinforcing the idea that eyewitness observation and actually "being there" in the landscape established an irreproachable validity. Additionally, Lowell's publications were filled with maps, sketches, and, later, photographs that were meant to legitimize his first-person narratives as objective, believable claims.[46]

To audiences well versed in the geographical language of scientific exploration and conquest, these conventions not only rendered Martian landscapes more familiar but also reinforced the notion that Mars could be conceptually controlled. Even when claiming that Mars was totally different from Earth, astronomers consistently used terrestrial analogies that constructed its physical geography as not only worldlike but specifically Earthlike. For instance, Holden argued in 1892 that terrestrial analogies failed to explain the seasonal color changes on Mars but then in the same paragraph suggested a terrestrial analogy to explain the faintly colored regions of the planet: "Are they vast shoals like the Grand Banks of Newfoundland?" Similarly, Schiaparelli wrote in 1893 that the general topography of Mars "does not present any analogy with the Earth" but then went on to note 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." Yellow areas on Mars were compared to the hues of Earth's own Sahara Desert, and its atmosphere was said to be akin to the rare air found at the top of the Himalayan Mountains. In using these analogies, astronomers echoed and reinforced Sir Robert Ball's early comment: "This globe is 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."[47]

Such direct comparisons inevitably raised the issue of inhabitants on Mars. Once told 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," readers had to make only the smallest conceptual leap to imagine actual Martian cities. Similarly, reports that the annual melting of Mars's polar ice caps "is of as much importance as the annual inundation of the Nile is to the Fellaheen of Egypt" helped cast Mars as a specific, legible, populated landscape. The fact that many of these comparative comments were made by astronomers and writers (such as Ball, Holden, and Antoniadi) who expressly rejected the general idea of plurality or remained unconvinced about the specific habitability of Mars did not diminish their

[46] Lowell, "Mars: The Water Problem" (cit. n. 40), p. 750; and Lowell, "New Photographs of Mars: Taken by the Astronomical Expedition to the Andes and Now First Published," *Century Magazine,* 1907, *75:*303–311. Tucker's "Science Illustrated" (cit. n. 25) includes a detailed discussion of how Lowell used photographs to shore up his credibility in the face of criticism.

[47] Edward S. Holden, "Note on the Mount Hamilton Observations of Mars, June–August 1892," *Astron. Astrophys.,* 1892, *11:*663–668, on p. 668; Giovanni Schiaparelli, "The Planet Mars [Pt. 2]," *ibid.,* 1894, *13:*714–723, on pp. 714, 719; E. M. Antoniadi, "Section for the Observation of Mars: Report of the Section, 1896," *Mem. Brit. Astron. Assoc.,* 1898, *6:*55–102 (Sahara Desert); Percival Lowell, "Mars: Atmosphere," *Pop. Astron.,* 1894, *2:*154–160 (Himalayan Mountains); and Robert S. Ball, *In Starry Realms* (London: Isbister, 1892), p. 150. See also Driver, *Geography Militant* (cit. n. 24).

persuasiveness. For many scientists and popular readers, geographical analogy was taken as definitive proof that Mars was like Earth: inhabited.[48]

PUTTING MARS IN GEOGRAPHICAL CONTEXT

Repeated use of geographers' conventions, competition for geographers' prestige, and cultivation of geographers' audiences clearly show that astronomers borrowed powerful representational strategies from the discipline of geography. This process of interdisciplinary adoption and modification helps to explain how outlandish and even illogical claims could become ingrained as scientific truths. Further, it suggests that the colorful narratives of Mars and its supposed inhabitants might be productively reexamined as *geographical* claims. To demonstrate the benefits such recontextualization offers, I will briefly examine the narratives that emerged from Mars science in the context of other descriptions of foreign landscapes and peoples.

