INTRODUCTION

A Sublime and Commercial Business

A *Chambers's Edinburgh Journal* article "The Central Sun" published in 1847 contains comments on the current situation of astronomy lecturing in Britain. Like many other articles in an all-inclusive magazine that provide knowledge about science, religion, history, and biography for common readerships, this one aims to introduce the topic of the sun's movement through space. Before getting into the main thesis, the anonymous journalist starts the article with a brief remark on the prevalence and popularity of astronomical lectures in recent decades. The journalist writes, "Lectures on astronomy have for many years been highly popular with a large portion of the public. . . . In the smaller provincial towns, the arrival of an itinerant lecturer, and the delivery of his 'course of three,' illustrated by an orrery, was an event productive of general satisfaction, and served to enliven one or two of the dreary weeks of winter." These astronomical lectures were presumably informative and entertaining, with extra amusements, as the journalist describes: "Something was generally added that largely excited the wonder of the auditors, who went away fully persuaded that they had learned the whole scheme and compass of astronomical science—for them it had no more secrets."[1]

The journalist's remark is a keen observation regarding the cultural phenomenon of popular astronomy lecturing at the dawn of the Victo-

rian era. This was not an isolated testimony. Less than a decade earlier, around 1839, another anonymous journalist made a similar observation, even calling such enthusiasm for the knowledge of heavenly bodies "astronomical mania."[2] The journalist was reviewing the activities of eight lecturers, including the then renowned Dr. Dionysus Lardner, in London theaters during the previous Lent. Although Lent was an especially significant season for astronomical discourses, as we will see later in this book, Victorian contemporaries acknowledged that a lecture on astronomy was a "good card" at any season of the year.[3] According to the author of a bestselling treatise on astronomy, Ebenezer Henderson, popular astronomy lectures had been developed by several prominent figures, including James Ferguson, Benjamin Martin, and Adam Walker, during the eighteenth century through mechanical apparatuses and diagrams. Furthermore, lectures were rendered attractive in later years by the introduction of improved transparencies produced by optical devices. Henderson was also an astronomical lecturer and a fellow of the Royal Astronomical Society; he delivered his own course of twelve astronomical lectures in London toward the end of 1835 and was asked by friends to publish a treatise on the course.[4] The treatise was published in a third edition by 1848, marking his success in the area of scientific lecturing. His brief mention of those renowned names in this trade was not only an homage to his eighteenth-century predecessors but also an implicit affirmation that he was on the same enlightenment path to explain the principles of the universe for broad consumption.

Popular lectures on astronomy were a phenomenon in Britain throughout the nineteenth century. Lectures were presented in various places, and the speakers were not necessarily working astronomers. It is true that several celebrated elite astronomers, such as George Airy, John Herschel, and Robert Ball, made significant efforts to popularize astronomical knowledge. Their cases have been thoroughly discussed in scholarly works.[5] Nevertheless, many more popularizers of astronomy were not among the scientific elite. Historians have paid scant attention to these institutional and private entrepreneurs.[6] Some astronomical shows were linked with, but not limited to, Lent, and featured transparent orreries as visual aids. Private lecturers' contributions to popular astronomy remain obscure despite the widespread popularity they enjoyed at the time.

This book explores the wide spectrum of popular astronomy lecturing in Britain during the Regency and early Victorian eras. Although I trace the pioneers of the astronomical lecturing trade to the 1780s and earlier, I focus on the period between 1820 and 1860, the heyday of private astronomy lecturing trade and theater-based Lenten lectures on astronomy. They were on the wane after the mid-nineteenth century. This period also witnessed the rapid growth of scientific institutions, ranging from specialist learned societies and literary and philosophical institutions in cities or provincial towns, to mechanics' institutes aiming at education of the working classes. Many of these institutions offered public scientific lectures and became hubs of local intellectual life. Despite this trend of institutionalization in science, private entrepreneurs occupied a notable place in the popular astronomy lecturing trade and continued thriving until the 1860s. They were not inferior to their institutional competitors in terms of popularity with and influence over audiences. I compare the activities of private entrepreneurs with those of institutional men of science, such as the discourses delivered by Airy at the Royal Institution of Great Britain.

