INTRODUCTION

In the autumn of 1909, as the planet Mars swung away from its closest approach to Earth in seventeen years, two astronomers got into a fight. It was over the control of news from Mars. Both men were senior figures in their field, and both wanted the exact same thing: to secure for their own observatories exclusive control over the distribution of telegraphic bulletins reporting breaking astronomical news. With victory in this battle came the responsibility to collect observers' reports, adjudicate what counted as newsworthy, and then broadcast this selected information around the world, transmitting it to all subscribing observatories and news agencies, sometimes within hours of its receipt. Since 1882 Harvard College Observatory had performed this task in North America, partnering with the Royal Observatory in Kiel, Germany, to collect and rapidly redistribute announcements of planetary, asteroid, satellite, and nova discoveries.[1] But after a quarter century of uninterrupted broadcasts, Harvard College Observatory's director, Edward Charles Pickering, found himself and his institution facing down a coup. Two and a half thousand miles away, high on the desolate Colorado Plateau, Percival Lowell plotted a takeover.

At the heart of this battle was a disagreement over a single fundamental question: was there evidence of life on Mars? Lowell thought that the answer was yes, and in 1894 he had built a state-of-the-art observatory in Flagstaff, Arizona, with the express intention of proving it. Pickering disagreed, and his frustration with Lowell's bold claims

about intelligent Martian life was soon exacerbated by their growing popular appeal. Lowell's success, Pickering realized, was predicated in part on his rival's access to Harvard Observatory's bulletin service, which simultaneously linked the Flagstaff astronomer to his colleagues and to the world's mass media. So Pickering wrote to Lowell to inform him of a change of service. Harvard Observatory would no longer redistribute any reports relating to Mars sent in to Cambridge from Flagstaff, ostensibly on the grounds that they were not time sensitive. But as Lowell knew very well, the rare close approach of Mars in 1909 put the planet in a prime position for making fresh observations and perhaps even revealing new details about its inhabitants. Reports of this work would very much be news, and their value as such would depend upon their ability to fit the time-critical demands of a telegraphically networked press. As far as Lowell was concerned, there could be no question that Pickering's move was anything other than a deliberate act of media sabotage, which could only be countered in kind. So in a cabled notice sent simultaneously to the press and to his American colleagues, Lowell "issued notice . . . that by an arrangement with the Centrale Stelle at Keil, Germany, the Lowell Observatory instead of Harvard hereafter will be the distributing center for planetary news in America."[2] Pressed by local journalists for a response, Pickering simply stated that no such takeover had occurred and that Harvard Observatory would continue to provide its own bulletin service as usual. In a bullish interview with the *Boston Journal*, the Harvard director openly conceded that this was a fight about news from Mars: "I presume the cause of the [takeover bid] can be found in my refusal to accept or reject Professor Lowell's claims relating to the habitation of Mars." In this matter, Pickering retorted, Lowell "is as safe from denial of his claim as is the man who has offered $1,000 for proof that under the old Charles River Park is the center of the world."[3]

This contest was defined by two intertwined problems. One was about Mars, and the other was about media. This book tells the story of this entanglement, why it happened, and what it meant for the practice of astronomy in that era. It explores the birth of two closely related new disciplines—astrophysics and planetary science—and argues that these disciplines' formative years can only be understood in relation to the cultural marketplace in which they were situated. As Lowell's fight with Pickering suggests, this marketplace was characterized, above all, by new, powerful, transnational forms of mass media. Both these new kinds of astronomy and these new forms of media grew up together

from the 1860s, and neither, this book argues, can be fully appreciated separate from the other. I trace this symbiotic history through four detailed case studies, moving chronologically from the advent of astrophysics (1860s and 1870s), through early interest in evidence for a living Mars (1880s), into the heyday of debates over the planet's enigmatic "canals" (1890s to 1900s), and conclude with the slow decline of theories of life on the red planet (1910s and 1920s). As this chronology suggests, Lowell's fight with Pickering comes near the end of my story. Neither man could agree about the physical constitution and appearance of Mars, nor about the appropriate ways in which planetary news should be shaped and circulated through the media. This book explains why these two issues came to become inseparable from one another and why it mattered so much for these astronomers.

