Maps, Images, and Icons: Creating the Geography of Mars

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This essay shows that maps, images and icons were central to the production of a contested geographical knowledge about Mars during a popular frenzy over the red planet from about 1890 to 1910. It reviews the history of Mars science and popular interest in the surface features of Mars, showing how geographical concerns were central to astronomers, other scientists, and general audiences alike. It focuses mainly on map production and mapping controversies, showing how cartographic icons became important drivers of belief in the existence of intelligent life on Mars.

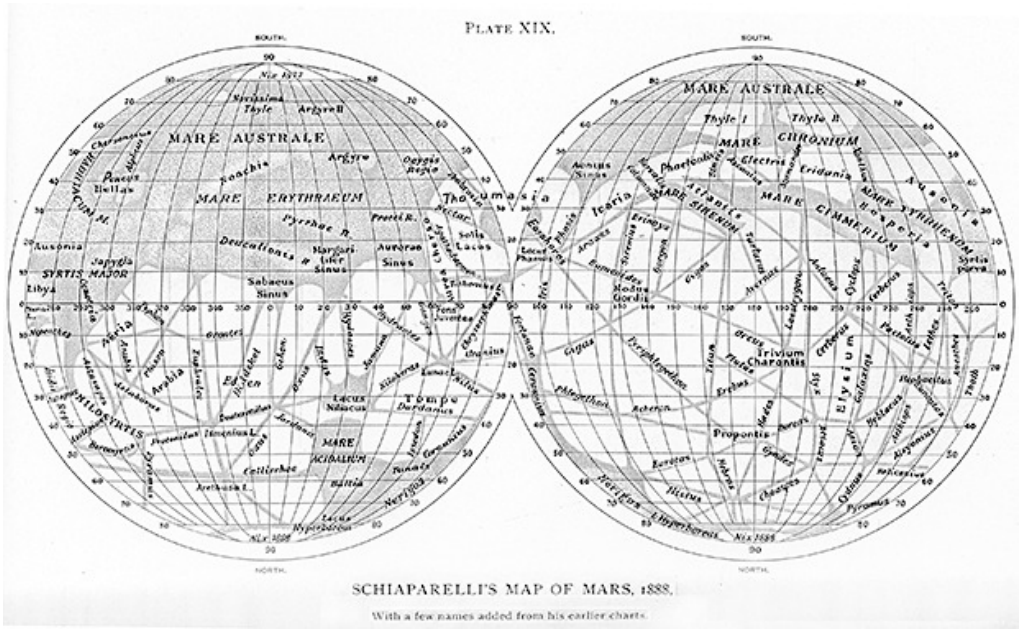
In today's scientific and mainstream news reports, images of the planet Mars abound. In false color, true color, infrared and stereo, observers can now view the planet's surface in a variety of highly manipulated formats. The increasing sophistication of camera technology and data processing tools over the last two decades has allowed robotic exploration missions to create dramatic images of surface characteristics, like soil chemistry, that are invisible to terrestrial observers on their own home planet. As a result, popular support for Mars exploration is now tied directly to iconic scientific images of Mars that show the planet's remote surface as visible, navigable, and sublime. Exploratory mission teams now explicitly discuss image production as part of their mandate, intentionally producing images for public consumption in concert with those needed for scientific inquiry. [1]

A century and a half ago, the situation was largely comparable. Although scientific inquiries and viewing technologies were admittedly different from those that dominate today's Mars research, the popular impact of Mars-surface imagery was dramatically similar. When widespread telescopic Mars observation began in the mid-1800s, scientists were highly uncertain about Mars's essential characteristics. It can be hard to understand this uncertainty in the modern age, when GoogleMars is freely available to computer users who wish to visually ‹fly› through the Martian landscape and observe its terrain from the comfort of their own homes. But last century's uncertainties about Mars inspired considerable debate over the planet's landscape features as well as over the proper methods that should be used to understand Martian geography. As these scientific debates intersected with popular interest in extraterrestrial life, many discussions about Mars, and its capacity to host intelligent life, revolved around maps and cartographic icons.

In this essay, I review the history of a Mars-related frenzy that unfolded from about 1890 to 1910, showing the many ways in which visual images and icons were central to the production of a contested geographical knowledge about Mars. The paper begins with a brief introduction to Mars science at the turn of the twentieth century, highlighting analytical perspectives that help us understand astronomers' speculation that the Martian landscape was crossed with intersecting canals. It then explores the maps and mapping of Mars, beginning with a discussion of some key transitions in Mars map production in the late nineteenth century. It examines a major controversy in 1877-1878 over cartographic appearance and placenames on various Mars maps, showing that the visual authority of certain maps contributed to beliefs that Mars was inhabited. It then offers a cartographic explanation for the reduction of belief in Martian life after 1909, before concluding with some thoughts about the role of icons and imagery in fusing astronomical science with themes, methods and theories from the discipline of geography. [2]

Understanding the Mars canal craze

Toward the end of the nineteenth century, some American and European astronomers reported seeing spoke-like patterns on the Martian surface during their telescopic observations [fig.1]. Not every observer could see these patterns, but those who observed from locations with calm atmospheric conditions or those who used high-powered telescopes were more likely to see the intersecting lines than viewers using small telescopes.