There are several good reasons to focus on private lecturers of astronomy outside the scientific elite. Besides the fact that they have received less attention from previous scholars, often, private entrepreneurs were not career practitioners of science. Their agendas and styles of lecturing differed from those of institutional men of science with which we are familiar. Historical studies of "popular science" and its agents have been a growing field in recent decades. Researchers view popular science variously as the popularization of scientific knowledge or as the representations of science in popular culture.[7] Bernard Lightman distinguishes the popularizer from the practitioner: the former focus on conveying scientific knowledge, whereas the latter engage in original research such as conducting experiments and analyzing natural worlds.[8] This distinction is not meant to be rigid: some practitioners of science—for example, Michael Faraday and John Tyndall—were also keen on popularization. Lightman, however, emphasizes a group of "nonpractitioner" popularizers, who offered sensational science to the public through writing or lecturing, but whose agendas often disagreed with the scientific elite's. The case studies presented in this book will show that many private entrepreneurs of astronomy operated independent lecturing businesses without affiliation to sci-

entific establishments. In contrast, institutional lecturers were usually associated with or employed by literary and scientific learned institutions. To analyze astronomy lecturing in the context of the popularizer's affiliation and the sites where they performed can help historians to better understand the complexity of the social and cultural milieu of science in the nineteenth century.

Here I must again defend the historical studies of popular science. Historians of science used to dismiss such subjects as irrelevant to the history of science "proper." In addition to historians, today's scientists often have pejorative attitudes toward popular science, believing that its practice accrues no benefits to their professional career. This was one reason that the "public understanding of science" movement emerged in the United Kingdom after 1985—not only to enhance the public's scientific literacy but also to encourage scientists to engage in communicating science to lay audiences.[9] In describing how nineteenth-century scenes of opportunities to buy and sell goods and services are related to the display of knowledge, James Secord uses the term "commercial science" for these various activities combined, rather than the easily dismissive catchall "popular science."[10] Nevertheless, popular science mattered throughout the development of institutionalized science, for the relationship between the two was dynamically changing and never fixed. The definitions and boundaries between the two were porous for most of the nineteenth century. Instead of a one-way process of knowledge transfer from elite science to the lay public, popular science worked as a "heterogeneous network of cultural exchanges and feedback loops between different social groups." Expert and nonexpert knowledge making often overlapped, forming two-way, interactive flows.[11] In astronomy, recent studies also reveal that nineteenth-century astronomers use the popular press as a channel to influence elite scientific practice and to promote public interest.[12] As Joshua Nall put it, "astronomers were journalists and editors too, eliding practice with communication in consequential ways."[13] Therefore, popular astronomy also contributed to the shaping of a new institutionalized astronomy.

As Ebenezer Henderson indicated in his 1843 treatise, thanks to the introduction of improved transparencies and optical technologies, popular astronomy lecturing underwent a welcome transformation during his time. Henderson's remark was an understatement; in fact,

this transformation was not only limited to the adoption of new visual aids but also involved a broader revolution in lecturing space and format. I argue that popular astronomy lecturing underwent a "theatrical turn" before the 1820s. This transformation related to the use of the theater, both the physical space and the showmanship employed by professional actors. The physical space of a site was a significant factor in shaping the format and style of lecturing as well as the audience for it. Astronomical lectures performed in some of London's famous West End theaters best exemplified this spatial effect. Some popularizers moved astronomical lectures into theaters and adopted theatrical devices in their performances. These lecturers developed numerous onstage devices for achieving scenic effects, and their performances emphasized both sensational amusement and scientific instruction. This trend began in the late eighteenth century and continued developing throughout the early nineteenth century. It benefited from the invention of the transparent orrery, a type of apparatus designed as an onstage visual aid for a large audience.