The narrative of this book is tightly periodized, being contingent upon two contemporaneous disciplinary moments. The first is the advent of astrophysics and, with it, what much later came to be called "planetary science." It is important to clarify up front that in the period studied here, from around 1860 to around 1910, neither of these appellations were in common use. "Planetary science" was used not at all, and "astrophysics" appeared only occasionally and inconsistently, alongside cognate terms like "solar physics" and "the physics of astronomy." As such, I have adopted in my title an actors' category that encompasses both of these disciplines-in-the-making and which more accurately captures the novel astronomical practices then emerging. Writing in 1885, the commentator Agnes Mary Clerke noted a recent phenomenon, "a so-called 'new astronomy'" that had recently "grown up by the side of the old."[4] Whereas the old astronomy took the movement and mathematical relations of the celestial bodies as its purview, this new astronomy deployed a suite of novel tools and instruments to interrogate the physical constitution of those same objects. Following the canonical spectroscopic work of Robert Bunsen and Gustav Kirchhoff in the early 1860s, astronomers had at their disposal what this pair called an "entirely new method of qualitative chemical analysis" capable of determining many of the elements and compounds present in the sun, stars, nebulae, and planets. As one London observer put it, astronomers could now "come to the chemist" if they "want to know something of the constituents of the heavenly bodies."[5] Concomitant efforts to increase the size and power of telescopes also gave those astronomers hopes of scrutinizing the physical appearance—and therefore physical

change over time—of those bodies. Used together, these new techniques opened up entirely new domains of stellar and solar system astronomy, concerned not with position and motion but rather with the physical composition and life history of stars and planets. "The unexpected development of this new physical-celestial science" was, according to Clerke, "the leading fact in recent astronomical history."[6]

From their outset, these revolutionary advances had a powerful public dimension. "One effect of [the New Astronomy's] advent," Clerke observed, "has been to render the science of the heavenly bodies more popular." On the one hand, this was because its results were "more easily intelligible—less remote from ordinary experience" than abstruse positional calculus. Just as important, however, was the fact that "its progress now primarily depends upon the interest in, and consequent efforts towards its advancement of the general public." The new astronomy, she asserted, "depends for its prosperity upon the favor of the multitude who its striking results are well fitted to attract."[7] Clerke, with characteristic insight, could already see what this book aims to recover: that progress in this new astronomy was inextricably bound up with a wider facet of late nineteenth-century culture—the rise of a massive and massively influential public marketplace for science. From its outset, the physical study of stars, sun, and planets was common knowledge, circulating as part of a wide range of scientific content consumed by an increasingly literate and leisured populace. The roots of this marketplace in the English-speaking world have been traced to an "industrial revolution in communication" in the first half of the century. The new technologies of steam printing, rail travel, and telegraphy, in particular, transformed and greatly expanded print culture and, with it, social access to knowledge. These were profound and often controversial transformations, calling into question science's relations to social, political, and religious norms, and stoking contests and controversies over the role of scientific entrepreneurship in the spread of "useful knowledge."[8]

By and large, however, accounts that focus their attention on developments in "popular" science do so through a limited range of genres and consumer products, above all books and periodicals. They often miss, therefore, the central quarry of this book's media focus: a second revolution in print and display, inaugurated in the 1830s in the United States and the 1860s in Britain, that witnessed the rise of a truly *mass* media, principally in newspapers but also in encyclopedias and great exhibitions. This was media consumed not by thousands or tens of

thousands but by millions. It was also principally a phenomenon of the transatlantic world, characterized by its speed, cheapness, populism, and, crucially, its novel Anglo-American ambit and sensibility. Though its origins are traced to the "yellow journalism" of 1830s New York, it was only after political and educational reforms in the 1850s and 1860s that its influence was felt in Britain. So at the same moment that commentators discussed the extraordinary revelations of the new astronomy, they also contemplated the rise of a "new journalism." These were rapid, profound, and potentially radical advances in the state of public culture. The affordable and populist print multiplying on both sides of the Atlantic was, one commentator lamented, "bright, racy, trivial, contemptible stuff, which should interest no one of intellectual capacity, and which does interest ninety-nine people out of a hundred." Yet for those more in accord with its progressive, democratizing spirit, this new mass media represented a watershed in public access to knowledge. It was, one advocate wrote, nothing less than "government by journalism," serving as "at once the eye and the ear and the tongue of the people . . . the visible speech if not the voice of democracy. It is the phonograph of the world."[9] Born at almost the same moment, these two revolutionary new practices, the new astronomy and the new journalism, would soon find their paths entwined.