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As a result, there was an early general acceptance that intersecting lines on Mars were real features in the Martian landscape, rather than optical illusions or visual disturbances.

Astronomers struggled, however, to interpret the unexpected patterns they perceived on Mars. The lines did not look like anything that could have been produced by natural geological or geomorphological processes, given that the spokes appeared to be unwaveringly straight over thousands of miles, with an unlikely number of straight lines meeting at perfectly round intersections. This curiosity raised the question of whether intelligent beings were responsible for modifying the planet's surface, either through agriculture, engineering, or some unknown activity. As astronomers pondered this likelihood, an influential explanation was put forward in the 1890s suggesting that the lines and patterns could be a system of irrigation canals used to bring seasonal snowmelt from the polar regions on Mars to the drier tropical and equatorial zones where inhabitants were most likely to reside. [3]

Today, we believe that the geometrical appearance observers noted during their nineteenth-century telescope observations was actually an illusory optical effect. At the time, however, the spoke-like patterns were taken at face value, prompting a widespread popular interest in Mars and a serious consideration of the possibility that Mars might be inhabited. [4]

Scientists, science writers and literary commentators responded to astronomers' astonishing reports in a wide variety of publications: scientific journals, newspapers, public lectures, pamphlets, magazines, books, and serialized fiction. The inhabited-Mars hypothesis was not accepted by everyone, especially not by leading astronomers who cautioned that it would be almost impossible to definitively prove the existence of Martian inhabitants even if they did exist. But the inhabited-Mars hypothesis achieved broad legitimacy with certain audiences, spurring a mania of speculation into the 1910s over what the Martians were like and how to communicate with them. A number of works were written about Martian irrigation, focusing on topics from the inevitability of landscape and climate change, to the promise of environmental engineering and the possibility of global social organization. In hindsight, it is unsurprising that these topics were of high interest to mainstream readers in both Europe and North America, regions that had deep theoretical and practical interests in how these same issues might influence their imperial and expansionist activities around Earth's globe. [5]

Looking back at this episode with a historical lens, some analysts have wondered how the story of an irrigation-based society of intelligent Martians was ever engaged as a serious proposition. Some have been temped to discount it as an example of science gone wrong, as a hoax, or as something more related to fiction and fantasy than to science. Others have taken the Mars frenzy seriously as a culturally meaningful development, usually focusing on the powerful role some astronomers played in influencing popular interest. These scholars have looked at astronomers' personalities, philosophical beliefs, and social networks for clues that help explain this influence. Such works have helpfully identified religion, the theory of evolution, and the culture of science popularization as key factors that led to rampant speculation about Mars and its supposed inhabitants. [6]

Building on this, my own research has worked to put the Mars frenzy and the debates over Martian geography into the context of other intellectual and geopolitical developments that were occurring at the same time. In focusing an analytical lens on the geographical elements of the turn-of-the-century Mars debates, I argue that much of the power of astronomers' claims actually came from the visual and iconic format in which they were most often presented – the map. Maps served not merely as graphic repositories for astronomers' observational data; they also presented visual arguments, sometimes unintended, for the existence and character of intelligent life on Mars.

First Maps of Mars

Starting in the mid-nineteenth century, improvements in telescope technology made it possible for astronomers to observe the planet Mars in better detail than ever before. Newly visible details, however, were not definitely known to be permanent landscape features, as some suspected they might be clouds or atmospheric phenomena similar to those on Venus and Jupiter. Given this uncertainty, observers typically used a representational convention of producing single-view sketches that showed the appearance of Mars's disk as observed at a single place and time. This form of mapping or sketching implicitly acknowledged that different viewers might see different things, even when observing Mars at the same time. [7]

Over time, as certain details were seen by different observers to appear repeatedly in the same location on Mars's disk, astronomers concluded that they must be viewing the visible surface of Mars, rather than a mass of swirling cloudcover. As this certainty improved, the representation of Mars evolved from the single-view sketches into composite mapping formats that used compilations of multiple observations to produce global charts of the planet.

When German astronomers Wilhelm Beer and Johann Madler first applied a latitude/longitude graticule to Mars in 1840, they essentially created a base map for other observers who could then add detail from their own observations after each biennial observation season. The expectation from that point forward was that all observers of Mars should see the same features on Mars, in the same places on its surface, time and time again. Individual observations from multiple viewings could thus be incorporated into a composite map that represented a sum total of scientific knowledge about the Martian surface.