Constructing a Familiar Landscape for Mars

Early speculative comparisons of Mars to various lush, watery regions known on Earth gave way by the turn of the century to a captivating and enduring construction of the red planet as an arid, irrigated landscape. In Schiaparelli's 1877 map dark areas were painted blue and labeled as oceans. By the mid 1890s, however, the dark areas had been recast as sparse vegetation, with the "ochre" stretches of the planet referred to as "one vast desert waste." The circular "lakes" had become "oases," and the irregular water's-edge look of Schiaparelli's first map had given way to an increasingly geometric appearance (see Figure 4).[49]

Lowell's aggressive promotion of his inhabited-Mars theory in 1894 and 1895, in fact, relied on a view of Mars as a dying desert world. On the basis of landscape observations, he insisted that Mars was undergoing a natural evolutionary process of unrelenting planetary desertification. The geometric lines, according to this hypothesis, comprised an ingenious network of irrigation canals built by intelligent inhabitants to protect themselves from the destructive effects of desiccation. Seasonal snowmelt from the polar caps was conveyed by artifice and gravity to the tropics, where it watered a parched landscape, eventually evaporated into suspended water vapor, and was then circulated by light air currents back toward the poles for wintertime deposition as ice. The visible "canals" were said to be not the watercourses themselves but, rather, thirty-mile-wide swaths of vegetation running alongside the system of waterways. These relatively frail lines on the map (see Figure 4) were nearly lost in a landscape that appeared as "really one vast Sahara, a waterless waste."[50]

Lowell was not alone in using such language. As other astronomers and popular science writers took up the desert chorus, they echoed language coming from the explorers of their

[48] Robert S. Ball, "Mars," *Living Age,* 1892, *195:*195–205, on p. 203; and Gregory, "Mars as a World" (cit. n. 42), p. 23. Crowe asserts in *The Extraterrestrial Life Debate* (cit. n. 1) that logical fallacies—such as the mistaking of analogy for proof—were instrumental to most of the claims made by early Mars scientists.

[49] Percival Lowell, "Mars: Seasonal Changes on the Planet's Surface," *Astron. Astro-Phys.,* 1894, *13:*814–821, on p. 821; and Lowell, "Mars: Oases," *Pop. Astron.,* 1895, *2:*343–348.

[50] Lowell, "Geography of Mars" (cit. n. 44), p. 15. Lowell presented these arguments in multiple articles and books, such as *Mars* (cit. n. 31); and Percival Lowell, *Mars and Its Canals* (New York: Macmillan, 1906). I would like to thank Robert Markley for very generously sharing with me a draft of his forthcoming *Dying Planet: Mars in Science and the Imagination* (Durham, N.C.: Duke Univ. Press, 2005) as I was revising this article.