Mars is a particularly good object through which to study this entanglement. My intention is not, however, to present a complete reassessment or systematic reconfiguration of historical accounts of Mars and the various debates over evidence for life there. (These events and their historiography are summarized in the next section.) Rather, my interest is in how more general transformations in astronomical practice that underpinned new accounts of Mars were co-constructed with the transatlantic news economy that discussed and circulated that knowledge. Significant for such an account is the fact that Mars was a challenging object to study and a fascinating object to contemplate and debate. Accounts of Mars from the 1860s onwards focused on the tentative claim that the planet was a living world, somewhat similar to Earth in composition, environment, and topography. These claims hinged on a complex matrix of experimental and visual evidence, incorporating hand-drawn observations made at the telescope eyepiece, spectrochemical analysis, and, eventually, photographic imagery. All of this evidence was then assessed and debated, by necessity, through an unstable prism of terrestrial analogy and biological speculation. This was an entirely new disciplinary terrain, and with it came new

problems of how to establish acceptable conventions of practice and discourse. Disagreements about Mars were always also disagreements about how a rapidly changing discipline should be organized, how its new techniques should be deployed, and how and where its diverse practitioners should, or should not, talk about these issues.

As with so many of the great controversies of nineteenth-century science, we must be careful from the outset not to presuppose where authority lay in these debates, nor to preemptively categorize certain aspects of them as orthodox or heterodox based on their eventual fortunes. Assessed on the terms of the actors who populate this book, it soon becomes clear that the possibility of some form of life existing on Mars constituted one of the more pressing questions facing astronomers through the turn of the twentieth century.[10] Important for what follows is the proposition that this question was not tackled or solved within the boundaries of elite astronomical science alone. On the one hand, my study implicates journalists, editors, and public consumers of astronomical knowledge within these debates. On the other hand, I argue that some of those whom we now take to be representative of a stable type of practitioner—the astronomer—actually forged complex hybrid identities that fail to map neatly onto a quintessentially modern distinction between those who "produced" esoteric knowledge and those who "disseminated" it in the exoteric realm.[11] Astronomers were journalists and editors too, eliding practice with communication in consequential ways. The general strictures of astronomy's cultural marketplace—the resources and constraints this public sphere provided—were embedded within and therefore constitutive of the practices of the new astronomy.

The past half century has seen a proliferation of scholarship on the history of Martian study and understanding. As my own approach is not synoptic and as I deploy four detailed case studies within a key phase of this history, it is worthwhile here to briefly sketch the general outlines of this larger story. Setting aside Kepler's important work on the motion of Mars, attempts to study the physical appearance and character of the planet had to wait until the turn of the nineteenth century and the development of large telescopes. Even then, and using the most powerful instruments available, little on the planet could be discerned with certainty beyond an axial inclination, polar caps, and apparent seasonal changes that were all strikingly Earthlike. Yet the continued difficulty of consistently making out fixed features and the

suspicion of some observers that Mars possessed a changeable atmosphere that obscured its "areography" below delayed the first attempts to set down a fixed map of the planet until midcentury. These maps, alongside a growing profusion of drawings and written descriptions, soon converged on a general consensus in which the Martian surface was depicted as being composed of darker, greenish areas called "seas" and lighter, ruddy areas called "continents."[12]

That these features might be Earthlike in ways beyond mere topographical analogy loomed large in wider discussions of the planet. As Michael Crowe has chronicled, the first half of the nineteenth century represents the high point for widespread enthusiasm for *pluralism*: belief in a plurality of inhabited worlds in the universe.[13] If natural theological arguments of purpose and plenty had formed the bedrock of such a prevalent belief before 1860, then the experimental results of the new astronomy only served to reinvigorate it after. Antipluralist arguments that posited Earth as a fundamentally unique place were dealt a decisive blow by the evidence of the spectroscope, which found chemical elements and compounds central to the maintenance of life on Earth also present in the sun, stars, and on its nearest neighbors. William Huggins's spectroscopic analysis of Mars's atmosphere, for example, led him to declare the detection of water vapor there in 1867.[14] No astronomer made more hay with this confluence of visual and spectroscopic evidence than the central actor in this book's first chapter, Richard Anthony Proctor. In the same year as Huggins's water announcement, Proctor produced a completely new map of Mars, and then, three years later, he made the planet a centerpiece of his rousing pluralist hit, *Other Worlds Than Ours*. Mars was, in his words, "the Miniature of our Earth," and it therefore presented firm visual and physical grounds for reasoned terrestrial analogy. "Until it has been demonstrated that no form of life can exist upon a planet," he asserted, "the presumption must be that the planet is inhabited."[15]