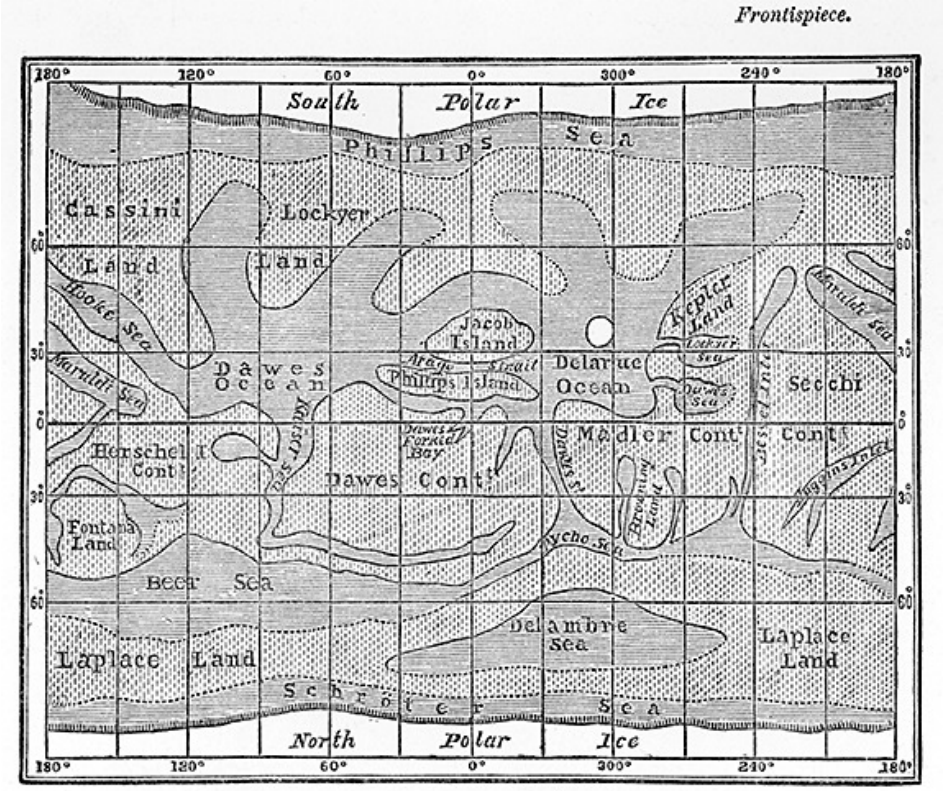

CHART OF MARS ON MERCATOR'S PROJECTION.

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As astronomers added new detail to the Mars map throughout the 1860s and 1870s, a significant popular interest developed around the landscape and geography of Earth's neighboring planet. I argue that this interest developed largely because of the way the planet was mapped. The primary views preferred by the astronomer-cartographers of Mars were the Mercator [fig.2] and stereoscopic [fig.3] projections. The Mercator projection was then very well known as a navigation map. Although Mercator maps introduce significant distortion of the shape and area of polar and sub-polar latitudes, their straight lines of latitude and longitude allowed explorers to orient themselves to the map by cardinal direction.

Use of this projection therefore implicitly introduced the idea that Mars was going to be understood in the same way as well-known sites of terrestrial navigation and exploration, like the tropical spheres of imperial expansion or of colonial settlement. The stereoscopic projection, on the other hand, mimicked the shape of earlier Mars sketches, thus relying on their perceived accuracy and objectivity. Furthermore, stereoscopic maps drew on popular excitement for new visual technologies, like the stereoscope, that promised to reveal new insights by offering visual access to phenomena that had previously been invisible to the naked or unaided eye. The emerging cartographic and visual formats of the Mars maps thus played a significant role in engendering popular interest in Mars, as well as influencing the nature of that interest. [8]