The theatrical turn of popular astronomy lecturing shows the diversity of the narrative and practice of science in the mass culture of the industrial age. Whether they were private entrepreneurs or institutional employers, popularizers of science competed to attract the largest audience. They had to consider the interests and tastes of the public. Astronomical lecturing had become such a potentially profitable business that many competitors entered this marketplace. It was precisely a part of the vast network of what Secord calls commercial science. On the other hand, using theatrical facilities and apparatuses to create spectacular displays of the celestial system not only enhanced the quality of amusement but also offered spiritual inspiration. The language and visualization often presented in astronomical lectures made a science that was traditionally linked with the glory of God's handiwork even more sublime. "Commercial" and "sublime" are therefore the two keywords that best describe the character of British popular astronomy lecturing in the first half of the nineteenth century.

The Sublime Science

Astronomy was the epitome of the sublime for many nineteenth-century contemporaries. When reporting astronomical lectures in newspapers and magazines, Victorian journalists often referred to the

studies of heavenly bodies as "the sublime science."[14] Thomas Milner in his extensively illustrated bestseller on astronomy and geology, *The Gallery of Nature* (1846), also described astronomy as "now the most perfect of all the sciences" and "the most sublime and ancient."[15] Similar descriptions can be traced to eighteenth-century authors such as James Ferguson in his opening remark in his classic *Astronomy Explained upon Sir Isaac Newton's Principles* (1756): "Of all the sciences cultivated by mankind, astronomy is acknowledged to be, and undoubtedly is, the most sublime."[16] These examples reveal that people of that time valued astronomy and elevated its study to a special status.

The common meaning of the term "sublime" is twofold according to the *Oxford English Dictionary*: the first is relevant to rational or spiritual achievement, a premier quality belonging to or designating "the highest sphere of thought, existence, or human activity; intellectually or spiritually elevated."[17] Astronomy had been regarded as the highest achievement of humanity, for the science attempts to decipher the code of the universe by human reason. The dissemination of scientific knowledge also indicates a path to reason. Humans benefited from the advantages of science and no longer linked natural phenomena with irrational superstition. Such progressive enlightenment narratives were common in scientific publications at the time, and the commentators included some of the most prestigious men of science. William Whewell, for example, asserted the benefits of astronomy for learning the character of the government of the world: "In considering the universe . . . as a collection of *laws*, astronomy, the science which teaches us the laws of the motions of the heavenly bodies, possesses some advantages."[18] John Herschel claimed that no science other than astronomy required the highest preparation of minds and intellectual liberality to see through "superficial and vulgar" observation.[19] Another meaning of "sublime" is in the scope of emotion: a sense of emotional uplift that "fills the mind with a sense of overwhelming grandeur of irresistible power," and such emotion "inspires awe, great reverence, or other high emotion, by reason of its beauty, vastness, or grandeur."[20] The immensity of the universe and the vast dimensions of celestial bodies are ideal for inspiring the feeling of the sublime. Both uses of the adjective, whether indicating intellectual or emotional uplift, had emerged and were commonly applied in the English language by the eighteenth century.

The concept of "sublime" had been much discussed in deeper philosophical or theoretical expositions. Edmund Burke's famous treatise *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful* (1757), for example, represented attempts to distinguish the senses of the sublime and beauty. Unlike the sense of beauty, caused by exquisite and pleasant things, the source of the sublime according to Burke is the terrors of pain, danger, and death. The sublime can produce strong emotion, hence passion. Burke regards the emotions of astonishment, admiration, and reverence as the effects of the sublime. He also links the sublime with other visual aspects such as vastness, infinity, and darkness. Burke's exposition does not directly involve astronomy, but it is noteworthy for the connections it makes between the sublime and passion. Burke's work is merely one of many examples of intellectuals pondering the concept of sublime in and before the nineteenth century.[21] Nevertheless, as Jan Golinski reminds us, the term "sublime" was often deployed casually rather than systematically in contemporary writings, and the nuances of its usage in learned debate were not necessarily connected to popular astronomy.[22] Newspaper journalists and authors of popular astronomical publications, after all, were usually not serious theorists or philosophers. Their accounts did not necessarily carry profound philosophical reflections.

