Hist. Sci., xxxvii (1999)

EPHEMERAL EVENTS: ENGLISH BROADSIDES OF EARLY EIGHTEENTH-CENTURY SOLAR ECLIPSES

Alice N. Walters
University of Massachusetts Lowell

Astronomy is an unusually public science; everyone who can see can see the Moon, the stars, the planets, the Milky Way, and unusual objects like comets (especially where there is no street lighting). The point is obvious, but, particularly in the context of better understanding the construction of public science in the eighteenth century, it is also provocative. Constructing a public science — that is, explanations for, and interpretations of, nature and natural phenomena that were at once useful and culturally and socially responsible — occupied many of the most prominent members of the community of scientific practitioners in eighteenth-century England.[1] They shaped the public's understanding of science and its cultural role in large part by means of the market, producing a range of mechanisms for the dissemination of scientific ideas, including books, instruments, lectures, and other formal and informal educational forums.[2] Thus, commerce played a role in mediating the space between the scientific community and the public; people bought a book or paid to see a lecture, and thereby consumed public science.

Astronomy featured prominently in the list of the sciences presented in these forums, and it was eagerly consumed by the public.[3] But astronomy also challenged the ability of the teachers and practitioners to control the public's interpretation and understanding of its phenomena, exactly because of the obvious point mentioned above: astronomy was "public" to an extent unequalled by most other physical sciences associated with the Newtonian enlightenment. The most dramatic phenomena at the heart of the new sciences of mechanics, chemistry, or electricity were largely presented to, and consumed by, the public via lecture demonstrations and commodities such as books and instruments, the prices of which limited their audience. In contrast, an astronomical event was accessible to all, regardless of income or education. For the practitioner or entrepreneur concerned with the construction of public science, astronomy thus offered both a large potential audience for scientific media, and great potential for a public interpretation of its phenomena based in ignorance and superstition.

Unusual astronomical phenomena, such as eclipses and comets, presented special challenges, as their interpretation in the context of public astronomy was complicated by the astrological meanings long associated with them. Astrology enjoyed

0073-2753/99/3701-0001/$2.50 © 1999 Science History Publications Ltd

its greatest influence in English culture in the latter half of the seventeenth century, and, while astrology may have lost much of its intellectual legitimacy among the learned of early eighteenth-century England, it still held considerable sway among the populace.[4] The almost visceral fear prompted by dramatic astronomical phenomena like eclipses seemed to blur the distinction between "rational" scientific cause and "irrational" astrological effect. For example, the anonymous author of a woodcut broadside published in advance of the partial solar eclipse of 1699, *The True Figure of that Great Eclipse of the Sun*, criticized the traditional (and obsolete) Ptolemaic scheme of Creation as "Vulgar" and "built upon a very Sandy Foundation", and noted that the eclipse "proceeds only from a Natural cause"; he nevertheless concluded his text with a caution and a prayer: "'Tis observable, That at the Time of this Eclipse, there happens an Opposition of *Saturn* and *Mars*, from *Leo* and *Aquarius*; Perhaps the Astrologers may take Notice of it; I pray God preserve the People of *Good Old England*, and Divert his Judgments from us."[5]

The unique accessibility of astronomical phenomena necessitated a medium for its public interpretation that was also uniquely accessible. That medium was developed early in the century through the modernization of an old European institution: the astrological broadside.[6] Since the development of printing, astrological broadsides had offered single-sheet predictions of doom, often vividly illustrated, based on the appearances of comets, eclipses, meteors, aurorae, and the like. Astronomical broadsides updated the medium by offering scientific explanations of many of the same phenomena, along with appropriate large-scale illustrations. In general, two kinds of prints were published: prints that displayed general facts about the solar system, along with data concerning the orbits of the planets and comets, and prints that contained predictions of forthcoming events, such as planetary transits, or eclipses of the Sun.[7] Their illustrations not only gave them value as "curiosities", they also made them didactically more effective than text-oriented media such as pamphlets and books.[8]

Their intellectual accessibility was matched by a commercial accessibility greater than that of other media; while a basic astronomy text might be had for three shillings, for sixpence or less a curious consumer could acquire an astronomical broadside showing an attractive and interesting illustration with a short explanation. Such a relatively inexpensive item might well have attracted consumers hesitant, or unable, to spend more money on a comprehensive pamphlet or book. Moreover, many of the events illustrated by such ephemera were themselves ephemeral; no medium could be more appropriate for illustrating and explaining to the public a rare and brief event like a solar eclipse than a sixpenny broadside.

Just as astronomical broadsides provided an attractive and accessible medium for astronomical information, so they also provided good possibilities to their producers for personal promotion and the advertisement of related goods. An astronomer who published a broadside of an event inevitably reached an audience beyond the usual readers of the *Philosophical transactions* or the latest book expounding the wonders of Newtonian astronomy; if that astronomer was also a lecturer, teacher,

TABLE 1. Astronomical broadsides published by John Senex.*

Date	Author	Title	Price
1712	William Whiston	*Scheme of the solar system*	2s 6d
1715	William Whiston	*Calculation of the great eclipse of the Sun*	6d
1715	Edmond Halley	*Description of the passage of the shadow of the Moon over England*	6d
1715	William Whiston	*Compleat account of the great eclipse of the Sun*	1s
1715	Edmond Halley	*Description of the passage of the shadow of the Moon over England as it was observed*	6d
1718		*An exact description of the total and visible eclipse of the Moon*	6d
c. 1723		*The Newtonian system of Sun planets and comets*	1s
1723	Edmond Halley	*Description of the passage of the shadow of the Moon over England*	6d
1724	Edmond Halley	*Description of the passage of the shadow of the Moon over Europe*	1s
1736	William Whiston	*The transits of Venus and Mercury over the Sun*	1s
1737	Thomas Wright	*The general construction &c. of a solar eclipse*	1s 6d
1737	Thomas Wright	*The passage of the annular penumbra over Scotland*	1s

*This list is based on "A catalogue of globes, maps, &c. made by the late John Senex, FRS..." (*c*. 1740) which records eleven prints and their prices (Science Museum Library, London, item 1951-685/67). I have examined copies of ten of these broadsides. To this catalogue I have added the first edition of Halley's *Description of the passage of the shadow of the Moon over England as it was observed*, published just after the eclipse of 1715.

or author, the increased name-recognition could easily translate into expanded markets for his other commercial activities.[9] Similarly, both the writers and the publishers of these broadsides could make use of them to advertise astronomically-themed products — globes, books, telescopes, and the like, as well as other broadsides.

In eighteenth-century London, two businessmen dominated the market for astronomical broadsides. From 1712 until his death in 1740, the bookseller and cartographer John Senex published or sold at least twelve single-sheet prints that addressed astronomical themes, in addition to several star maps, and maps of the Sun and Moon (Table 1).[10] Nine of these focused on eclipses of either the Sun or Moon; one addressed transits of Venus and Mercury; and two presented general information concerning the solar system and its comets. Four were written by William Whiston, four by Edmond Halley, and two by Thomas Wright of Durham. Most included some advertisement for other products available from Senex, especially his globes. Prices of these broadsides ranged from 6 pence to 2 shillings 6 pence.

During the second half of the century, leadership in the astronomical print business shifted to that most energetic marketer of scientific commodities, Benjamin Martin.[11] Between 1739 and around 1765, Martin published nine of his own broadside prints, of which at least eight were astronomically oriented. His first effort, *Synopsis Scientiae Caelestis, or Knowledge of the Heavens and Earth Displayed*, appeared in three editions (in 1739, 1743, and 1752), and sold for three shillings; it was later superseded by his *New Geographical Map; Shewing the First Principles of Geography and Astronomy*, published around 1758, which sold for half the price of the *Synopsis*. The remaining seven astronomical prints all concerned unusual phenomena: three focused on comets; two addressed transits of Venus; and one displayed the paths of totality of the five major solar eclipses of the eighteenth century. These prints sold for between 6 pence and 3 shillings, and provided an opportunity for Martin to advertise other astronomical goods available from his firm (including, for example, his editions of Senex's globes).[12]

In addition to the broadsides published by Senex and Martin, others contributed one or more prints to the market over the course of the century, including Charles Leadbetter, George Smith, George Witchell, Joseph Betts, and Samuel Dunn; a large number of initialled and anonymous prints were also published. In all, over three dozen astronomical broadsides were published during the eighteenth century, most in the fifty years between 1715 and 1765.[13] Of the phenomena addressed in these prints, none appears to have inspired more notice than solar eclipses. The reason has to do with the drama of the phenomenon itself. For example, recording his impressions of the 1715 eclipse for the readers of the *Philosophical transactions*, Edmond Halley commented particularly on "the *Chill* and *Damp* which attended the Darkness of this Eclipse, of which most Spectators were sensible, and equally Judges". Even natural philosophers, he continued, "could not behold it without some sense of Horror".[14]

The British witnessed five major solar eclipses during the first two-thirds of the century, in 1715, 1724, 1737, 1748, and 1764. Each excited greater or lesser degrees of commercial effort and public comment, varying according to how far from London the path of totality ran. Despite the striking illustration of it published in the *Universal magazine* (Figure 1), the eclipse of 1748, which was partial in London and total only north of the Firth of Forth, does not appear to have prompted great comment in the capital; the eclipse of 1737 — of which the southernmost edge of the path of totality ran along the banks of the Tyne river in northern England — excited only a little more notice.[15] In contrast, the eclipses of 1715, 1724, and 1764 stimulated a significant amount of commercial activity in and around London, providing opportunities for entrepreneurs to make money from lectures, pamphlets, instruments intended to illustrate the mechanics of the phenomenon, and a variety of accoutrements designed to enhance (and make safer) the public's observation of the events.