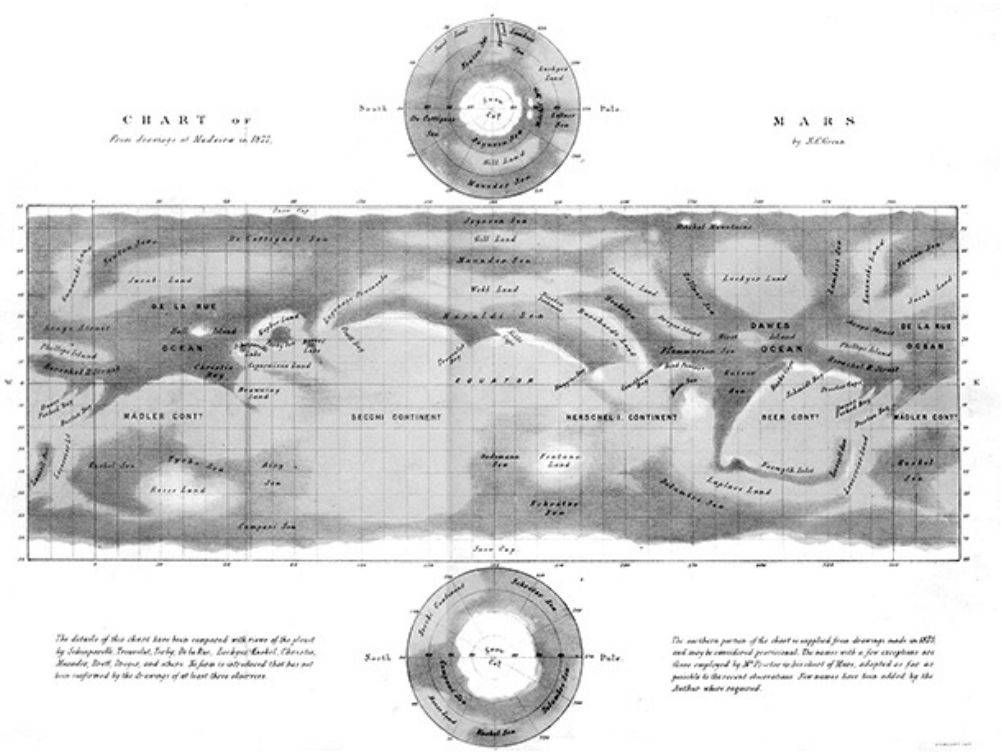
The Mapping Controversy of 1877-1878

The map of Mars was augmented throughout the nineteenth century as observational detail was added every time Mars made its biennial orbital lap past the Earth, sometimes passing close enough for excellent telescopic viewing. After decades of incremental cartographic development, a major mapping controversy then developed in the 1870s and 1880s, leading to major changes in scientific perspectives on Mars as well as to widespread popular belief in Martian canals and inhabitants. To understand these scientific and popular developments, it is critical to understand what was happening with the Martian map.

In the summer of 1877, Mars passed Earth very nearly at the point where the two planets' elliptical orbits are closest to each other and also closest to the sun. This combination of Mars's being extremely close to Earth and also highly illuminated offered an exciting opportunity for astronomer-cartographers to improve their maps of the red planet. After the planetary conjunction, two important maps became embroiled in controversy, one by the British astronomer Nathaniel Green and another by the Italian astronomer Giovanni Schiaparelli. Both of these maps capitalized on the opportunity to present incredible new geographic details for Mars, yet the two maps were so radically different that most astronomers felt the need to reject one of the maps in order to accept the other as correct. To understand how these maps differed in appearance and in their impact on map viewers, this section examines both the production and consumption of the Schiaparelli and Green maps.

Green, an English amateur who was a portrait artist and landscape painter by profession, left his London home and voyaged to the Portuguese island of Madeira to observe Mars during the summer of 1877. For two months, he observed Mars under good conditions and created 41 painstaking detailed color sketches of Mars.

After his expedition, he returned to England and used the sketches to prepare a new map [fig.4]. Incorporating his own observations with many others that had been completed in recent years, Green produced the most detailed map yet known for Mars. He used a striking naturalistic style of representation to present a cartographic view of Mars that was as similar as possible to what appeared in the telescope. [9]



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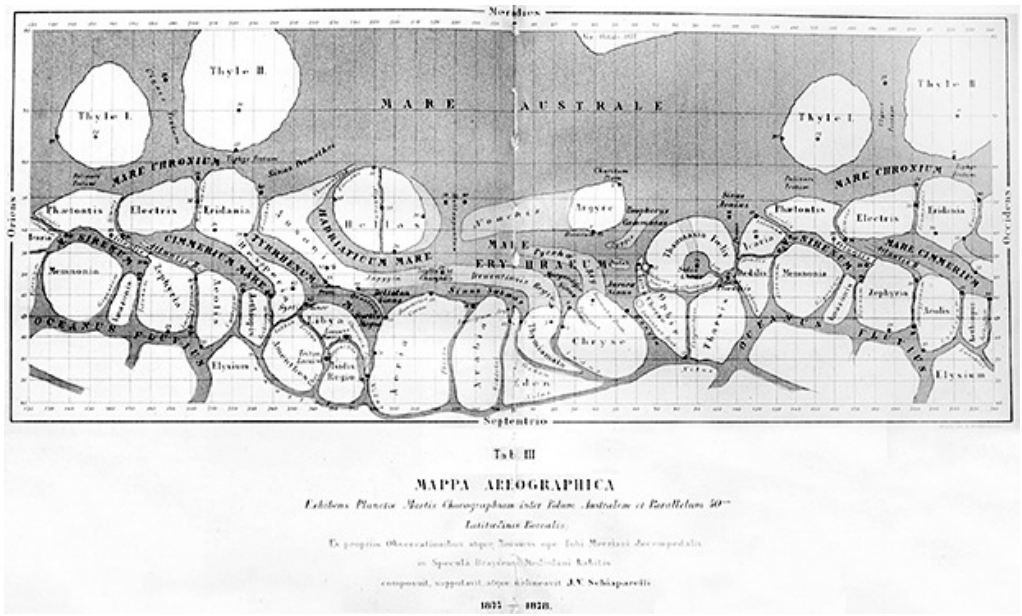
Schiaparelli's map production process was rather different. A professional Milanese astronomer, Schiaparelli was not usually a Mars observer but had decided to take advantage of the rare conditions of the red planet's close approach to Earth in 1877. He did not travel to a remote location but instead observed Mars from his observatory in northern Italy, continuing his observations for seven months after Mars had passed Earth at its closest point. He made 31 complete drawings of Mars and more than 100 detailed pencil sketches of various Martian regions. He also prepared a number of composite views of Mars, which he sent to colleagues for comment, but his final map [fig.5] was based only on his own observations. [10]