From Burke's treatise, it is not difficult to imagine that the notion of sublime could be highly spiritual and connected with religious belief. Since feelings of the sublime can be linked with strong emotions, reverence for magnificent power, and a sense of elevation, such emotion is commonly evoked through religious experience and rhetoric. This book discusses the rich religious elements in popular astronomy lectures of the nineteenth century. Lecturers often applied rhetorical devices from then popular natural theology, including the idea of sublimity: the universe is an unparalleled source of inspiration for feelings of awe and wonder. People discerned the existence and divine wisdom of a benevolent Creator through the majesty and order of the universe, God's handiwork. Such a religious trend accorded with many popular science works at the time, as studies of the Bridgewater Treatises and evangelical publications have shown.[23] Theological reflections were not necessarily high on the agenda of all astronomical lectures, but religious and relevant moral inspiration had become a good way for lecturers to promote popular astronomy.

The theatrical turn of popular astronomy lecturing was critical to solidifying astronomy as the sublime science in popular culture. Adam Walker and his sons, who allegedly invented the transparent orrery in the late eighteenth century, initiated the theatrical turn of the trade and made astronomy a star in show business. The Walkers pleased the audience's minds, eyes, and ears, as they incorporated scenic displays and euphonious music into their lectures. Michael Faraday once commented on the lecture of William Walker, Adam Walker's eldest son, that he "has shewn in the most splendid and sublime manner that Astronomy may be illustrated."[24] Visual and acoustic technologies introduced into the performance helped enhance the sense of the sublime. These techniques shaped astronomy as the sublime science, in which awe and wonder of the universe had become a universal theme.

Science in the Marketplace

The spread and popularity of astronomical lecturing also has to be examined in the context of both the scientific and consumer cultures in the industrial age. The growing power and pervasiveness of science in daily life had become such a powerful phenomenon that nineteenth-century contemporaries found it impossible to overlook. "Science is no longer a lifeless abstraction floating above the heads of the multitude," as an author described it in 1852, "it has descended to earth. It mingles with men. It penetrates our mines. It enters our workshops. It speeds along with the iron courser of the rail."[25] Science, now a fashionable conversation piece, drew the general public's attention and fascination. Science also had many practical uses. The Whig politician Henry Brougham asserted that men could gain positive advantage in worldly wealth and comforts by increasing their stock of information.[26] As an avid reformer of scientific education, Brougham founded the Society for the Diffusion of Useful Knowledge (SDUK) in 1826. A series of SDUK publications was launched during the next two decades under the supervision of the publisher Charles Knight, including the *Penny Magazine* and the *Penny Cyclopaedia*. The founding of the Royal Institution of Great Britain at the turn of the nineteenth century also embraced the vision of popularizing useful science. The proposal for this new establishment sought to launch an institution for "diffusing the Knowledge, and facilitating the general Introduction, of Useful Mechanical Inventions and Improvements; and for teaching . . .

the application of Science to the common Purposes of Life."[27] Within the next few decades, the Royal Institution consolidated the image of science as a rational and practical agent of improvement and change.

The milieu of science was undergoing a tremendous transformation during the same period. Historians of science concur that the long nineteenth century was a pivotal age during which many characteristics of modern science were taking shape.[28] The younger generation of scientific intellectuals such as Charles Babbage claimed that British science was declining; the British Association for the Advancement of Science (BAAS) was set up to avert the decline and to reform the sluggishness of the Royal Society. Whewell coined the term "scientist" at the meeting of the BAAS in 1833 and in a subsequent book review argued that the term was, like "artist," appropriate for those pursuing the study of nature. Initially, Whewell's use of the term was not intended to be serious, and not until the twentieth century did the practitioners of science embrace it.[29] A career in science was previously unprecedented, but the process that transformed science into a profession was also beginning.