Astronomical broadsides played an especially important role in shaping the public understanding of the eclipses of 1715 and 1724, in part because the public had access to few other published sources that provided meaningful and useful information about these events. Compared to the variety and range of astronomical texts that were to become available to the English public beginning around the 1740s, relatively few astronomical works were published during the first quarter of the eighteenth century. Those that were available were generally of two types: introductory texts on "the use of the globes" published primarily for students, such as John Harris's *Description and use of the celestial and terrestrial globes* (first edition 1703) and Edward Well's *Young gentleman's astronomy, chronology, and dialling* (first edition 1712); and books derived from university lectures, such as William

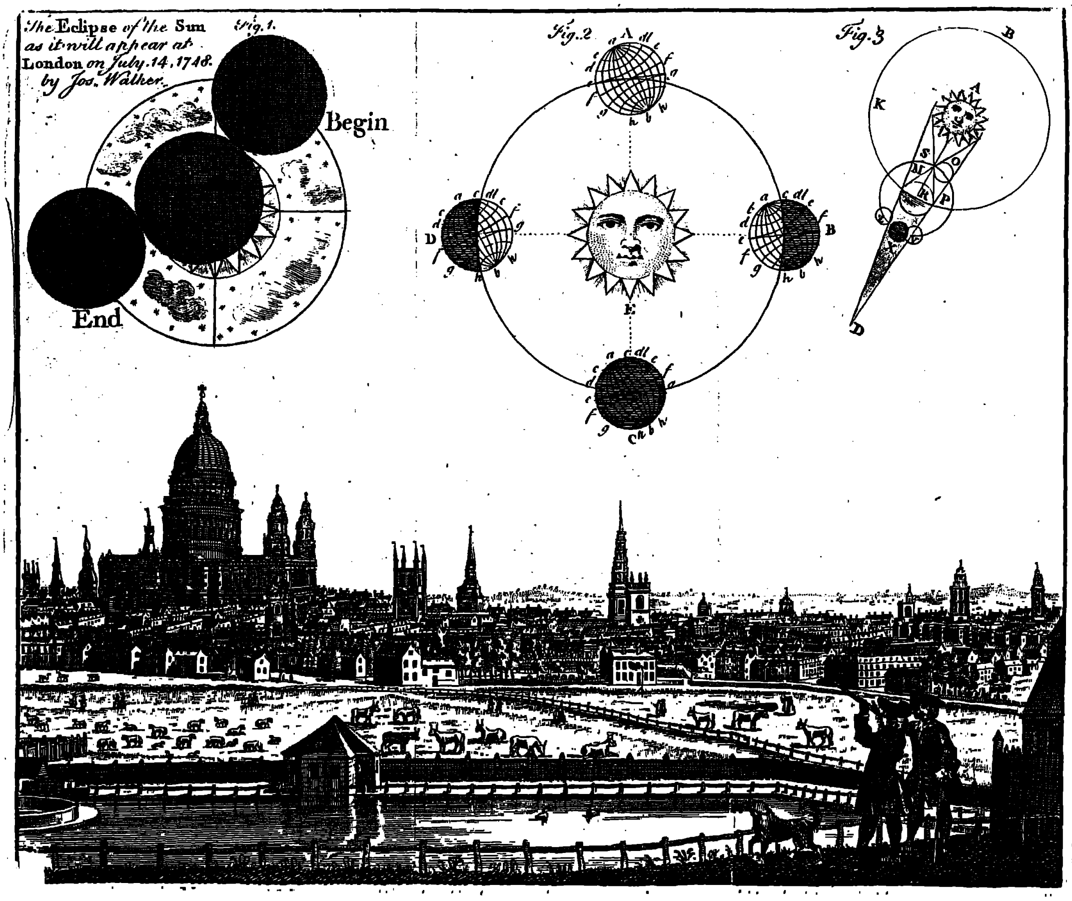

FIG. 1. "The cause of Eclipses and the Motion of the Earth Delineated" (1748). Originally published in the *Universal magazine*. Author's collection.

Whiston's *Astronomical lectures* (first English edition 1715), David Gregory's *Elements of physical and geometrical astronomy* (first English edition 1715), and John Keill's *Introduction to the true astronomy* (first English edition 1721). Among the very few works falling outside these types were William Derham's *Astrotheology: or a demonstration of the being and attributes of God from a survey of the Heavens* (first edition 1715), a sequel to his best-selling *Physico-theology*, and a work that can be considered "astronomical" only in the most general sense; and John Harris's *Astronomical dialogues between a gentleman and a lady*, an anglicized update of Fontenelle's *Dialogues on the plurality of worlds.*[16]

All of these works offered some discussion of eclipses. At the very least, each offered basic definitions of the different kinds of solar and lunar eclipses (partial, total, and annular), and some explanation of eclipses based on the movements of the Earth-Moon-Sun system, which illuminated the key distinction between a lunar and solar eclipse — that, while a lunar eclipse is caused by the shadow of the Earth moving across the Moon (thereby preventing the Moon from reflecting the Sun's light), a solar eclipse arises from the Moon itself blocking the light of the Sun from falling on a part of the Earth. Both basic texts on globes and the texts of university

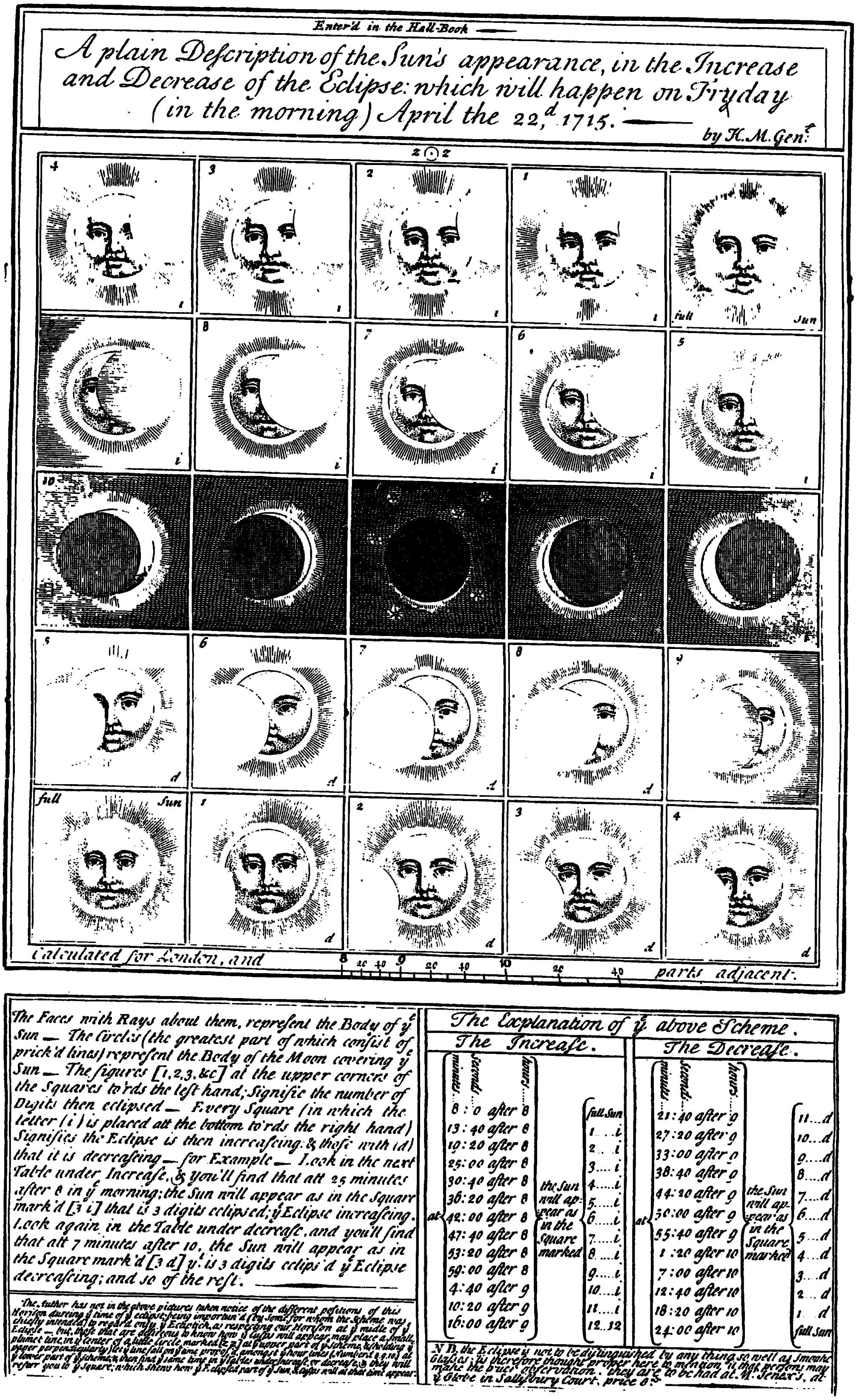

FIG. 2. Illustration of the solar eclipse of 1715. Adler Planetarium. 36 × 24 cm.