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Green's and Schiaparelli's maps were both very detailed, and they both used the same combination of cartographic projections: a Mercator projection for the tropics and mid-latitudes and an azimuthal projection for the Martian poles. But despite these similarities, the two maps were irreconcilably different. The style of illustration was probably the most striking difference, as Green had chosen to use subtle naturalistic shading whereas Schiaparelli used definitive lines, hard-edged features, and artificial colors. In addition, the placenames on the two maps were radically different.

Green had followed a decades-long convention of using astronomers' surnames to label the surface features of Mars. Where he mapped known features, he used names already designated on previous maps; where he mapped new features, he applied new names of English and European astronomers.

Schiaparelli, on the other hand, rejected the surname convention altogether. He wiped all astronomers' names off the map and applied a fully new nomenclature based on the classical and mythological geography of the Mediterranean world. Finally, the maps differed in terms of the amount and type of detail shown. Schiaparelli's map had numerous straight-line features that were nowhere to be seen in Green's map. Straight lines, in fact, dominated Schiaparelli's map, even though such lines had never appeared on previous maps of Mars.

The two astronomers themselves were at pains not to disrespect one another in correspondence or in publication, but it was obvious that the two maps could not both be correct. Both astronomers claimed to have been perfectly objective and to have made accurate maps, but the maps did not seem to be reconcilable in any way. Green suggested that the differences were merely a matter of artistic representation. He gently pointed out that Schiaparelli did not have any artistic training and had simply drawn things more definitely because he didn't know how to represent the Martian surface naturalistically, or as it appeared. But Schiaparelli claimed that the cartographic differences stemmed from differences in observation. For his part, he gently suggested that Green did not have the same level of training in astronomical observation and therefore simply hadn't perceived everything that Schiaparelli had seen through his telescope. [11]

Despite these discussions between Green and Schiaparelli about their maps' differences, it was really up to the map viewers to settle the debate over which of the maps was most correct, meaningful, or useful. From that perspective, it is clear that Schiaparelli's map won over both scientific and popular audiences. Although the historical record shows considerable controversy and even skepticism over the network of linear features (or canals, as they came to be called) on Schiaparelli's map, astronomers almost immediately began working to confirm their existence.

From 1877 to 1884, Schiaparelli repeated his observations, confirming numerous linear features and adding new canals every two years. During that same time, no other major astronomer saw any linear features on the surface of Mars. Even so, it appears that most astronomers were actively trying to observe canals, indicating through their persistence that there was something fundamentally convincing about Schiaparelli's map. In 1886, Schiaparelli's «canals» were finally confirmed by independent observations in France and Belgium. [12] The two following decades were then marked by numerous canal observations and dramatic additions of detail to the Martian map. As the map changed and expanded, astronomers closely followed the authoritative standards Schiaparelli had set in 1878 for a geographically-based nomenclature and a definitive representation style.

The enduring influence of Schiaparelli's Mars map stemmed partly from his own professional status (versus Green's status as a highly respected amateur), but the visual authority of his map was a more important driver of his legitimacy as a Mars observer and interpreter. Schiaparelli's map was drawn much more authoritatively than Green's, making its claims nearly indisputable. The dark lines, sharp edges, definitive colors, and specific geographic labels visually implied that Schiaparelli was more certain than Green of what he saw.

By relying on subtle shading and color gradients to represent a naturalistic view, Green visually undermined the certainty viewers could perceive from his representation. Since his map additionally showed far fewer features than Schiaparelli's line-covered view, Green's work simply appeared to be the result of a lesser observation.