Within a decade, Proctor's stirring pluralist assessment would receive further corroborating evidence. Working at Milan's Brera Palace observatory in 1877 during an unusually close approach of Mars to Earth, the Italian astronomer Giovanni Schiaparelli systematically studied and remapped the Martian surface.[16] Among his findings was the conclusion that the four large continents on Proctor's map were, in fact, a multitude of islands, separated by a series of narrow strips of water. Working, as was typical, by recourse to terrestrial analogy, Schiaparelli dubbed these new features "canali," in so doing inaugurating

the debate that would come to dominate Mars studies for the ensuing half century over the nature and reality of these enigmatic "canals."[17] At play in this great "Martian canal controversy" were a wide range of interlocking questions: Did these "canals" actually exist as delineated? Did they periodically appear, disappear, or even double into parallel sets? Were they channels of water? Or areological fissures? Or bands of vegetation? Or optical illusions? Or the manufactured edifices of an intelligent race of Martians? Many of the details of this debate will feature in the chapters that follow. At this stage, it is enough to say that the nature of the canals themselves followed a clear representational arc, in which their geometric certainty increased over time, as Schiaparelli's relatively few large canals multiplied through a succession of discoveries and resightings by a range of observers (see figure I.1). By the turn of the century, the canals had emerged as a comprehensive network of narrow, straight features, inscribed into a small set of precise, abstract maps that, as K. Maria D. Lane has persuasively shown, "eventually became powerful cartographic icons that were viewed as indications of intelligent Martian life."[18] On this telling, the network seen on Mars was simply too geometric and rational to be anything other than artificial, a point extrapolated by Lowell in particular into a comprehensive theory of a planet-wide irrigation system, manufactured by industrious Martians in the face of an arid and dying planet. It was these ideas that so excited astronomical and public interest in the planet and that so agitated more skeptical observers like Edward Pickering.

The notion that Mars was covered in a canal network of some kind did not entirely die out until the mid-1960s, when NASA's Mariner 4 mission finally secured close-up photographs of the planet's surface. During the ensuing five-plus decades, historians have developed a rich and varied account of the planet as it was understood before this time, as a body of enigmatic features and questionable habitation. Within this historiography, three distinct eras can be readily determined. The first emerged in the immediate aftermath of the canal's final demise and represents planetary astronomy's own discipline-building efforts to explain—or rather explain away—an episode that these practitioners suddenly found deeply embarrassing, if not an active threat to their reputations. In these accounts, therefore, emerges the first sense that the canals and broader ideas of Mars as a living planet represented nothing more than an unimportant mistake, liminal to the workings of astronomy proper. Faced with a recognition that the trouble over Mars could not be conveniently ignored, this literature instead

Figure I.1. Globes of Mars, 1873–1913. Considered in chronological sequence (*left to right*), these globes demonstrate the changing representation of Mars by astronomers over the period of this book's study, moving from an Earthlike planet of continents and seas to a desert planet dominated by a comprehensive network of geometric, interconnected canals. *From left:* Nine-inch globe of Mars by Malby of London, 1873. Commissioned by Captain Hans Busk the Younger and based on the 1867 map by Richard Proctor (see figure 1.1), this was the first mass-produced globe of the planet. Eleven-centimeter globe of Mars, published by Camille Flammarion and made by E. Bertaux, Paris, 1884. This is the first globe to show Schiaparelli's "canali," which here retain their naturalistic shape as broad channels between broken up sections of continent. Ten-centimeter globe of Mars, published by Louis Niesten and made by J. Lebèque, Brussels, 1892. As the number of reported canals increased, they also narrowed and their edges began to straighten. Fifteen-centimeter globe of Mars, published by Camille Flammarion and Eugène Antoniadi and made by E. Bertaux, Paris, 1898. Flammarion became a keen advocate for evidence of life on Mars, and his own maps of the planet shifted the representation of the canals toward their being a comprehensive network of narrow features on an otherwise dry landscape. Eight-inch globe of Mars by Ingeborg Brun after the maps of Percival Lowell, Svendborg, Denmark, 1913. Lowell's maps of Mars represent the apotheosis of the artificial canal theory, and would come to be the dominant representation of the planet at the start of the twentieth century. Image © Whipple Museum of the History of Science, Cambridge: Wh.1268; Wh.6622; Wh.6625; Wh.6238; Wh.6211.