lectures offered mathematical discussions of the geometry of an eclipse (complete with figures), but (as might be expected) only Whiston, Gregory, and Keill outlined how one might go about calculating a given eclipse. At the other end of the spectrum, Derham and Harris avoided any mathematical discussion of eclipses; Derham noted the utility of eclipses to chronology and the determination of the longitude, while Harris characteristically digressed from his brief introduction to eclipses into poetry and flirtation. Perhaps the best account of eclipses available to the English reader in the early eighteenth century was either that written by John Flamsteed for publication in Jonas Moore's *Mathematicks* (a work published in 1680, and thus likely not widely available) or that found in William Whiston's 94-page *Calculation*

Text of Figure 2]

Enter'd in the Hall-Book

A plain Description of the Sun's appearance, in the Increase and Decrease of the Eclipse: which will happen on Fryday (in the morning) April the 22^{d}, 1715.

by H.M. Gen^{t}:

The Faces with Rays about them, represent the Body of y^{e} Sun. The Circles (the greatest part of which consist of prick'd lines) represent the Body of the Moon covering y^{e} Sun. The figures [1, 2, 3, &c] at the upper corners of the Squares to'rds the left hand; Signifie the number of Digits then eclipsed. Every Square (in which the letter (i) is placed att the bottom to'rds the right hand) Signifies the Eclipse is then increaseing: & those with (d) that it is decreaseing – for Example – Look in the next Table under Increase, & you'll find that att 25 minutes after 8 in y^{e} morning; the Sun will appear as in the Square mark'd [3 i] that is 3 digits eclipsed; y^{e} Eclipse increaseing. Look again in the Table under decrease, and you'll find that att 7 minutes after 10, the Sun will appear as in the Square mark'd [3 d] yt is 3 digits eclips'd y^{e} Eclipse decreaseing; and so of the rest.

The Author has not in the above pictures taken notice of the different positions of this Horizon dureing y^{e} time of y^{e} eclipse; being importun'd (by Some for whom the Scheme was chiefly intended) to regard only y^{e} Ecliptick, as respecting our Horizon at y^{e} midle of y^{e} Eclipse – but, those that are desireous to know how y^{e} Cusps will appear may place a small plumet line in y^{e} Center of a little Circle marked [z z] at ye upper part of y^{e} scheme, & (holding y^{e} paper perpendicularly) let y^{e} line fall on y^{e} time propos'd amongst y^{e} hour lines (Number'd 8, 9, 10) at y^{e} lower part of y^{e} scheme; & then find y^{e} same time in y^{e} Tables under Increase, or decrease & they will referr you to y^{e} Square; which shews how y^{e} Eclipsed part of y^{e} Sun & Cusps will at that time appear.

[Table with the times of the eclipse keyed to the illustrations; including the following times:]

8′0″ after 8^{h}	full Sun
...	
16′00″ after 9^{h}	12 digits eclipsed
...	
24′00″ after 10^{h}	full Sun

NB. the Eclipse is not to be distinguished by any thing so well as smoake Glasses; 'tis therefore thought proper here to mention it that persons may make the truer observation. they are to be had at M^{r}. Senex's, at y^{e} Globe in Sallisbury Court, price 6d.

I. Nutting Sculpsit

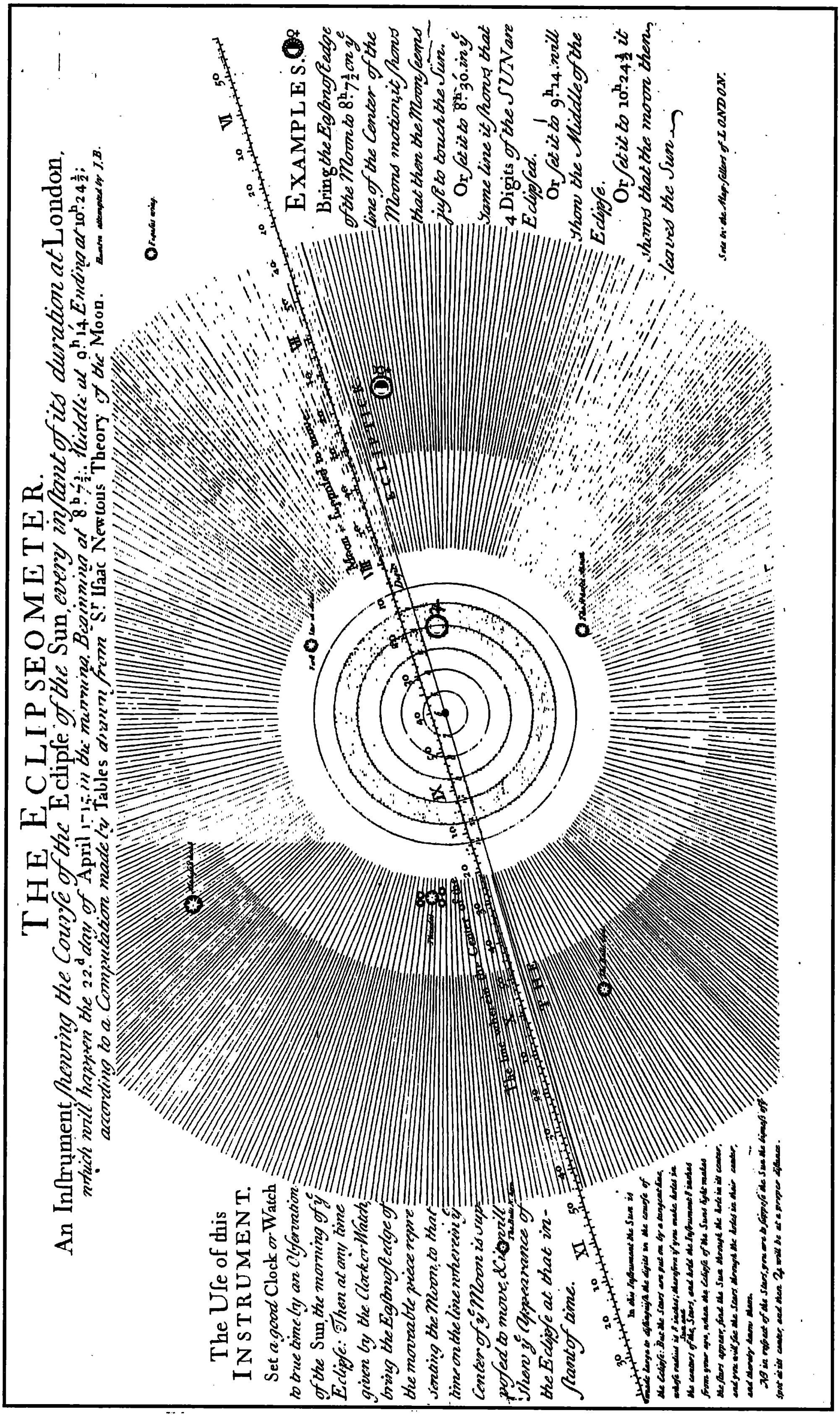

FIG. 3. "The Eclipseometer", a device that encouraged active participation in the solar eclipse of 1715. Oxford Museum of the History of Science.

of solar eclipses without parallaxes, which was published to coincide with the eclipse of 1724.[17]

However useful these texts may have been in explaining the cause (and perhaps the calculation) of an eclipse, none answered, or could answer, the questions uppermost in the minds of those members of the public anticipating an imminent eclipse: "Where and how can I see it, and what will it look like?" These books treated eclipses *in general*; they usually did not offer extended discussions and predictions of a *specific* eclipse. Astronomical broadsides filled that need. Some might merely offer minute-by-minute illustrations of what the eclipse would look like to observers at a given location (Figure 2); others could serve as instruments to encourage and facilitate the active participation of their purchasers in the observation of an eclipse (Figure 3). The best not only surveyed the astronomy of eclipses and suggested scientifically sanctioned interpretations of the phenomenon, they also offered predictions of the timing and the area to be covered by an upcoming eclipse, instructed users in safe eclipse-viewing, and provided directions for observing other astronomical objects during the eclipse. Thus, as accessible, attractive media

---

Text of Figure 3]

THE ECLIPSEOMETER.
An Instrument *shewing the Course of the* Eclipse *of the* Sun, *every instant of its duration at* London, *which will happen the* 22^{d} *day of* April 1715 *in the morning, Beginning at* 8^{h} 7½′: *Middle at* 9^{h} 14′: *Ending at* 10^{h} 24½′; *according to a Computation made by* Tables *drawn from* S^{r}. Isaac Newtons Theory *of the* Moon. *Humbly attempted by J.B.*

The Use of this INSTRUMENT.
Set a good *Clock* or *Watch* to true time by an Observation of the *Sun*, the morning of y^{e} Eclipse: Then at any time given by the Clock or Watch, bring the Eastmost edge of the moveable piece representing the Moon, to that time on the line wherein y^{e} Center of y^{e} Moon is supposed to move, & it will shew y^{e} Appearance of the Eclipse at that instant of time.