The fact that Schiaparelli's map was authoritative does not mean that it was undisputed. Schiaparelli was criticized for his artistic style and also – more vociferously – for his selection of placenames. British astronomers, in particular, expressed considerable displeasure with the way Schiaparelli had taken astronomers' names off the map and replaced them with geographical names. The underlying subtext of this criticism was concerned with the fact that most of the surnames had been British, while the new classical-mythological names prioritized a different part of the world: the Mediterranean basin. In protesting against the wholesale change, British astronomers and their advocates engaged in vigorous and explicit nationalist discourse that rejected the scientific legitimacy of southern Europe. [13] Despite these protests, Schiaparelli maintained the upper hand, mainly because he could claim to have discovered something that no one else had seen on Mars. Once the canals were added to cartographic depictions of the Martian surface, it was clear that they would need new names. No one could dispute this, even if there was disagreement about revising the names for features already known.

It is best, then, not to think of Schiaparelli's map as privileged or as undisputed. Rather, it was the winner in a major cartographic competition. Its influence became most clear after the 1884 confirmations of Schiaparelli's canal observations, when astronomers throughout Europe and North America switched attention to a new competition. As lines on Mars suddenly seemed to become more visible to more viewers, astronomers rushed to find, map, and name these canals on the Martian surface. Maps of Mars exploded with new linear features and new placenames, making it impossible for British astronomers to reclaim the old nomenclature that had prioritized their names and contributions.

If we look at this in the context of cartography at the time, it is clear that a less definitive map could simply never gain authority over a more detailed map. Cartographers in the late nineteenth century were in the business of showing their geographical knowledge with certainty. It was critical for explorers, likewise, to acquire cartographic detail on their journeys as a way of protecting their status and respect. In the exploration of Africa, for instance, explorers who didn't add anything to the map quickly lost funding. This same process played out with the maps of Mars after 1884.

Detailed canal maps became very authoritative with scientific and general audiences, influencing widespread philosophical speculation about the probability and nature of Martian inhabitants. Many historians attribute belief in Martian life to a simple mistranslation of «canale» in Schiaparelli's original Italian to «canal» in English, when it would have been rendered more exactly as «channel,» which implied natural rather than artificial origins. I argue, however, that it was the image of the canals, not the word, that was so convincing.

Maps, Icons, and the Inhabited Mars Hypothesis

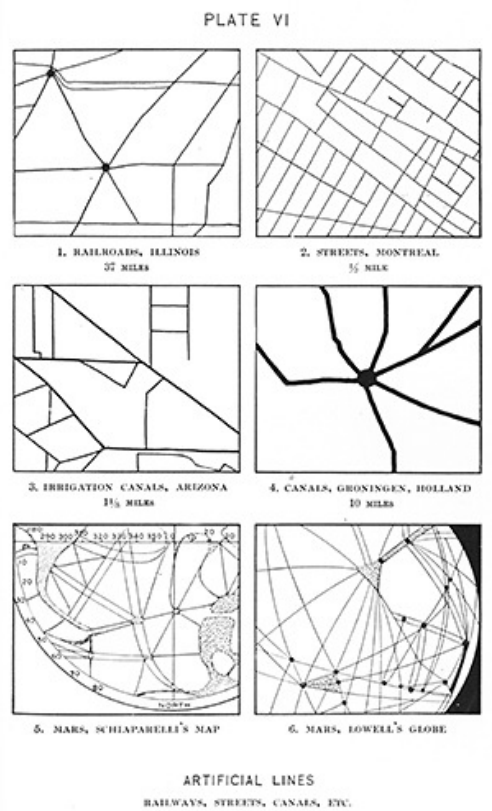
The new style of mapping set the stage for belief that Mars was inhabited. It showed a geometric network of such complex intersecting landforms that it was hard to imagine the network's origin without considering some form of intelligent environmental manipulation. Despite continuing debate among astronomers about whether the canals were optical illusions, or some form of unknown natural geological feature, the most widely accepted interpretation of the new maps was that they provided convincing evidence of intelligent life.

In the years after Schiaparelli's map became a standard, American astronomer Percival Lowell put forth a very influential hypothesis, arguing that Mars was a desert planet, with its polar caps providing the only source of water. According to Lowell, intelligent Martians (if any existed) would have had to create canals thousands of miles long to capture and control seasonal snowmelt. These canals then would have produced strips of vegetation on their banks and circular vegetative oases at their intersections, creating the patterns visible from Earth. Lowell built this hypothesis through cartography, arguing that it was the very «artificialness» of the map's appearance that proved the existence of intelligent life. [14]

In addition to building his hypothesis through cartography, Lowell also built his scientific authority through cartography. He opened the Lowell Observatory in 1894 specifically to observe Mars, adding 116 new canals to the map in his first season of observations. As Lowell established his reputation as an excellent cartographer of Mars, he also generated scientific legitimacy that extended to his interpretations of Mars. Even Lowell's opponents had to admit that he had the best maps, even if they didn't like his interpretation.