The advancement of technology and industry also revolutionized the communication of scientific knowledge. Steam-powered printing machines made inexpensive mass printing possible. Railway, telegraphy, and postal systems provided faster, more efficient means of transportation and transmission. The spread of religious tracts, Sunday schools, and secular education also cultivated greater literacy among the middle and working classes. All these factors changed the businesses and culture of publishing, distribution, and reading.[30] A new type of readers emerged and numerous low-priced scientific publications for ordinary readers were sprouting by the mid-nineteenth century. This wave of literature included Brougham's and Knight's ambitious *Penny Magazine* (1832–45) and other SDUK publications (e.g., *Penny Cyclopaedia*, 1833–43). The periodical *Chambers's Edinburgh Journal* (1832–1956) coedited by the Scottish publishers William and Robert Chambers was another representative example among the army of affordable publications.[31] Robert Chambers anonymously wrote another more scandalous work, *Vestiges of the Natural History of Creation* (1844), to promote the controversial theory of evolution, which caused an immediate and lasting sensation. In addition to secular reformers, Christian denominations were also keen to popularize

scientific knowledge, and they were a force to be reckoned with in the marketplace of popular science publishing. The representative works endorsed by religious authorities included the Bridgewater Treatises (1833–36), based on natural theology and written by several celebrated scientific savants, and the "Monthly Series" (1845–55) published by the evangelical Religious Tract Society (RTS).[32]

When the transformation of science led to the coining of the term "scientist," the expression "popular science" also came into use. Jonathan Topham indicates that publications before 1820 seldom appeared under the designation "popular science," yet the phrase rapidly came into regular usage after that. The new genre of popular publications was born of a social change. It appealed to a broader audience: a new class of readers covering not only the Enlightenment bourgeois public but also the working classes. The popular science genre had multiple meanings: it could refer to a text that made scientific knowledge more accessible to a general reader or to publications that were mass-produced and more affordable. Both meanings indicate the burgeoning mass culture of the early nineteenth century. Therefore, some historians consider the nineteenth century as the dawn of popular science.[33] The rise of popular science, in Topham's words, reflected a "diversification of reader audiences," a movement to accompany the trend of specialized and disciplinary science, and was "loaded with consciousness of the new social order."[34]

In addition to print culture, lecturing was another important channel for diffusing scientific knowledge. Public lectures on natural philosophy had been presented in Britain since the early eighteenth century.[35] Their business mode became the precursor of many scientific lectures including astronomical ones (see chapter 1). During the first half of the nineteenth century, public lectures not only grew in audience scale but also were increasingly conducted by the fast growth of scientific institutions, such as the Royal Institution and the London Mechanics' Institution in the British capital. Private or itinerant lecturers who operated their own businesses and traveled around provincial towns remained active alongside their counterparts employed by scientific institutions.

Shows, exhibitions, and different types of entertainment displays other far-reaching forms of media alongside print culture and public lectures. In big cities like London, this form of media in particular

thrived and dazzled. Various exhibitions, shows, and spectacles were staged in the metropolis to appeal to spectators' intellectual curiosity and amusement. The Adelaide Gallery (1832–52) and the Royal Polytechnic Institution (1838–81) were two renowned examples among the splendid array of metropolitan galleries. The British were proud of their love of shows, as a letter to the newspaper the *Examiner* remarked: "Well might the great Napoleon say, we trafficked in every thing; but he was little aware that to 'a nation of shopkeepers,' he might have added, of show-keepers."[36] Among numerous bizarre shows in the metropolis, exhibitions and spectacles displaying scientific curiosity or mechanical ingenuity occupied a distinct part of this marketplace. A pioneering classic by Richard Altick, *The Shows of London* (1978), documents a wide range of entertainments and exhibitions in London during the Georgian and early Victorian periods until the Great Exhibition of 1851. Many of the cases Altick investigates, such as the exhibitions of automatons and other mechanical inventions in the West End, involve applications or disseminations of scientific novelties.[37] Following his work, scholars have also paid increasing attention to the function of performativity in scientific practice as a means of attracting audiences or reinforcing cultural authority.[38]