EXAMPLES.
Bring the Eastmost edge of the Moon to 8^{h} 7½ on y^{e} line of the Center of the Moons motion, it shows that then the Moon seems just to touch the Sun.
Or set it to 8^{h} 30′ in y^{e} same line it shows that 4 *Digits* of the SUN are Eclipsed.
Or set it to 9^{h} 14. will show the Middle of the Eclipse.
Or set it to 10^{h} 24½ it shows that the moon then leaves the Sun.

In this Instrument the Sun is made large to distinguish the digits in the course of the Eclipse: But the Stars are put on by a tangent line whose radius is 8 inches; therefore if you make holes in the centers of the Sun and Stars, and hold the Instrument 8 inches from your eye, when the Ellipse of the Suns light makes the stars appear, find the Sun through the hole in its center, and you will see the Stars through the holes in their center, and thereby know them.

NB in respect of the Stars, you are to suppose the Sun the bigness of y^{e} spot at its center, and then [Jupiter] will be at a proper distance.

Sold by the Map sellers of LONDON.

providing up-to-date scientific information about eclipses, these broadsides offer a unique insight into the ways in which the English astronomical community of the first quarter of the eighteenth century encouraged, shaped, and benefited from the public's interest in astronomy.

1. A "SUDDAIN DARKNESS": EDMOND HALLEY AND THE PUBLIC ASTRONOMY OF ECLIPSES

The solar eclipse of 22 April 1715 (3 May according to the new calendar) provided the first opportunity for the marketers of scientific commodities to package a major astronomical event. John Senex took particular advantage of the anticipated eclipse, publishing three different broadside predictions of the event, two with texts by William Whiston, and one with a text by Edmond Halley. Halley's broadside, *A Description of the Passage of the Shadow of the Moon over England* and Whiston's first print, *A Calculation of the Great Eclipse of the Sun*, were advertised twice during March and April of 1715 in the *London Gazette*. The second advertisement, appearing in the edition dated 2–5 April 1715 (old style), asserted that an extraordinarily long time had passed since such an event had been visible from London:

> This Day is Published a new Edition of Mr. Professor Halley's Description of the total Eclipse of the Sun on Friday the 22d Day of this Instant April in the Morning, when by reason of the sudden Darkness the Stars will be visible about the Sun, the like Eclipse having not been seen in the Southern Parts of Great Britain for above 500 Years. N.B. The Map shews every part of England over which the total Darkness will pass, and may be sent by the Post for the same Charge as a single Letter. Printed for J. Senex in Salisbury-Court, and William Taylor at the Ship in Pater noster-row. Where may be had Mr. Whiston's Calculation of the Eclipse; also his Astronomical Lectures, being a Survey of the Heavens.[18]

This advertisement demonstrates that Senex made good use of the opportunity presented by this dramatic event to expand the audience for astronomy, and so the market for astronomical commodities, in particular, by adopting advertising strategies designed to target markets outside the bounds of both London and the community of astronomical cognoscenti. First, he promoted orders from the provinces; the advertisement promised a map of "every part of England" over which the eclipse would be total (without revealing exactly where those areas were), and further noted that curious provincial customers could receive the map by post for a nominal cost. Second, he used the occasion to advertise a work on general astronomy — in this case, his newly-published English edition of Whiston's *Astronomical lectures*, an introductory collection originally intended, as the subtitle of the work noted, "For the Use of young Students in the University".[19] Senex's insertion into the notice of the print of an advertisement for Whiston's book is a typical eighteenth-century advertising strategy, and both of the prints mentioned in this advertisement referred to other products available to customers through Senex's business, including most particularly "the Newest and Correctest Maps, and Globes of 3, 9, 12, and 16 Inches Diameter, at moderate prices".[20]

Although the advertisement mentioned Whiston's broadside *Calculation of the Great Eclipse of the Sun* (discussed below), it focused on Halley's *A Description of the Passage of the Shadow of the Moon over England*, which had a broader appeal. Engraved by Senex and sold by him for 6 pence, Halley's *Description* (Figure 4) displayed a map of England with Halley's prediction of the path over which the eclipse would be total and partial superimposed.[21] In the text attached to the map, and an account of the eclipse subsequently published in the *Philosophical transactions*, Halley expressed two goals in publishing this print. First, he sought to distance the astronomical event from its unfortunate timing. The Hanoverian succession of 1714 had provoked a period of civil unrest in London that became particularly serious in the spring of 1715.[22] In this climate, the prospect of a solar eclipse — with its inevitable astrologically-inspired political interpretations — must have been alarming to many. Halley consequently began his text with the reassurance that the eclipse was a purely astronomical event, and not a political portent:

> The like Eclipse having not for many Ages Been seen in the Southern Parts of Great Britain, I thought it not improper to give the Publick an Account thereof, that the suddain darkness wherein the Starrs will be visible about the Sun, may give no surprize to the People, who would, if unadvertized, be apt to look upon it as Ominous and to Interpret it as portending evill to our Sovereign Lord King George and his Government, which God preserve. Hereby they will see that there is nothing in it more than Natural, and nomore than the necessary result of the Motions of the Sun and Moon.[23]

Halley's fear that "the People" might interpret the eclipse as a bad omen for the new king was not misplaced; the author of a poem published in commemoration of the eclipse expressed similar concern over its timing, noting with relief that it just missed the 23 April celebration in remembrance of St George, the patron saint of England:

> But, Interposing Globe, we can't forbear,
> Of Timing this Eclipse to tell thy awful care;
> Surely Thou did'st our Calendar inspect,
> And thereby prudently thy course direct,
> As not to blemish *Albion's* day of Fame,
> Doubly by us rever'd, for SAINT and NAME.
> For our Great Monarch's sake, thy sullen shade
> On fam'd St. GEORGE'S day durst not invade
> This Realm, tho' near approaches thou hadst made.[24]

George I and the House of Hanover survived the eclipse. However, as one English author subsequently noted, not all kings were as lucky; "The Sun King", France's Louis XIV, died in August 1715.[25]

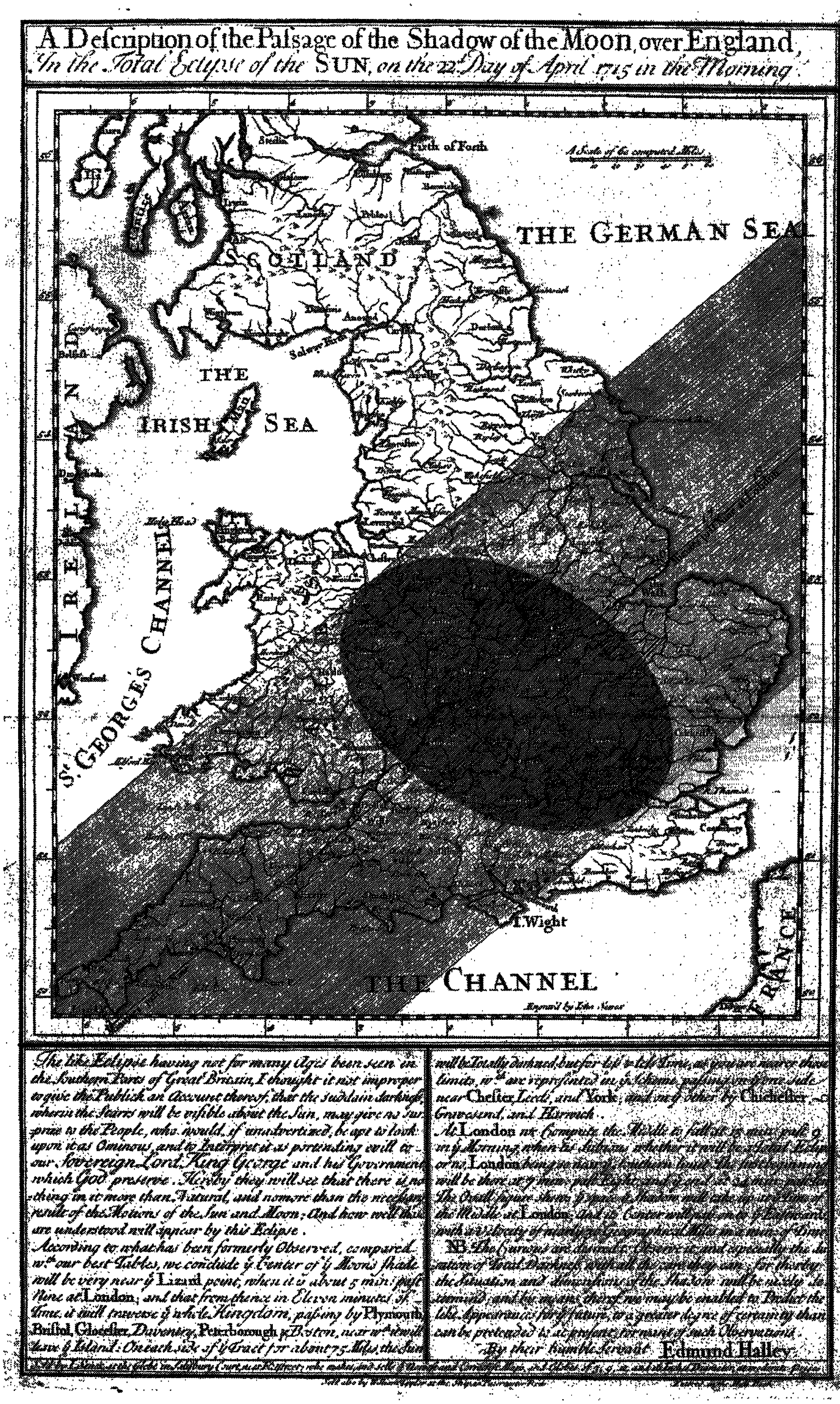

FIG. 4. Halley's broadside with his prediction of the path of the solar eclipse of 1715. Royal Astronomical Society. 43 × 27 cm.