It is important to note that the appearance of the network as a whole was much more important than any of the individual details in terms of supporting the inhabited-Mars hypothesis. It wouldn't have been remarkable if Mars happened to have a linear marking or two; but the fact that it was covered in canals was startling. By the early 1900s, the canal network had become a powerful cartographic icon [fig.6].

It could be visually equated with abstract drawings of familiar street layouts, rail networks, and irrigation systems, thus reinforcing the certainty of artificiality, intelligence, and civilization on the red planet.



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It is therefore somewhat ironic to note that the Martian landscape inscribed in the map was quite different from that which astronomers reported seeing through their telescopes. Not a single astronomer ever actually saw or claimed to see an interlinked canal network while sitting at the telescope. Mars was notoriously difficult to see, even with a good telescope, and very few of the sketches that astronomers drew in their observation logbooks or sketchpads depicted more than a few Martian surface details at any given time. It was only through the process of gathering, compiling, and cartographically projecting dozens or even hundreds of sketches onto a comprehensive map that the canal network came into being. Lowell's influential maps of the 1890s, for instance, were made by plotting the details from hundreds of his own and his colleagues' sketches directly onto a wooden globe, which was then tilted to the proper angle and photographed before tracing the negative into a Mercator projection. [15] Thus, very simple sketches blossomed cartographically into complex and interlinked networks that had never been seen by any single individual or on any single night.

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

Once this network existed on the map, however, it became a powerful icon. Popular Sunday papers frequently published geometric images of Mars; lecturers prepared lantern slides showing canal maps; and books about Mars used the canal-map to augment their arguments that Mars was inhabited. This cartographic icon performed significant visual work, conveying the objectivity of cartography, the idea that Mars was fundamentally visible or legible through science, and the near-certainty of intelligent life on Mars. From a present-day perspective, when we know this was all based on an optical illusion, the near-certainty may seem fantastic or laughable. At the time, however, this was the most reasonable interpretation of the data available, given the iconic cartographic format in which these data made their way into scientific narratives and popular consciousness.

New Imagery and the Decline of the Martian Canals

So far, this essay has shown that map-related controversies spurred increasing interest in the red planet, that Mars maps established the initial authority of the inhabited-Mars hypothesis, and that the iconic image of Mars that was ever-present during the popular canal mania was purely an artifact of cartographic projection. To further appreciate the iconic power of the map, this section will also examine the role cartography played in contributing to declining belief in Martian inhabitants in the early twentieth century. The concept of the canals had always been challenged, whether through criticism of Schiaparelli's artistic skills, through insistence that the lines were merely optical illusions, or through debates over whether the existence of lines necessarily indicated the existence of intelligent beings. It was not until 1909, however, that those challenges really began to have an impact.

Somewhat ironically, it was the champion of the inhabited-Mars hypothesis, Percival Lowell, who initiated the end of his own era. By 1900, Lowell had garnered significant popular interest in his inhabited-Mars hypothesis, prompting several professional American astronomers to oppose his interpretations rather vocally in the popular press. In the ensuing battle for public opinion with these critics, Lowell pioneered a new method for photographing the Martian surface. In 1905, he used this new technology at his Arizona observatory to capture photographs that indeed showed some dark markings in areas where Lowell had drawn canals on the maps. Lowell circulated these small photographs to astronomers and other scientists, claiming they discredited any charges of optical illusion because of the perfect objectivity of the photographic format. When Lowell's critics persisted with their criticism, he sent a very high-profile expedition to South America to get additional photographs of Mars in 1907.

This expedition received extensive coverage and hype in the popular press, and the photographs were anxiously awaited in the United States as a tool for settling the simmering debate. [16]

Unfortunately for Lowell, however, the photographs proved to be a disappointment to general audiences. They were grainy, tiny, dark, and difficult to reproduce. Furthermore, they showed only about as much detail as could be found in the average sketch – nowhere near the amount of detail shown on one of Lowell's maps. Lowell touted the South American photographs as important confirmations of his theory but, in the process, he unwittingly undermined the power of his maps. By emphasizing that the photographs were perfectly objective and free from imagination, he implied that the maps were not. As a result, photography essentially replaced cartography after 1907 as the proper visual format for scientific Mars observations. Book editors and encyclopedia compilers began to prefer the objective photographs in place of the disputed maps, and the maps quickly disappeared from popular publications. Lowell's elaborate maps thus became nearly obsolete as scientific images. Given that his scientific authority had been built visually through cartography, Lowell's inhabited-Mars hypothesis was also weakened significantly.