These numerous enterprises, as Aileen Fyfe and Bernard Lightman indicate, were a part of the economy involving the display of knowledge in the marketplace of science.[39] Scientific businesses took place in various venues ranging from learned institutions, museums, botanical gardens, shops, and theaters to exhibitions and spectacles. Practitioners of science could earn their livelihoods from a variety of activities including authorship, editing, lecturing, curatorship, instrument making, show-running, and so on. A metropolis like London had abundant opportunities for entrepreneurs who wanted to make money or young people who aspired to build a reputation in scientific circles. The clichéd story of Michael Faraday rising from a post as laboratory assistant to become a star professor at the Royal Institution is one of many examples. Among Faraday's contemporaries were many writers who composed scientific pieces for periodicals and monographs, as well as performers who demonstrated experiments with current and sparks in places like the Royal Polytechnic Institution and the Colosseum at Regent's Park. Contemporaries and later researchers often dubbed these myriad activities "popular science." This term is, howev-

er, not without problem as many scholars have indicated. Recall, for example, Secord's criticism of the phrase "popular science" as a dismissive catchall that could easily mislead by confusing its historical significance with today's perceptions. Thus, Secord suggests using the term "commercial science" as an alternative.[40] Nevertheless, like many other alternatives, this expression cannot cover the complex and diverse facets of relevant engagement in history, so it is not necessary to abandon the term "popular science," and some researchers retain it.[41]

A Shared and Contested Arena

So far, I have set the scene for the theatrical turn of popular astronomy. The tradition of itinerant public lectures on natural philosophy, together with the fashion of stage astronomy, formed the cornerstone of popular astronomy lecturing at the turn of the nineteenth century. The industrial boom and economic prosperity of Britain during this period prepared a growing market for readers and audiences; social and political upheavals influenced the taste for and representation of popular science. The prevalence and popularity of astronomy lecturing in the nineteenth century was no isolated development, and it did not appear from nowhere. It was an extension of the previous century's legacy as well as a reflection of the noticeable social change in the early nineteenth century. Like other contemporary spectacles of chemistry, electricity, and geology, which have been explored by other scholars, public displays of astronomy demonstrate the zeitgeist and the transformation of society.

Many scholars have indicated that nineteenth-century science was a contested space in which rival notions of how and by whom legitimate knowledge should be constructed competed and were promulgated.[42] This perspective suggests a decentering approach to the sites, actors, and practices of science; as Iwan Morus remarks, the locus of scientific authority was diverse—"both everywhere and nowhere."[43] This approach also echoes Lightman's attempt to reconstruct a distinctive place for nonpractitioner popularizers in the topography of nineteenth-century British science. The agendas of these popularizers were usually at odds with institutional elites of science.[44] Popular astronomy lecturing in the nineteenth century embodied such a contested arena, where different classes of popularizers coexisted and competed, performing with potentially opposed agendas in various venues.

"Commercial" and "sublime," I argue, are the two aspects that best characterize British popular astronomy lecturing in the nineteenth century. As we have seen, previous scholars have approached the popular products and phenomena of science from the perspective of mass consumer culture, whether using the phrases "science in the marketplace" or "commercial science" to designate the hotchpotch of paid pursuits of science in the period. It is true that not all popularizers of science intended to make a profit—some were motivated by religious, political, or philanthropic causes and not concerned with money in the first place. Nevertheless, the approach that treats science in the context of mass consumer culture is valuable for highlighting the economic factor and everyday operations in the practice of popularizers.[45] The concept "commercial" can thus serve as an analogy between popular astronomy and profitmaking, and as a way to interpret the role of audiences as consumers of science. It also underscores the competition among astronomy lecturers to gain audiences, develop innovative apparatuses, and protect trade secrets. In this book I will show the rivalry among metropolitan lecturers during Lent; improved apparatuses, showmanship, and advertisements for marketing; the itinerant lecturing circuit between the metropolis and the provinces, and the audiences that followed a fashion, a cause, or a utility. These activities involved competition for profits and commercial practices of buying and selling. Even "nonprofit" institutional establishments, such as the Royal Institution, were more or less involved in some commercially oriented practices.