recast it, anachronistically, as a salutary tale of astronomy gone wrong, in which the advocates for an inhabited planet were assessed and characterized on the terms of the Space Age as nothing more than

outsider "popularizers." Such accounts are actively harmful to our understanding of the subject, and I return to their cause and effect in the conclusion.[19]

From the late 1970s, a number of historians of astronomy began to take Mars and its canals seriously, and in their work we find the first critical accounts of debates about the planet's physical constitution. These histories make clear that in the wake of the canals' discovery and amid continued widespread fascination with the question of plurality, a diverse range of actors, including the public at large, began to earnestly and vigorously debate the evidence for and against Mars's possessing some form of organic life—possibly highly evolved and intelligent life. Front and center in such accounts is the man typically understood as the driving force behind the canal controversy, Percival Lowell. Portrayed as idiosyncratic, energetic, and hugely successful at capturing a large public audience, Lowell's advocacy of evidence for a living Mars—centered upon his own observatory's maps and an accompanying series of very successful books—dominates this historiography.[20] As helpful as this work is, therefore, it propagates a problem I have attempted to avoid in this book, that of "Lowell mania." Lowell was, in truth, a relative latecomer to debates over Martian life, establishing his observatory in Flagstaff, Arizona, over a decade and a half after discussion of the canals had begun. Furthermore, such focused attention on Lowell perhaps distorts his role and those of his key rivals and risks dividing the debate into a "popular" Lowell camp and a "professional" anti-Lowell camp. The result has been a sense that the work of Lowell's critics represents something like a singular, coherent, and rational response and thus is not itself worthy of close analysis.[21] Of the four case studies that comprise this book, only the last features Lowell, and it does so mainly from the perspective of his opponents, who, I argue, were just as invested in attracting popular audiences as their Flagstaff colleague.

My own account most directly draws on and augments work from the third era of Mars studies. The last twenty years have seen the emergence of a new cultural history of the red planet that has integrated and synthesized scientific, social, and political narratives, greatly invigorating our wider understanding of Martian astronomy. Literary, ecological, geographical, and visual aspects of the debate have been fruitfully explored, explicating seemingly eccentric claims about Mars through a sociocultural analysis of scientific practice, representation, and reception. This literature has shifted accounts of Mars away

from the more timeless, philosophical framework of the "plurality of worlds" question, recontextualizing the planet as a significant facet of late nineteenth-century culture. A common theme across these works is the ability of Mars to act as a cultural mirror apt for the reflection of scientific, social, and political narratives and concerns. Mars was an object of study, but it was always also a site of projection for terrestrial affairs, which ranged from imperialist conceptions of the "other" to fears of ecological decay and entropic heat death.[22] This historiography has greatly advanced our understanding of both Mars and the era's wider culture, and this book draws on and reinforces many of its findings, while also diverging from it in several important ways. I do not, for example, share these studies' often keen interest in the science fiction of the era. This topic has already been extensively treated, and—with some notable exceptions—it falls outside this book's focus on the implication of media within astronomical practice itself.[23]

Placing media at the center of my account does not make this a book about popular science or about popularization. This is not to deny the immense significance of the public sphere in what follows. It is, rather, to foreground a key element of my general argument: that media matters in an assessment of news from Mars precisely because of the impossibility of separating out the popular from the professional in this story. Central to this book's account is the now well-recognized point that categories such as "professional" were very much still in the making at the turn of the twentieth century. To use them unthinkingly, therefore, is to risk freighting into our historical understanding a suite of essentially modern assumptions about status, roles, and expertise and in so doing to very obviously beg the question.[24] This is a particularly important point for the history of early astrophysics, given the still common assumption that astronomy by 1900 had witnessed the field's bifurcation into "amateur" and "professional" camps.[25] To take such a divide seriously is to risk imposing onto an unusually unsettled period of disciplinary reorganization the categories established after the fact by the victors of this struggle.