Halley's second purpose in publishing the *Description* was to invite "the Curious" to observe the eclipse, and report their observations back to him, so that he would be able to determine "the Situation and dimension of the Shadow".[26] He explained after the event in the *Philosophical transactions* that no total solar eclipse had been visible from London since 1140:

> The Novelty of the thing being likely to excite a general Curiosity, and having found, by comparing what had been formerly observed of Solar Eclipses, that the whole Shadow would fall upon England, I thought it a very proper Opportunity to get the Dimensions of the Shade ascertained by Observation;

Text of Figure 4]

A Description of the Passage of the Shadow of the Moon over England, *In the Total Eclipse of the SUN on the 22d Day of April 1715 in the Morning*

The like Eclipse having not for many Ages Been seen in the Southern Parts of Great Britain, I thought it not improper to give the Publick an Account thereof, that the suddain darkness wherein the Starrs will be visible about the Sun, may give no surprize to the People, who would, if unadvertized, be apt to look upon it as Ominous and to Interpret it as portending evill to our Sovereign Lord King George and his Government, which God preserve. Hereby they will see that there is nothing in it more than Natural, and nomore than the necessary result of the Motions of the Sun and Moon; And how well those are understood will appear by this Eclipse.

According to what has been formerly Observed, compared wth our best Tables, we conclude y^{e} Center of y^{e} Moon's shade will be very near y^{e} *Lizard* point, when it is about 5 min: past Nine at *London*; and that from thence in Eleven minutes of Time, it will traverse y^{e} whole Kingdom, passing by *Plymouth*, *Bristol*, *Glocester*, Daventry, *Peterborough*, & Boston, near w^{ch} it wil leave y^{e} Island: On each side of y^{e} Tract for about 75 Miles, the Sun will be Totally darkned; but for less & less Time, as you are nearer those limits, wch are represented in y^{e} Scheme, passing on y^{e} one side near *Chester*, Leeds, and *York*; and on y^{e} other by *Chichester*, Gravesend, and Harwich.

At *London* we Compute the Middle to fall at 15 min: past 9 in y^{e} Morning, when 'tis dubious whether it will be a Total Eclipse or no, *London* being so near y^{e} Southern limit. The first beginning will be there at 7 min: past Eight, and y^{e} end at 24 min: past Ten. The Ovall figure shews y^{e} space y^{e} Shadow will take up at y^{e} Time of the Middle at *London*; And its Center will pass on to y^{e} Eastwards, with a Velocity of nearly 30 Geographical Miles in a min: of Time.

NB. The Curious are desired to Observe it, and especially the duration of Total Darkness, with all the care they can; for therby the Situation and dimensions of the Shadow will be nicely determined; and by means therof we may be enabled to Predict the like Appearances for y^{e} future, to a greater degree of certainty than can be pretended to at present, for want of such Observations.

By their humble Servant
Edmund Halley

Sold by I. Senex, at the Globe in Salisbury Court, near Fleetstreet; who makes and sells y^{e} Newest and Correctest Maps, and Globes of 3, 9, 12, and 16 Inches Diameter, at moderate Prices.

Sold also by William Taylor at the Shop in Paternoster Row

Entered in the Hall Book

> and accordingly, I caused a small Map of England, describing the Track and Bounds thereof, to be dispersed all over the Kingdom, with a Re-quest to the Curious to observe what they could about it, but more especially to note the Time of Continuance of total Darkness, as requiring no other Instrument than a Pendulum Clock with which most Persons are furnished....

Armed with observations from volunteers throughout the country, Halley was confident that he would be able "to establish several of the Elements of the Calculus of Eclipses, so as for the future we may more securely rely on our Predictions".[27]

Although Halley separated his two stated objectives for publishing the map — that of rationalizing the eclipse and that of obtaining its dimensions with the aid of a nationwide network of volunteer observers — these objectives complemented each other. By soliciting observations, Halley's print presented the eclipse as a public, participatory event, thereby making it seem less like a supernatural disaster happening "to" the people of Britain; offering a prediction of the time of the eclipse merely reinforced the fact that the astronomical community had mastered the phenomenon.[28] This strategy placed the eclipse firmly within the empirical, hands-on experience of science emerging in the lecture theatres and instrument shops during the second decade of the century. It also suited the unique character of the phenomenon; since an eclipse cannot be duplicated at will by lecturers, the more who were encouraged to observe it — and the more who were properly primed to understand it as a natural event — the better for the advancement of Newtonian science. Even those lacking either the instruments or the skill to observe the eclipse with the precision necessary to contribute to Halley's "Calculus" could nevertheless have understood the message underlying Halley's request: the eclipse is an occasion not for fear, but for the advancement of astronomy.

While the message, layout, and cost of Halley's *Description* made it broadly accessible, Halley's declaration in the *Philosophical transactions* that he assumed that most of his volunteer observers would have a pendulum clock available to time the eclipse defined the segment of society from which he expected the most accurate eclipse observations. Lorna Weatherill's study of British probate records indicates (not surprisingly) that the best indicators of clock ownership were wealth, education, and residence in London; in 1715, 52% of all London households owned clocks, while clocks might be found in fully 90% of the homes of wealthy tradesmen and merchants living in London. In contrast, only 33% of the households of the entire country possessed clocks, with the majority found in the homes of professionals, the gentry, and those in high-status trades.[29] Thus, not only the technical complexities of eclipse observations, but also its material demands, selected the volunteer observers likely to produce data of use to Halley.

Nevertheless, Halley discovered that for some would-be surrogates, their enthusiasm for contributing to the refinement of eclipse theory exceeded their resources; not everyone who sent observations to Halley had good clocks available to them. Halley commented in his account of the eclipse published in the *Philosophical* *transactions* that observers at Barton in Northamptonshire and King's Walden in Hertfordshire who were furnished with "good Pendulum-Clock(s)" measured the time of totality to be 3′ 53″ and 3′ 52″, respectively. In contrast, observers who reported from Plymouth, Exeter, Weymouth, Daventry, Northampton and Lynn Regis reported that totality lasted four minutes or more, leading Halley to suspect that they had relied on "pocket Minute-Watches" in making their measurements.[30] But, in the table of data he published in the *Philosophical transactions*, Halley made no distinction between the observations based on his evaluation of their quality or reliability; rather, he expressed his gratitude to "all those who have been willing to promote our Endeavours to perfect the Doctrine of Eclipses". Moreover, he declared that the sum result of their efforts was something of which they should be proud: "this is the first Eclipse of this kind that has been observed with the Attention and Dignity of the Phenomenon requires (*sic*) ...."[31]

Readers of the *Philosophical transactions*, like the 20-some volunteers who contributed their observations to Halley, might have been expected to aid in the advancement of eclipse theory. But, in the aftermath of the eclipse, Halley also attempted to reach beyond this limited audience to a wider public. Once again, he turned to the broadside as his medium (Figure 5). In a print evidently published some months after the event, Halley provided a corrected path for the eclipse, and acknowledged the contributions of his volunteer observers:

> Since the Publication of our Predictions of this Eclipse has had the desired effect, and many curious Persons have been excited thereby to communicate their Observations from most parts of the Kingdom, we thought it might not be unacceptable to represent after the same manner the passage of the Shade, as it really happened; whereby it will appear that tho' our Numbers pretend not to be altogether perfect yet the correction they need is very small.[32]

In that it provides both the corrected path of the 1715 eclipse, and the predicted path of the forthcoming eclipse of 1724, Halley's post-eclipse print, *A Description of the Passage of the Shadow of the Moon over England as it was Observed in the late Total Eclipse of the SUN April 22d 1715*, serves as a material link between the two events. Although it lacked the obvious political connotations of the 1715 eclipse, the eclipse of 1724 nevertheless provided the community of scientific entrepreneurs with another opportunity to shape the public's understanding of eclipses — and another opportunity to make money. Thus, in November 1723, in anticipation of the eclipse of 1724, Senex reprinted Halley's nine-year-old broadside, publishing it under the title *A Description of the Passage of the Shadow of the Moon over England In the Total Eclipse of the Sun on the 11th day of May 1724 in the Evening. Togather* (sic) *with the Passage of the Shadow as it was Observed in the last Total Eclipse of 1715*, and amending the print to make note of Halley's new status as Astronomer Royal.[33]

For this eclipse, however, Senex also attempted to reach an audience beyond the Channel, engraving and publishing another map displaying Halley's prediction: *A*