The adjective "sublime," in contrast, was an original description extensively used by nineteenth-century contemporaries rather than an invented term reconstructed by modern scholars. Nineteenth-century popular science was filled with emotional appeal. Authors and lecturers loved to arouse feelings of awe, wonder, and pleasure by using passionate language in their narratives. Scientific issues were also associated with other spiritual concerns like morals and Christianity. Discourse about the heavenly bodies was usually relevant to earthly orders, too. As Golinski suggests, the use of the term "sublime" might allow lecturers to introduce some potentially subversive ideas, such as the plurality of worlds, under the cover of religious or quasi-religious sentiments.[46] Popular astronomy lecturing made extensive use of different means, from the rhetoric of natural theology to the application of visual and

acoustic technologies, to render the sublimity of astronomical science. The "sublime" aspect also reflects the richness of religious elements in nineteenth-century popular astronomy. The spiritual perspective of "sublime" is therefore a good supplement to the material perspective of the commercial culture.

Many nineteenth-century practitioners of popular astronomy, as well as their activities, exemplified the commercial and sublime features. The appendix provides a full list of the lecturers discussed or mentioned in this book. The book focuses on individuals who were active in London and regularly operated lecturing businesses between 1820 and 1860. Some prominent names among the popularizers, such as the Walker family, have frequently been discussed in previous scholarly works. Some lecturers, such as C. H. Adams and John Wallis, have been mentioned in literature before, but few details of their activities or biographical information are known. I supplement the latest biographical findings of these two individuals in this book. Two figures are recognized for other occupations yet their involvement in popular astronomy lecturing is not widely known: George Bartley is recognized for his career in the theater, and George Henry Bachhoffner is discussed by historians of science for his demonstrations of electricity at the Royal Polytechnic Institution.[47] Several notable men of science who delivered public lectures on astronomy, such as George Airy, John Pond, John Pringle Nichol, and Baden Powell, are also covered in this book. Nevertheless, my research is not intended as a complete survey or biographical account of particular astronomical lecturers.

The structure of this book is thematic rather than biographical or chronological. Each chapter discusses one theme related to a specific area of astronomy lecturing. Chapter 1 considers the pioneers of popular astronomy lecturing in the late eighteenth century, whose discourse and apparatuses profoundly influenced subsequent popularizers. Chapter 2 explores the geography of popular astronomy lecturing, to investigate the different venues in metropolitan or provincial regions where popular astronomy took place. In other words, the chapter addresses the question of "where." Chapter 3 deals with the affiliations of lecturers. By analyzing the relations between lecturers and institutions, the identity and place of a lecturer within the web of scientific practitioners is revealed—that is, the issue of "who." Chapter 4 concerns the subjects that were included in the curricula of pop-

ular astronomy. Some recurring subjects contained not only widely accepted Newtonian science but also controversial issues like the nebular hypothesis and the plurality of worlds. We also find that scientific novelty and religious sentiment were strong attractions for the contemporary audience. This chapter relates to the questions of "what" and "how," as does chapter 5, which explores the use, popularity, and constraints of the transparent orrery and lantern slides—the two major types of apparatus used in nineteenth-century popular astronomy lecturing. The mechanism of the transparent orrery has remained a matter of debate until recently. I will extrapolate its possible nature from the latest available sources. This large-stage apparatus certainly had a prominent place in nineteenth-century popular astronomy, yet very little literature and almost no physical remnants have survived. Application of the transparent orrery in stage astronomy influenced other visual technologies such as the magic lantern. Finally, chapter 6 discusses the audiences for popular astronomy, in which a few accounts of contemporaries are presented as specimens reflecting the fashion of astronomy lecturing, the responses from spectators, and the conflicts between various stances concerning science.