Misconceptions about how actors used media are one of the central features of this kind of anachronism. Especially when it comes to talking about life on Mars, it is all too easy to slip into a modern assessment of certain skeptical actors as inherently professional and pit them against an opposing force of mere popularizers, with the latter group making up for their lack of astronomical expertise with a

countervailing wealth of skill as mass media manipulators. A now large body of recent scholarship on Victorian science in the public sphere has cogently called into question just such a set of categories and divisions. In so doing, these accounts have effectively decentered historians' view of where scientific authority lay during the nineteenth century.[26] The case studies explored here build on and corroborate this work, and in what follows I place particular stress on the ways in which supposed dichotomies between popular and professional are actually undermined. Widely read champions of life on Mars were also major players in the senior hierarchy of the Royal Astronomical Society. August and skeptical mathematical astronomers were also authors of cheap books and encyclopedia entries on Mars. These seemingly topsy-turvy relations of expertise and public science did not necessarily endure, but their eventual demise makes them no less central to the story at hand.

My account is as such an exploration of a fluid and conflicted moment in disciplinary history, at a time when norms of practice were in flux and categories such as "amateur" and "professional" were rarely used. The challenge becomes explaining how this instability was caused, what its effects were, and how, eventually, it came or did not come to be resolved. The answers lie, I argue, in the entanglement of new forms of public discourse with new forms of astronomical practice that were themselves unusually public. By the end of the period studied here, some of this uncertainty had been removed, some of it by processes that we might fairly call professionalization. But we need to understand the contingent and situated processes through which this occurred before we can begin to safely apply such categorizations onto histories of astrophysics and planetary science.[27]

In seeking to recover actors' understandings of expertise and its relations to media, my analysis deliberately shifts attention away from any broadly construed public sphere, focusing instead on a more limited set of individual practitioners active within it. My intention is to pursue an analysis of media in science rather than science in media. This means turning away somewhat from the streets and raucous showrooms of "spectacular science" and returning to the observatory, study, and lecture hall to recover the roles played by media in science at an essentially disciplinary level.[28] This approach enables me to scrutinize the particular, situated sociology of roles at play in disputes over evidence for life on Mars. Disagreements and assertions regarding astronomical technique and disagreements and assertions regarding appropriate forms of astronomical discourse were, I suggest, both related

elements of the same set of social actions. In both cases, practitioners were working to establish priority, defend findings, and redraw disciplinary boundaries. To accomplish these goals meant drawing on material, literary, and social resources from the wider cultural spheres within which these actors positioned themselves, and this maneuvering was shaped, therefore, by a practitioner's status, income, and favored techniques, as well as their various publics' expectations. To trace the progress of these moves is to study not the inevitable development of advancing professionalization or disciplinary regimentation, but rather a range of subtle and multifaceted contests over authority and hierarchy within the scientific community.[29]

In the case of Mars, astronomy's sudden plurality presented a range of apparently viable options for how planetary studies should be publicly presented and professionally certified. In the first chapter of this book I recover one such option, which I dub "imaginative astronomy," an egalitarian and anti-elitist model that predicated successful practice on its financial success in mass media marketplaces. Imaginative astronomy was, I argue, a guide for disciplinary practice that was hugely influential in its time but that has since been lost to the historical record through its ultimate defeat at the hands of less social alternatives. Its recovery suggests that the eventual concretization of only certain norms of practice should not obscure from us the various ways different practitioners worked to forge a range of identities for themselves and, with them, alternative principles for their discipline. Mars became a crucial site for the elaboration of such identities and models.

A key concept within this analytical framework is that of mass media. Astronomers' efforts to forge viable identities required the marshaling of allies and the projection of knowledge claims, work for which genre proved to be pivotal. The ways that new knowledge appeared—chronologically, geographically, and stylistically—affected the reception of that knowledge and therefore its meaning and impact. How practitioners responded to the expectations and actions of diverse consumers of astronomical content must, therefore, be understood as a trajectory of action shaped by these marketplaces.[30] Central to my account is the claim that it was *mass* media rather than esoteric specialist journals or private correspondence networks that proved particularly important for the progress of news from Mars. As such, this category is used here specifically to denote genres of mediation that had a very wide impact, reaching large audiences and penetrating deep into the public sphere. This is not to suggest that mass media can be taken as

a value-free or neutral category—"the masses," after all, was one way in which turn-of-the-century intelligentsia dismissively characterized a newly educated reading public that they neither understood nor cared for. But as an overarching category for my account, it nonetheless serves a useful purpose, foregrounding as it does the era's cultural democratization and the diversity and sheer quantity of new forms of communication and audiences.[31] Its use also leaves me free to take note of the ways in which my own actors deployed the categories of "popular" and "popularization."[32] Most importantly, the phrase "mass media" captures the fact that the debates under analysis progressed during a period in which media established itself on a truly massive scale internationally, making it pervasive within the astronomical sciences. Telegraphically networked newspapers that reached audiences in the millions, encyclopedias that sold in the hundreds of thousands, expositions that were experienced by tens of millions, lecture tours that visited hundreds of towns, and cheap periodical literature with circulations in the tens of thousands all mediated novel knowledge claims about planetary astronomy, and all were therefore part of the working world of astronomers.