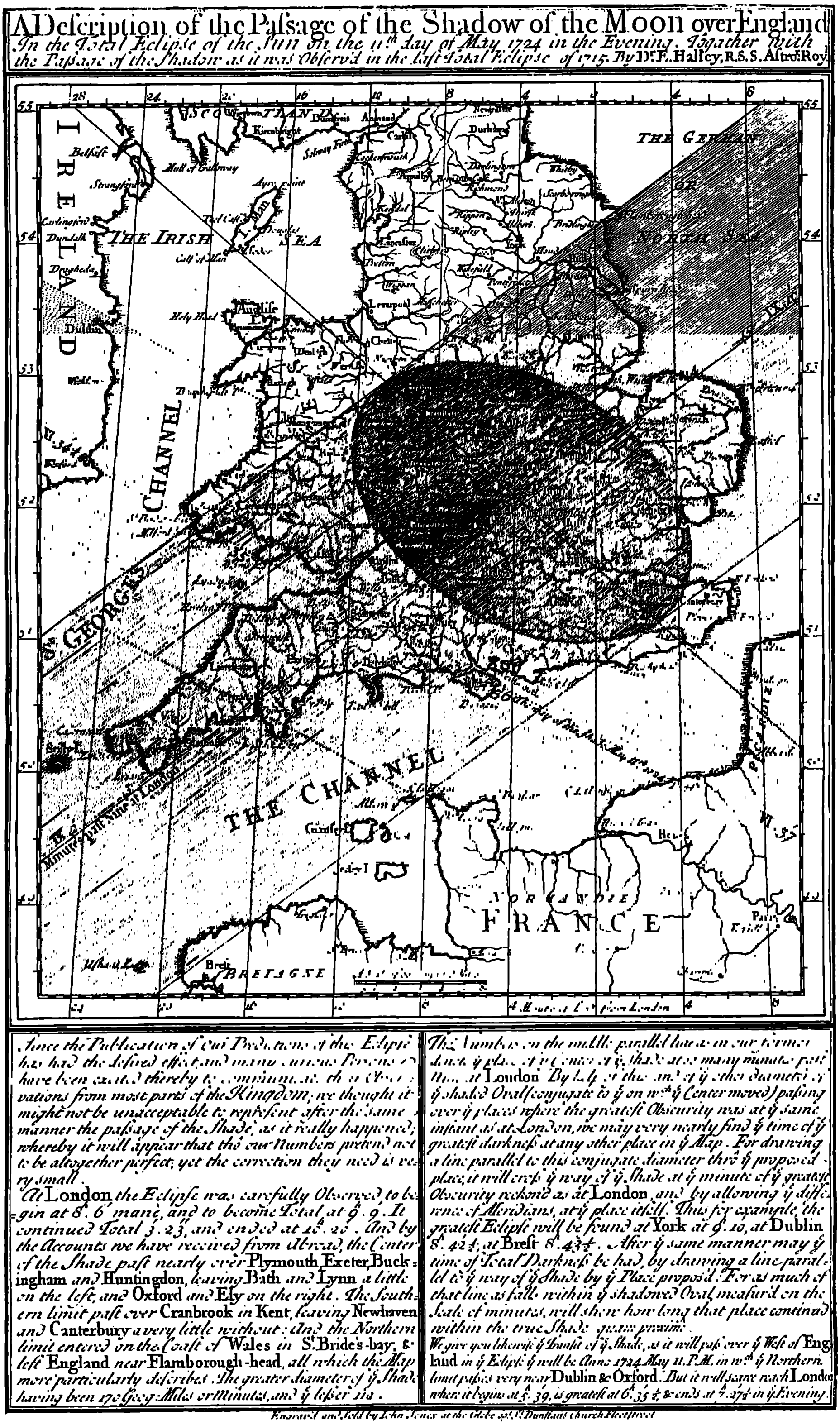

FIG. 5. Halley's broadside with his retrospective description of the path of the solar eclipse of 1715 and his prediction of the path of the eclipse of 1724. Science Museum Library, London. 41 × 27 cm.

Description of the Passage of the Shadow of the Moon over Europe, as it may be expected May 11th 1724 in the Evening (Figure 6). The intent to target an international audience is suggested not only by the geographical scope of the map — it shows the path of eclipse extending from western Ireland through England, France, Switzerland, and northern Italy to Venice — but also by the brief text appended to the map, which compared this event not to the eclipse of 1715, but to a solar eclipse that had occurred in 1706. In the *Philosophical transactions* account of the 1715 eclipse, Halley had expressed some frustration with Continental astronomers, who had (he believed) neglected properly to observe the earlier event. After noting his efforts to ascertain the northern and southern limits of the 1715 shade, he continued,

---

Text of Figure 5]

A Description of the Passage of the Shadow of the Moon over England In the Total Eclipse of the Sun on the 11th day of May 1724 in the Evening. Togather with the Passage of the Shadow as it was Observed in the last Total Eclipse of 1715. By *Dr. E. Halley, R.S.S. Astror. Royl*

Since the Publication of our Predictions of this Eclipse has had the desired effect, and many curious Persons have been excited thereby to communicate their Observations from most parts of the Kingdom; we thought it might not be unacceptable to represent after the same manner the passage of the Shade as it really happened; whereby it will appear that thô our Numbers pretend not to be altogether perfect; yet the correction they need is very small.

At *London* the Eclipse was carefully Observed to begin at 8^h 6′ manè and to become Total at 9^h 9′. It continued Total 3′23″ and ended at 10^h 20′. And by the Accounts we have received from Abroad, the Center of the Shade past nearly over *Plymouth*, *Exeter*, *Buckingham*, and *Huntingdon*, leaving *Bath* and *Lynn* a little on the left and *Oxford* and *Ely* on the right. The Southern limit past over *Cranbrook* in *Kent*, leaving *Newhaven* and *Canterbury* a very little without: and the Northern limit entered on the Coast of *Wales* in *St. Bride's-bay* & left *England* near *Flamborough-head*, all which the Map more particularly describes. The greater diameter of ye Shade having been 170 Geog. Miles or Minutes, and ye lesser 110.

The Numbers on the middle parallel line, as in our former, denote ye place of ye Center of ye Shade at so many minutes past Nine at *London*. By help of this and of ye other diameter of ye shaded Oval (conjugate to yt on wch ye Center moved) passing over ye places where the greatest Obscurity was at ye same instant as at London, we may very nearly find ye time of ye greatest darkness at any other place on ye Map. For drawing a line parallel to this conjugate diameter thrô ye proposed place, it will cross ye way of ye Shade at ye minute of ye greatest Obscurity reckon'd as at *London*, and by allowing ye difference of Meridians, at ye place itself. Thus for example, the greatest Eclipse will be found at *York* at 9^h 10′, at *Dublin* 8^h 42½′, at *Brest* 8^h 43½′. After ye same manner may ye time of Total Darkness be had, by drawing a line parallel to ye way of ye Shade by ye Place proposed: For as much of that line as falls within ye shadowed Oval, measur'd on the Scale of minutes, will shew how long that place continu'd within the true Shade. quam proxime

We give you likewise ye Transit of ye Shade, as it will pass over ye West of *England* in ye Eclipse yt will be Anno 1724 May 11 P.M. in wch ye Northern limit passes very near *Dublin* & *Oxford*. But it will scarce reach *London* where it begins at 5^h 39′, is greatest at 6^h 35½′, & ends at 7^h 27½′ in ye Evening.