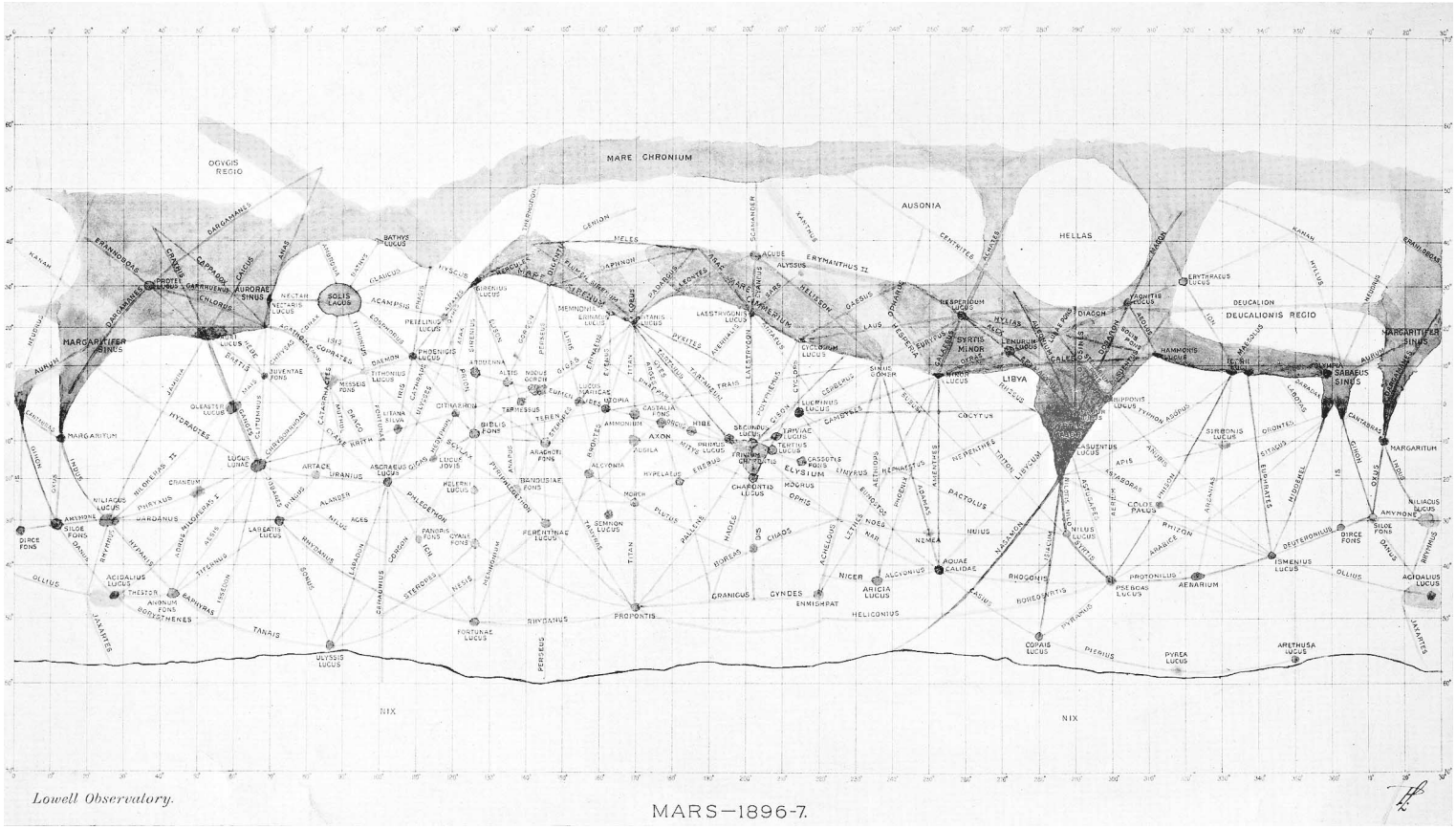

Figure 4. *Mercator projection map by Percival Lowell, 1897. Originally published in* Annals of the Lowell Observatory, *1905, p. 3. Courtesy Lowell Observatory Archives.*

own planet. The famous French survey of Egypt during the 1798–1801 invasion campaign, for instance, had fascinated European readers with its maps, sketches, and descriptions of a waterless landscape in which civilization depended heavily on irrigation systems. When the British assumed control of Egypt later in the nineteenth century, they used the British territories in South Asia as a training ground for irrigation engineers who were then brought to North Africa to reclaim the desert. In the frontier territories of Lowell's own country—including his observatory's home base of Arizona—water management had emerged as a major concern, limiting settlement expansion and economic development.[51]

Alongside these prominent terrestrial narratives of aridification, climate change, and resource depletion, scientific depictions of Mars allowed for a conceptual projection of emerging anxieties that functioned as a powerful geographical narrative. For instance, Mars was thought to have lost its once-extensive oceans and become a desert world as it aged, with Lowell's canals representing the last hope for any unlucky inhabitants. And if the nebular hypothesis was to be believed, all planets cooled and shed moisture as they aged, eventually becoming as dry and dead as the moon. Thus Mars, being further evolved than Earth, became a type of futuristic looking glass, where the supposed Martians' water-management challenges figured as a certain future scenario for Earth.[52]

As the inhabited-Mars hypothesis became sensationally popular, fiction writers began to use an arid Mars as an allegorical setting for Western civilization's environmental challenges, going well beyond Lowell's science to express and address their anxieties about resource decay and depletion at home. In Lowell's depiction, the Martians had responded to their crisis calmly and rationally by increasing their social organization and developing fantastic new technologies. In alternative fictional scenarios, however, the planet was depicted as having been plunged into global mayhem, with warfare, struggles over resource control, and anxieties about possible catastrophe governing daily life.[53] In this sense, the tropes of a familiar landscape—casting Mars as Earth—provoked a certain disquiet.