My contention is not that Martian astronomy was merely "mediatized" in this era, a process that suggests the external agency of a nonscientific reportage appended to the astronomy itself.[33] There was no necessary disjuncture, I argue, between the scientific event and the media that covered it. Often the journalist was also the astronomer. Time and again, my story indicates that mass media were—or at least could be—embedded within astronomical practice itself. As a result, the (always contested) place of mass media *in* astronomy was integral to the shape and fortunes of the various fights over validity, authority, and hierarchy occasioned by the advent of the new astronomy. The actors within these debates themselves recognized this fact, enabling me to trace the specifics of these astronomers', journalists', and editors' defenses of and attacks upon various forms of mediation. These arguments, as discipline-defining acts intended to delineate right practices and unsuitable "others," were themselves necessarily mediated processes. This was not a question of scientific versus popular media, but rather a much more subtle and intricate question of genre and its relations to practice. My account therefore highlights the fact that critics of certain types of popular astronomical discourse were often not themselves any further removed from mass media but were, rather, closer to different types of mass media—hence my account's concern with

not only mass-circulation periodicals and books but also newspapers, globes, public expositions, magic lantern lectures, and encyclopedias.

One salient consequence of a media-focused history of astrophysics and planetary astronomy is the attention it draws to both the temporality and geography of the movement of knowledge. Time is significant for my account because Martian observations and the rhythms of mass media were consonant with one another through their mutual seriality. Serial modes of organization, production, and communication loomed large over nineteenth-century science, and the periodic nature of such practices was a central feature of news from Mars. Mars approached Earth at distinct time intervals (see figure I.2), meaning that new observations and claims about the planet were disseminated and consumed in discrete, concatenated chunks. Fascination with the red planet waxed and waned according to its periodic orbital cycles, and people's responses to the latest astronomical research changed and progressed over these serialized time intervals. Mars's ability to generate news was consonant, then, with the rhythms of the era's serialized platforms of communication, such as the newspaper, the periodical, and the lecture, all of which "defined knowledge as a material commodity distributed, consumed and disposed of on a regular basis."[34] This seriality, I suggest in chapter 3, propagated a form of "event astronomy" in which the meanings of novel knowledge claims emerged from the context of their specific spatial and chronological movement.

A signal feature of this event astronomy was its transatlantic scope. The new technologies that underpinned the emergent mass media of the late nineteenth century—above all telegraphy—transformed both the extension and the social possibilities of communications practices.[35] Disciplines like astronomy whose new, contested epistemologies were both public and organized in part through mass media therefore underwent changes consequent to these new social encounters and cultural developments. In the English-speaking world, one key element of this transformation was the post-1850 emergence of a common transatlantic form of journalism defined by its speed, boldness, populist spirit, and mass appeal. Crucial in what follows is the observation drawn from the history of journalism that such changes were essentially transnational, but only in the restrictive sense of being Anglo-American. Underpinning the convergence of the practices and norms of English-language journalism, it has been argued, was "a common framework of democratization and of joint cultural formation."[36] As this book traces the implication of this Anglo-American media within