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The inhabited-Mars hypothesis probably would have survived the cartography-to-photography transition if the photographs had shown more detail on the Martian surface. The problem for Lowell and his advocates was that the photographs did not reveal anything like a complex geometric network in their representations of Mars. After 1909, then, observers were not expected to compare their observations to a spiderweb-like map but to a mottled photograph. When the French-British astronomer Eugene Antoniadi observed Mars in 1909 at Meudon Observatory outside Paris with one of the world's biggest telescopes, he credibly reported an absence of canals for the first time since Schiaparelli's confirmation. [17] Claiming instead to see an intricate mess of detail that was almost impossible to sketch or represent accurately, Antoniadi submitted a map-like rendering that looked very similar to the latest photographs [fig.7].

If Antoniadi had submitted a map like this in 1903, he would not have trumped Lowell, because the visual authority of Lowell's maps was still dominant. After those maps had been weakened, however, the detailed artistic representation available through sketching became legitimate once again. Confirmed by photography, Antoniadi's sketches were thus very powerful in changing astronomers' and general audiences' opinions about the geometric or «artificial» appearance of the red planet's surface.

Conclusions

With Antoniadi's observations, an era of excitement and speculation over Martian inhabitants began to close. Popular belief in the canals actually persisted over several decades, with astronomy textbooks reproducing canal-maps well into the 1950s and science fiction novels and movies addressing the theme of intelligent Martians even into the present. But the active scientific debates over cartography and Martian surface geography changed considerably after Antoniadi's 1909 map was produced. The speculation about Martian irrigation practices, the debates over Martian social organization, and the discussions about Martian global environmental control faded into the background of scientific and popular attention. The geographical themes, methods and theories that had seemed so critical for a general understanding of Mars lost their importance as the quintessential and iconic geographic format – the map – ceased to be relevant as a form of representing observational Mars data.

In this episode, we can therefore see the powerful visual and scientific role of the cartographic icon. Maps and map-images turned discussions about Mars to geographical themes, allowed data accuracy to be perceived as a visually obvious element, and became powerful indicators of Martian civilization.

The popular press then seized on the simple geometric imagery of the map, often without pretending to present cartographic or observational data. This hybrid geographic-astronomical icon thus became a primary way of communicating knowledge and spurring the development of knowledge about Mars.

Additionally, iconic cartographic images played a critical role in the development of scientific and popular knowledge about the supposed cultural geography of Mars. Proper maps, made by mathematically projecting data onto the page, could be produced only by scientists. The cartographic icons they spawned, however, were easily communicable to broad popular audiences. This created a situation in which scholars from outside the discipline of astronomy, as well as non-scientists like commentators and fiction writers, were able to weigh in on the discussion in influential ways. Mainstream astronomers were usually hesitant to comment on speculative elements of the Mars mania, but the fact that it existed had significant effects on funding opportunities for astronomers in an era that was still dominated by private donations and wealthy benefactors rather than government-funded institutions. And the fact that a Mars mania existed at all was primarily, I argue, due to the prevalence of widespread and iconic imagery of the Martian landscape.

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Fussnoten

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See for example Meeting of the Royal Astronomical Society, April 12, 1878, in: Astronomical Register 16/185, 1878, pp. 115-123.

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For examples, see A. Marth, Nomenclature of markings visible upon the planet Mars, in: Astronomical Register 17/193, 1879, pp.24-25; E.B. Fennessy, Nomenclature of markings on Mars, in: Astronomical Register 17/195, 1879, p.70; David Gill, The nomenclature of markings on Mars, in: Astronomical Register 17/196, 1879, p.95; William Noble, Names of markings on Mars, in: Astronomical Register 17.196, 1879, pp. 95-96.

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After writing a variety of articles about his Mars observations and interpretations (see note 3), Lowell presented his theory comprehensively in Percival Lowell, Mars, Boston, 1895.

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Lowell described his cartographic practices in Lowell, Mars (as note 14).

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For the eagerly-awaited magazine «exclusives» that reported on the expedition activities and findings, see David Todd, Professor Todd's own story of the Mars expedition. First article published from the pen of the leader of the party of observation, in: Cosmopolitan Magazine 44/4, 1908, pp. 343-351; Percival Lowell, New photographs of Mars. Taken by the

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Abbildungen

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Giovanni V. Schiaparelli, Stereoscopic projection map of Mars, 1888.

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Richard Proctor, Mercator projection map of Mars, 1869.

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Richard Proctor, Stereoscopic projection map of Mars, 1868.

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Nathaniel Green, Mercator and planar projection maps of Mars, 1878.

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Giovanni V. Schiaparelli, Mappa Aerographica, Mercator projection map of Mars, 1878.

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Illustration showing manmade networks compared to Mars's surface patterns, from Edward B. Morse, Mars and its Mystery, Boston, 1906, p. 113.

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Eugène M. Antoniadi, Sketch of Mars, 1909.