Engraved and Sold by Iohn Senex at the Globe agt St Dunstans Church Fleetstreet

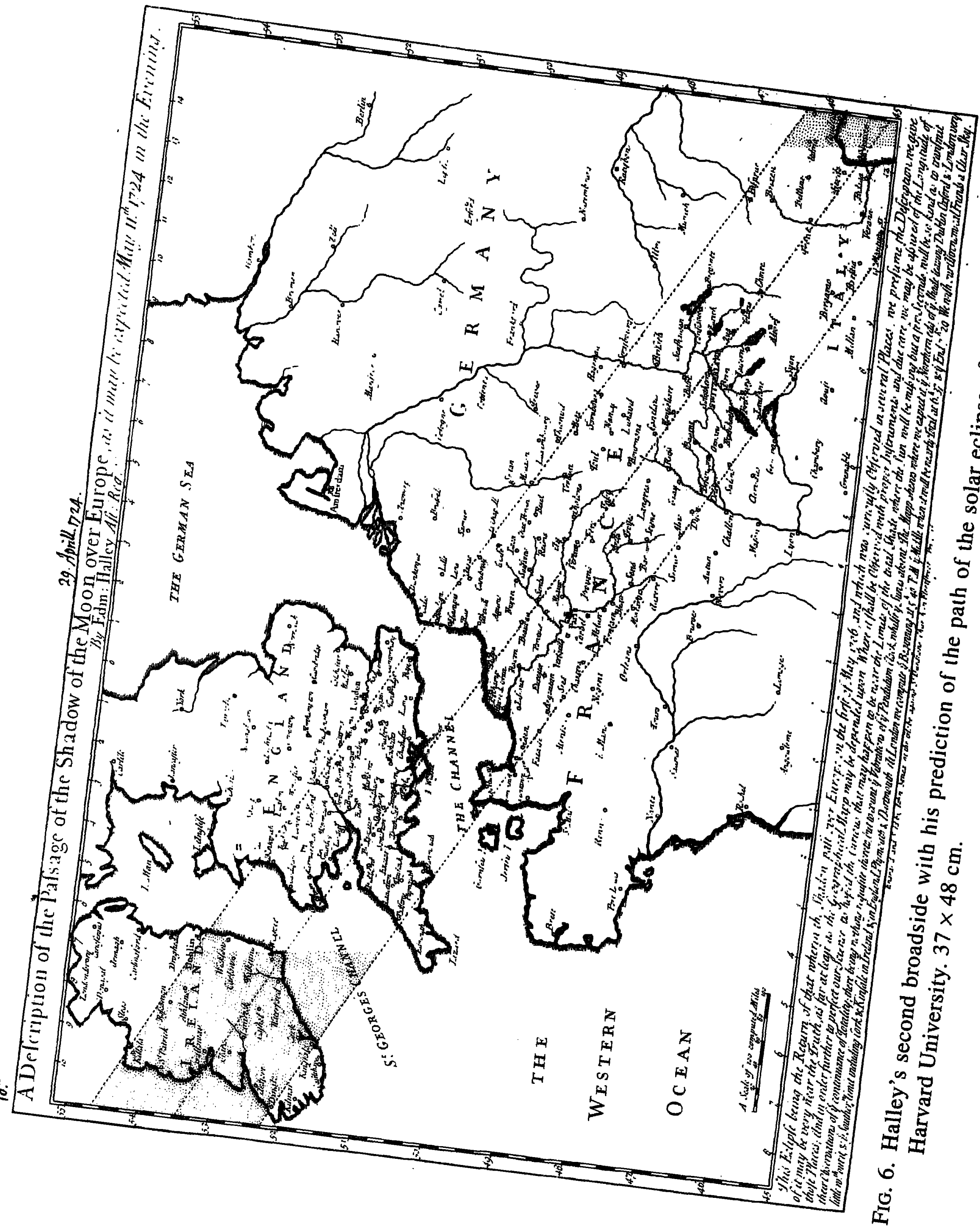

FIG. 6. Halley's second broadside with his prediction of the path of the solar eclipse of 1724. Houghton Library, Harvard University. 37 × 48 cm.

"we should have been glad the *French Astronomers* had done the like for the Total Eclipse that past over *Languedoc*, *Provence*, and *Dauphiny* on the first of *May* 1706".

Senex's publication of Halley's *Description of the Passage of the Shadow of the Moon over Europe* may thus be seen as an effort to succeed internationally where they had succeeded on a national level in 1715. Once again, the broadside extended an invitation to dispatch observations to Halley, but this time, rather than offering the refinement of eclipse theory as the sole objective, Halley also declared the data to be of importance for another reason:

> This Eclipse being the return of that wherein the Shadow past over Europe on the first of May 1706, and which was curiously Observed in several Places; we presume the Description we give of it may be very near the Truth, as far at least as the Geographical Mapp may be depended upon. Where it shall be Observed with proper Instruments and due care, we may be assured of the Longitude of those Places; And in order further to perfect our Science, 'tis hoped the Curious that may happen to be near the Limits of the total Shade, where the Sun will be missing but a few Seconds, will be so kind as to transmit their Observations of y^e^ continuance of Totality; there being nothing requisite thereto, but to count y^e^ Vibrations of y^e^ Pendulum Clock, whilst y^e^ Sun is absent.[34]

In fact, Halley's science of eclipses needed perfecting. He had proudly noted in 1715 that his prediction of that April's eclipse required little correction, but the actual path differed from the predicted path by about 20 miles.[35] A similar error

---

Text of Figure 6]

A Description of the Passage of the Shadow of the Moon over Europe, *as it may be expected May 11^th^ 1724 in the Evening. By* Edm: Halley, *Ast: Reg.*

This Eclipse being the Return of that wherein the Shadow past over Europe on the first of May 1706, and which was curiously Observed in several Places; we presume the Description we give of it may be very near the Truth, as far at least as the Geographical Mapp may be depended upon. Where it shall be observed with proper Instruments and due care, we may be assured of the Longitude of those Places; And in order further to perfect our Science, 'tis hoped the Curious that may happen to be near the Limits of the total Shade, where the Sun will be missing but a few Seconds, will be so kind as to transmit their Observations of y^e^ continuance of Totality; there being nothing requisite thereto, but to count y^e^ Vibrations of y^e^ Pendulum Clock, whilst y^e^ Sun is absent. The Mapp shews where we expect it, y^e^ Northern edg of y^e^ Shade leaving Dublin Oxford & London very little w^th^out it, & y^e^ Southern limit including Cork & Kinsale in Ireland, & in England Plymouth & Dartmouth. At London we compute y^e^ Beginning at $5^h\,40'$ P.M. y^e^ Middle when it will be nearly Total at $6^h\,37'$ & y^e^ End $7^h\,29'$. We wish our Astronomical Friends a Clear Sky.

Engrav'd and Sold by Iohn Senex at the Globe against St. Dunstans Church in Fleetstreet. Price 1s.

arose in Halley's prediction of the 1724 eclipse: Halley's map predicted a path that would pass just to the west of London, with the eclipse showing totality at Reading and Windsor. In fact, he was off by some 25 miles, an error that did his reputation little good. According to James Logan, visiting England from Philadelphia, Halley's inaccuracy frustrated "vast numbers" of would-be observers, who travelled west of London only to be greeted by a view of a partial eclipse (and that only visible through the clouds). Logan himself attempted to view the eclipse from Windsor, but discovered "it was not total there, as Dr. Halley then the Kings Astronomer had by his Map given the world to expect". Logan's disappointment was exacerbated by the fact that a broadside by William Whiston had offered another prediction, which was, according to Logan, more accurate; he noted in frustration on the corner of his copy of Whiston's broadside that its prediction was "by much the truest".[36]

2. PROPHECY AND PROFITS: WILLIAM WHISTON AND THE BUSINESS OF ECLIPSES

Halley and Whiston had competed for the mastery of an eclipse before. In 1715, both had offered their predictions of the eclipse in broadsides published by John Senex; recall that Senex had advertised Whiston's *Calculation of the great eclipse of the Sun* in the same newspaper advertisements that had publicized Halley's eclipse map. But, while both astronomers produced prints for publication by Senex, the prints they produced, and the objectives that shaped those prints, differed greatly. In 1715, Halley's professional star was on the rise. Elected FRS in 1678 at the age of 22, Halley had at various times in his life served Britain and science as a sea captain, astronomer, diplomat, bureaucrat, secretary of the Royal Society, and Savilian Professor of Geometry at Oxford; at Flamsteed's death in 1720, Halley replaced him as Astronomer Royal, a post he held for 22 years. In contrast, in 1715, Whiston's fortunes were in decline. Although he had held a position of some prestige — the Lucasian chair of mathematics at Cambridge (to which he was appointed as Newton's successor in 1701) — his expulsion from Cambridge in 1710, a consequence of his imprudently vociferous Arianism, had all but destroyed his chances of future preferment. Of course, Whiston's heretical beliefs made election to the Royal Society impossible.[37] Thus, after 1710, Whiston was forced to support himself and his family through longitude projects, lecturing, writing, teaching, and the generosity of patrons.[38]

Consequently, the publication of predictive eclipse broadsides served quite different purposes for Whiston than it had for Halley. Neither his 1715 nor his 1724 print reveals any hint that Halley sought financial profit from the eclipse business; instead, Halley apparently tried to use eclipses as opportunities to enhance his status as a leader and organizer of the astronomical community, first nationally and then internationally. In 1715, he may also have felt compelled to ingratiate himself with the new regime, in order to distance himself from his rather shady past as a Tory.[39] In contrast, both of Whiston's two 1715 prints and his 1724 broadside feature prominent advertisements for several of his other products (relating to both general astronomy and the eclipse itself), suggesting his financial interest in whetting the public's appetite for astronomical commodities. In short, it seems that while Halley's primary objective for contributing to the eclipse business was to increase his scientific prestige, Whiston's interest lay primarily in the profits of public astronomy.

His commercial interest in popular astronomy did not begin in 1715. In 1712, Whiston, along with John Senex, had pioneered the production of broadsides intended for the public presentation of astronomy. His *Memoirs* records his collaboration with Senex in the production of a large-format, general astronomy print:

> About the same Year 1712, I published a *Scheme of the Solar System*, with the Orbits of 21 Comets; in a large Sheet of Paper, engraved on Copper, by Mr. *Senex*, *Price* 2s. 6d. Which Scheme has been of great Reputation and Advantage among the curious ever since.[40]

In fact, Whiston's *Scheme* proved to be an extraordinarily long-lived item. Senex himself probably published two editions, which may be distinguished by their advertisements for his globes; although these editions are not dated, as many as fifteen years may have separated their publication.[41] Just before Senex's death in 1740, the print was advertised in Thomas Wright's textbook *The use of the globes: or, the general doctrine of the sphere*; after his death, the plate for this print — like the plates and jigs for his globes — was evidently sold to another member of the trade, probably either John Bowles or Robert Sayer, who republished it in partnership around 1760. An epitome of Whiston's *Scheme*, entitled *The Newtonian System of Sun, Planets, and Comets* was also published by Senex around 1723; this print was republished one hundred years later by the instrument maker Francis West.[42]