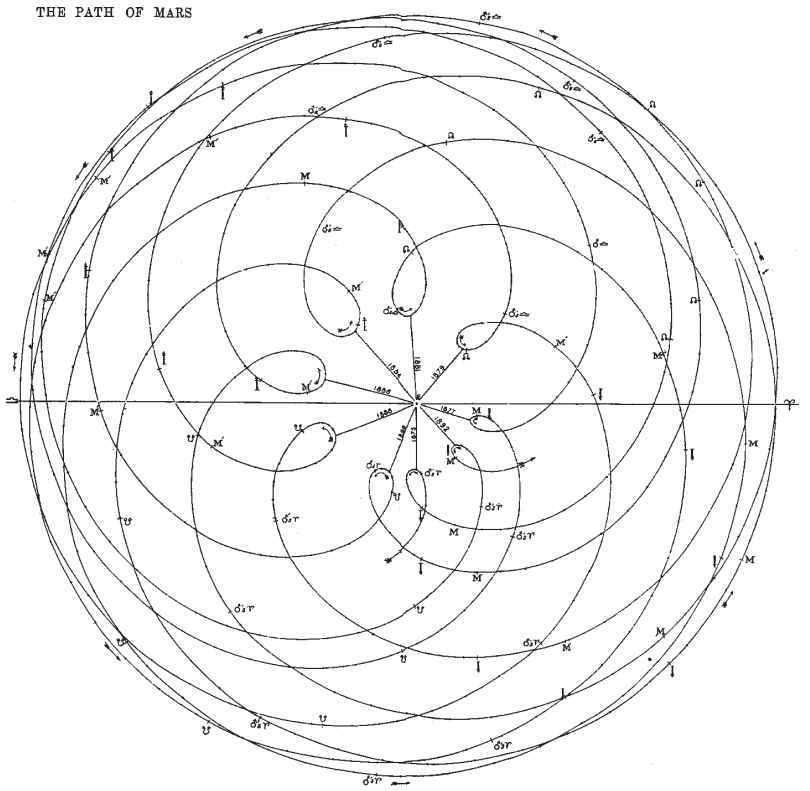

Figure I.2. This chart shows the path of Mars relative to a stationary Earth (at center), from 1877 to 1892. Mars could only be scrutinized at brief periods of close approach—called "oppositions"—that occured roughly every two years (as indicated by the nine loops near Earth in this chart). The quality of these oppositions also varied, with the best, called "perihelic oppositions," occurring only every fifteen or sixteen years, here shown by the closest approaches in 1877 and 1892. Martian study and debate therefore tended to follow the episodic rhythms of the planet's path. Richard Proctor, "The Path of Mars," *Knowledge* 1 (March 24, 1882): 452.

astronomical practice, it follows actors almost exclusively from Great Britain and the United States (though their actual working sites were, as we shall see, somewhat more geographically diverse). Indeed, one striking feature of this book's four case studies is the dominance of the English language in all of them. French astronomer Camille Flammarion, for example, who was spectacularly successful in his own country as an author on Mars and extraterrestrial life, only began to make

a significant impact on transatlantic news from Mars when his works were (somewhat belatedly) translated into English, most prominently by the Paris edition of the *New York Herald*. This primacy of English in transatlantic coverage of Mars reiterates the overwhelming importance of mass audiences in my story. Languages prevalent among working astronomers, such as French and German, made little headway in a debate dominated by a globally networked English-language media.[37]

Neither the telegraph nor mass media altered astronomy's social relations and practices overnight, however, and their impact needs to be traced over time and—as befits our subject's serial progress—in chronological order. We begin therefore in the period between the early 1860s and the early 1880s, at the dawn of the age of Martian intrigue. Chapter 1 chronicles the rise of the new astronomy, assessing the key role played by Mars in this nascent subdiscipline's disputes and contests and arguing for the central importance of a new transatlantic media marketplace in early debates over life on the planet. New Anglo-American journalistic ideals of egalitarianism and anti-elitism, it is suggested, underpinned a powerful new model for astronomical practice—imaginative astronomy—that, though relatively short lived, had a long-term impact on conceptions of the red planet. Chapter 2 then considers a significant geographical shift in astronomy during the 1880s and 1890s, consequent to reorientations of the place of the observatory in an age of internationally networked telegraphic news distribution. This move positioned certain privileged locations in the American West as new, exceptional sites for Martian study and implicated these sites within a marketplace of newspaper astronomy. Chapter 3 explores one episode in this new marketplace, the "great Mars boom" of 1892, and illustrates how the implication of newspaper coverage within the working practices of certain observatories shaped the emergence of a canal-focused narrative for Mars. Chapter 4 then presents one significant response to the extraordinary speed and reach that came to typify both the power and the potential problem of this newspaper astronomy. In the early 1900s, I suggest, it was the combined scope, authority, and permanence of encyclopedias that made them an important medium through which rival disciplinary claims could be presented. My conclusion, finally, considers the nature of the slow decline in interest in a living Mars during the first half of the twentieth century and addresses some of the methodological lessons that can be drawn from my overall account. But first, we must start at the very beginning, with the shock of the new.