Projecting an Alien Cultural Geography

Scientific representations of the red planet also raised issues of Mars's cultural geography in ways that did little to relieve the anxieties associated with its physical landscape. Cultural representations of the imagined Martians drew from both Social Darwinist philosophy and the orientalist tradition of geographical writing. These undertones not only reflected the intellectual context in which astronomers and science writers were working but also shaped popular interest in the subject of Mars as an inhabited planet. The most significant facet

[51] 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,* 1995, *20:*5–28; and 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,* 2002, *92:*548–572.

[52] Percival Lowell, *The Evolution of Worlds* (New York: Macmillan, 1909). On narrations of terrestrial climate change and resource depletion see A. T. Grove and Oliver Rackham, *The Nature of Mediterranean Europe: An Ecological History* (New Haven, Conn.: Yale Univ. Press, 2001); Diana K. Davis, "Environmentalism as Social Control? An Exploration of the Transformation of Pastoral Nomadic Societies in French Colonial North Africa," *Arab World Geographer,* 2000, *3:*182–198; 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), pp. 5–36; and Roderick Nash, *Wilderness and the American Mind* (New Haven, Conn./London: Yale Univ. Press, 1967).

[53] Lowell describes the Martians' calm response to environmental challenges in *Mars* (cit. n. 31). In contrast see, e.g., Edgar Rice Burroughs, *A Princess of Mars* (1917; New York: Dover, 1964) (first serialized in *All-Story Magazine* in 1912).

of the Martian representations in this context was the presentation of a superior Other that conceptually challenged the traditional self-image of Westerners and scientists as occupying the pinnacle of a structured cultural hierarchy.

Although speculations about extraterrestrial life had been raised throughout history, the turn of the twentieth century saw an unprecedented scientific, intellectual, and popular acceptance of the possibility that Mars hosted intelligent beings. Starting with the publication of Schiaparelli's map in 1877, the notion of Martian inhabitants was intimately tied to the supposed artificiality of the planet's landscape. By century's end, Lowell relied almost exclusively on the geometrical appearance of the Mars maps for his argument that the planet was inhabited. Noting that Martian canals were typically seen to be a thousand miles long (or more) and that they followed the arcs of great circles, sometimes stretching from pole to equator without any deviation, he furthermore credited the Martians with supremely advanced intellects, an unthinkable mastery of technology, and utopian levels of social organization: "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."[54] Such characteristics were said to have arisen deterministically from the planet's desiccation crisis: environmental pressures had supposedly spurred natural selection of higher and better traits in the surviving Martians, thereby producing evolved beings unlike any that had ever lived on Earth.

Skeptical scientists and writers found it difficult to temper the enthusiasm Lowell generated in the popular press. Many of those who harbored opposition to his newly popular theory of Martian habitability, however, had themselves laid the groundwork for its acceptance. In describing the appearance of the growing and shrinking of Mars's white caps, for example, early astronomers regularly commented on how Earth's polar caps might appear to a Martian observer, thus inadvertently postulating a believable inhabitant on the red planet. In its many variations, the trope usually painted the hypothetical Martian as an intelligent, scientific astronomer, capable of casting a penetrating reverse gaze toward Earth:

> These facts . . . lead us to speculate as to the kind of inhabitants there may be upon that faraway 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 pole? Are they a race of great engineers, and do they construct public works on a gigantic scale?

This rhetoric of Earth's visibility from Mars was used by many writers, including, significantly, some who argued against the similarity of the two planets. Robert Ball, for one, did not support the idea of life on Mars; yet his writing reinforced the idea of an inhabited Mars by invoking hypothetical inhabitants: "Quite otherwise would be the appearance which our globe would present to any observer who would view it say from Mars, or from some other external world at the same distance. The greater part of our globe would seem

[54] Lowell, "Mars: Oases" (cit. n. 49), p. 234. Regarding the unprecedented acceptance of the idea of Martian life see Guthke, *Last Frontier,* trans. Atkins (cit. n. 1). Crowe traces belief in plurality back to antiquity; see Crowe, *Extraterrestrial Life Debate* (cit. n. 1).

swathed with vast clouds through which only occasional peeps could be had at the actual configuration of its surface."[55]

And so the canals not only came to be used as evidence that Mars was almost certainly inhabited but also served as the primary clues to what the supposed Martian civilization was like. On the evidence of their artificial landscape—a technical wonderland of engineered topography, controlled water, and efficient agriculture—the Martians were thought to be superior to Earth's inhabitants in intellect, organizational abilities, and social advancement. Much of the power of this view drew from Lowell's linking of his Mars hypothesis and his Social Darwinist vision of racial hierarchy as a natural law. In painting the desert Mars and its environmentally determined culture as a futuristic vision of Earth, Lowell relied heavily on a belief in Spencerian philosophy and its concomitant theories of the unity of natural and social laws. Though Spencerian philosophy was past its prime as an explanation of the physical laws of the universe, the social dimension that gave rise to Social Darwinist thought continued to resonate in popular and scientific geographical writing about other cultures.[56]

In the Lowellian vision of Mars, every individual accepted his place (i.e., class) in society, acceded to the power of the state, and appreciated the societal leadership of the upper classes. As impending environmental crisis was sure to hasten the competitive selection process, Lowell believed that those societies at the upper end of the racial hierarchy were destined to succeed by virtue of their natural superiority.[57] Throughout Lowell's writings, noble, high-class Martians served as laudable exemplars of effective resource management and peaceful social organization, Lowell's prescribed remedies for the Western world's own ills. In moralistic and prescriptive tones—the same voice he had adopted for his books about Japanese and Korean culture—Lowell aggressively promoted his view of the world and vilified anyone who dared challenge his Martian hypothesis.

Martian narratives also participated in the broader process we now identify as "orientalism"—the discursive construction of geographical knowledge about foreign landscapes and peoples through uncritical repetition of simplistic yet powerful tropes. In the terrestrial realm, orientalist practice and Social Darwinist philosophy helped to define the fledgling discipline of geography and establish its importance to Western imperialism in the mid- to late nineteenth century.[58] Among astronomers and science writers, the repetition of various tropes—the polar caps, the canals, the oases, the climate—served to reinforce an imaginative geography of Mars as alien and impenetrable, yet open to the scientific gaze of the telescope.

Despite their many similarities with writings in the orientalist tradition, however, the

[55] H. C. Wilson, "Mars and His Canals," *Sidereal Messenger,* 1889, *8:*13–25, on p. 14; and Ball, "Mars" (cit. n. 48), p. 202. 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,* ed. Lightman (Chicago/London: Univ. Chicago Press, 1997), pp. 187–211.

[56] David N. Livingstone, "The Geographical Experiment: Evolution and Founding of a Discipline," in *The Geographical Tradition* (Oxford: Blackwell, 1993), pp. 177–215. See David Sutton Dolan, "Percival Lowell: The Sage as Astronomer" (Ph.D. diss., Univ. Wollongong, 1992), for a discussion of Lowell's belief that his role as a scientist and intellectual was to interpret the natural world and spread his interpretations to the masses. Strauss's excellent biography treats Lowell's 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 was Alexander von Humboldt, whose five-volume *Cosmos* sought to explain the operation of the universe": Strauss, *Percival Lowell* (cit. n. 2), p. 101.

[57] Dolan, "Percival Lowell."

[58] Livingstone, "Geographical Experiment." More broadly, see Edward W. Said, *Orientalism* (New York: Pantheon, 1978).

scientific and popular narratives regarding Mars differed from geographical narratives in important ways. In contrast to the orientalist propensity to erase existing cultures from foreign landscapes, the Mars narrative actually projected unseen inhabitants. The map of Mars, in fact, was once said to be "too full"—with "none of the tantalizing blank spaces" that exist on Earth's map.[59] More important, the very elements responsible for the map's "fullness"—the canals—were generally understood as the imagined Martian inhabitants' self-representations, the visible expressions of their agency. Compared to the lack of subjectivity generally afforded to colonial subjects, this attribution of representational ability to the Martians is remarkable.

In essence, the Martians' presumed superiority was the key to their popularity—but also a source of anxiety. On the one hand, following Lowell, the Martian irrigation network could be seen as a model of efficiency and peaceful organization, a success story to inspire Earth's inhabitants. On the other, the existence of a race more powerful and intelligent than humans was frightening. What if there was a meeting of the two cultures? Would Earth's leading imperial powers become the new "savages"?[60] The Martian behind the telescope knew more about Earth than the American or British astronomer could claim to know about Mars. The Martian canal engineer had achieved unthinkable skill in earth moving and water control. To the poor observer at home on Earth, these achievements seemed impossible. The anxieties that accompanied imaginings of Earth as physically similar to a dying Mars were thus not relieved by the shift to imagining Mars as culturally alien from, and superior to, Earth.

CONCLUSIONS

Comparison of texts and images depicting Mars with geographical representations from the turn of the twentieth century reveals that astronomers often relied on geographical conventions to promote their claims about the nature of the red planet. The visual authority of Schiaparelli's 1877 map powerfully inscribed his canals as real features, despite initial opposition. His map (and others) gave rise to a powerful new view of Mars as a geographical world with an artificial landscape. Subsequent maps became even more artificial in appearance, visually refuting even the most logical natural explanations for Mars's appearance. In conjunction with the map, astronomers' use of representational styles and tropes drawn from geographical writing further solidified the view of Mars as an Earthlike, inhabited planet. Even those astronomers who rejected the inhabited-Mars theory contributed to its popular establishment by participating in a geographical discourse that fascinated popular audiences.

In making the link between geographical and astronomical science more explicit, this essay further suggests that turn-of-the-century representations of Mars should be contextualized as geographical writing. Preliminary analysis proposes that the competing tropes of familiarity and alienness that resonate throughout the narratives of Mars echo the anxieties at work in Western scientists', science writers', and audiences' conceptualizations of foreign lands and peoples. Depictions of Mars's landscape as familiar or even utopian were tempered by the underlying narrative of environmental decay as the future of Earth.

[59] Brewster, "Earth and the Heavens" (cit. n. 42), p. 262. On erasure see Simon Ryan, "Inscribing the Emptiness: Cartography, Exploration, and the Construction of Australia," in *De-scribing Empire: Post-Colonialism and Textuality,* ed. Chris Tiffin and Alan Lawson (London: Routledge, 1994), pp. 115–130.

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

Yet depictions of Mars's culture as alien were equally uncomfortable in that they forced readers to admit and confront the weaknesses and imperfections of human cultures, which were generally agreed to be inferior to the Martians' imagined civilization.

The geographical representations of Mars did not end in 1910, of course. Although scientists generally stopped taking the notion of an inhabited Mars seriously after the first decade of the twentieth century, cultural narratives for Mars continued to blossom in fiction and other popular genres well into the 1920s and 1930s.[61] The prominence of Mars in American popular culture in the early twentieth century certainly drew on the planet's established geographical meanings. Similarly, NASA's midcentury 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 the scientific imagination. After the first successful Mariner missions of the 1960s, scientific cartography again became a way of projecting terrestrial ideals onto the Martian surface.[62]

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.[63] In this sense, 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 Mars's geography and with the possibility of using it as a future home for humans, we would do well to begin with the tropes and ideas produced a century ago.

[61] For a discussion of the codependence of science and science fiction in the late Victorian era see Paul Fayter, "Strange New Worlds of Space and Time: Late Victorian Science and Science Fiction," in *Victorian Science in Context,* ed. Lightman (cit. n. 55), pp. 256–280.

[62] See "Mars: MEC-1 Prototype," one of several maps produced for the Mariner missions by the Aeronautical Chart and Information System of the U.S. Air Force. This 1962 Mercator projection map, which uses an equatorial scale of 1:35,000,000, shows dozens of linear and spokelike markings that are noted as "representative of the 'canals' as they have been drawn by many prominent observers of Mars." Lowell's close associate E. C. Slipher, who was still at the Lowell Observatory in 1962, is one of two astronomers credited for "advisory assistance" on the map. For further discussion of the ways in which space-age Mars maps reflected terrestrial imaginations see Oliver Morton, *Mapping Mars: Science, Imagination, and the Birth of a World* (London: Fourth Estate, 2002).

[63] Richard A. Kerr, "Breakthrough of the Year: On Mars, a Second Chance for Life," *Science,* 2004, *306:*2010–2012.