The persistence of these prints suggests the profitability of their production for their publishers. Engraving in copper plate required a considerable investment of both money and time.[43] Senex evidently found the investment in engraving and publishing astronomical prints profitable, as he made that investment a dozen times over his very successful career. Similarly, Bowles and Sayer — neither of whom seemed to have had an interest in the production of scientific commodities other than maps — evidently thought that the republication of Whiston's *Scheme* some fifty years after it was engraved would prove more profitable than merely melting down the plate.[44]

The text of the *Scheme* reveals Whiston's penchant for superimposing religious (and consequently political) interpretations onto astronomical and meteorological events, both in his publications and in the coffee-house lectures he began giving in London after 1710.[45] Whiston considered comets especially potent portents; in the *Scheme*, he suggested that comets could bring about "Deluges and Conflagrations" on planets that passed through their tails, thereby serving as "the instruments of Divine vengeance upon the Wicked Inhabitants" of those unfortunate worlds.[46] In 1714, Whiston proposed a specific instance of this, extending a theory proposed earlier by Halley and himself to the effect that the Noachian deluge had been caused by a collision between the Earth and a comet; he further suggested that a similar

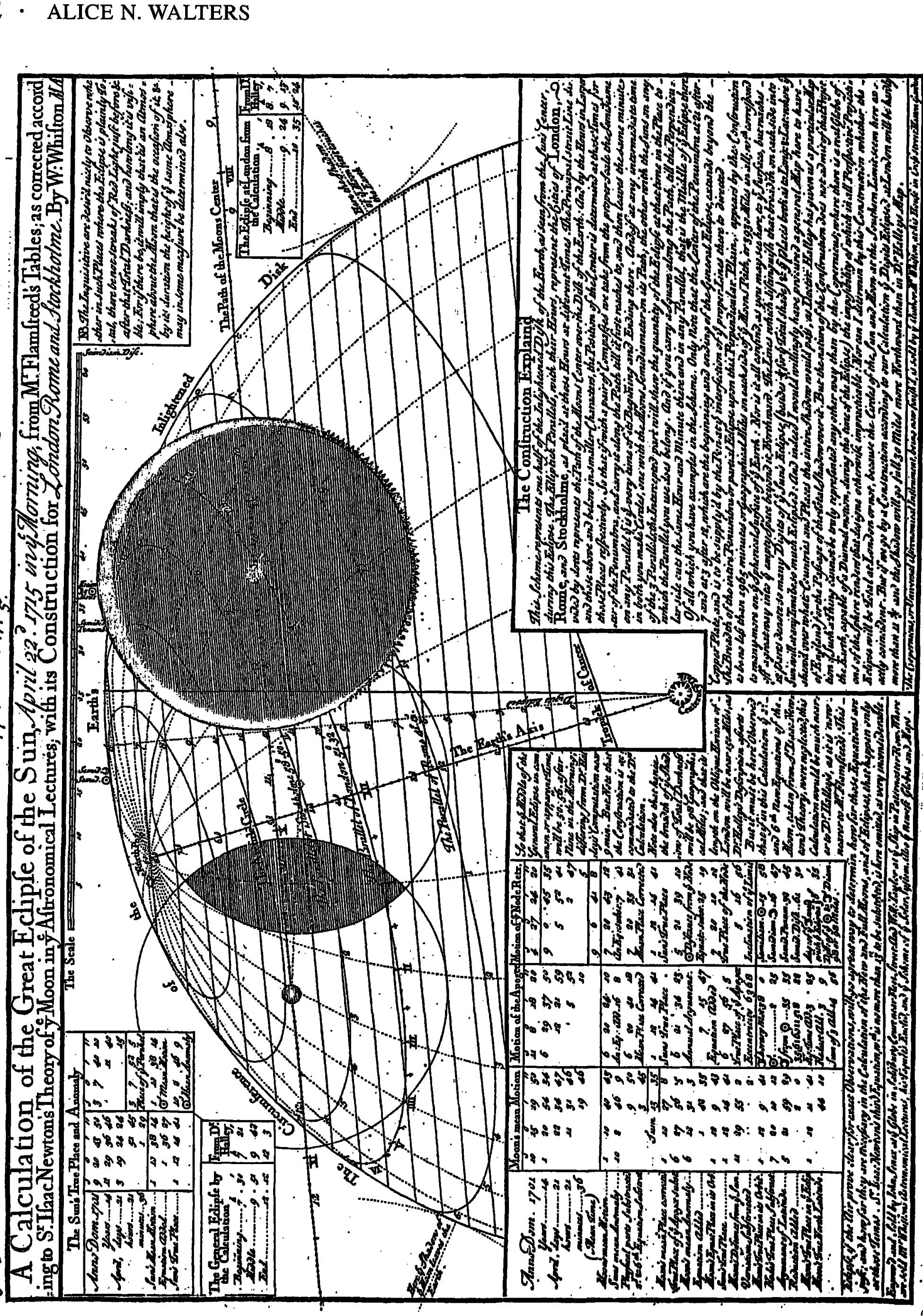

FIG. 7. Whiston's *A Calculation of the Great Eclipse of the Sun, April 22d 1715*. Houghton Library, Harvard University. 27 × 41 cm.

Text of Figure 7]

A Calculation of the Great Eclipse of the Sun, *April 22^{d} 1715 in y^{e} Morning*, from M^{r}. Flamsteed's Tables; as corrected according to S^{r}. Isaac Newton's Theory of y^{e} Moon in y^{e} Astronomical Lectures; with its Construction for *London Rome and Stockholme*. By W: Whiston *M.A.*

Upper left, top: [Table: "The Sun's True Place and Anomaly" for April 22 1715]

Upper right, top: NB. The Inquisitive are desir'd nicely to Observe whether in such Places where the Eclipse is plainly Total, there be not streaks of Red Light just before & after that Total Darkness; and how long it is visible; For if there be, it will imply that 'tis an Atmosphere about the Moon that is the occasion of it, & by its duration the height of y^{e} same Atmosphere may in some measure be determined also.

Upper left, bottom:

The General Eclipse by the Calculation			From D^{r}. Halley	
Beginning	7^{h}	30′	7^{h}	21′
Middle	9^{h}	51′	9^{h}	42′
End	12^{h}	12′	12^{h}	3′

Upper right, bottom:

The Eclipse at London from the Calculation			From D^{r}. Halley	
Beginning	8^{h}	18′	8^{h}	7′
Middle	9^{h}	24′	9^{h}	13′
End	10^{h}	35′	10^{h}	24′

Bottom left, table:
["Moon's mean Motion", "Motion of the Apogee", "Motion of y^{e} Node Retr.", and Whiston's calculation of the Eclipse]

Bottom left, text:
So that y^{e} Middle of the General Eclipse in common or apparent Time will be 50′ 56″. after Nine in the Morning; differing from D^{r}. Halley's Computation near 9 min. But Note that the Construction is accommodated to the D^{rs}. Calculation.

Note also that hence the breadth of y^{e} Shadow of Total Darkness will be 98 Geographical Miles; and that its length on the Oblique Horizon of London will be near 150 Miles, as D^{r}. Halley's Description asserts.

But it must be here Observed that if in this Calculation y^{e} 2^{d} and 6th New Equations of the Moon, taken from S^{r}. Isaac Newton's Theory, were neglected, this Calculation would be much nearer to D^{r}. Halley's, as it is now nearer to M^{r}. Flamsteed's. This Eclipse, if the Air prove clear for exact Observations, will go a great way to determin how far those Equations are just; and how far they are necessary in the Calculation of the New and Full Moons, and of Eclipses, that happen only at those Times. S^{r}. Isaac Newton's third Equation, w^{ch} is no more than 13″ to be subtracted, is here omitted, as very inconsiderable.

Bottom right, text:

The Construction Explain'd

This Scheme represents one half of the Inlightened Disk of the Earth, as seen from the Sun's Center during this Eclipse. The Elliptick Parallels, with their Hours, represent the Cities of *London*, *Rome*, and *Stockholme*, as plac'd at those Hours at different Times. The Principal strait Line divided by dotts represents the Path of the Moons Center over the Disk of the Earth: And by the Hours in Larger and those above and below in smaller Characters, the Position of the Center is determind at those Times for those Places respectively. So that if with a pair of Compasses we take from the proper Scale the Semidiameter of the Penumbra, and carry it along the Path till it first reaches to, and then leaves the same minute on any parallel y^{t} is y^{e} very time of its Beginning and Ending there. And if at any intermediate time in both you make Circles, one with the Moons Semidiameter on its Path; the other with the Suns on any of the 3 Parallels; the Intercepted part will shew the quantity of the Eclipse at that time in event in the future would precipitate the end of the world.[47] Between 1715 and 1717 a series of remarkable celestial phenomena occurred, including, in addition to the eclipse, the appearance of a nova, an unusually cold winter, and a particularly intense aurora, all of which, according to Whiston's coffee-house lectures, "were unequivocal warnings to mankind about the apocalypse and manifested divine discontent with a corrupt and sinful humanity".[48]

Near the end of his life, eclipses came to occupy a special place in Whiston's cosmology, as he felt that they were connected to the fulfilment of biblical prophecies.[49] In contrast to Halley, who at the time cautiously dismissed speculation that the 1715 eclipse had any political meaning, thirty-four years after the event Whiston celebrated the eclipse as signalling the end of the uncomfortable conservatism of the Stuart regime (which had certainly made his own professional and personal life difficult): "This Eclipse of the Sun, tho' I then did not think of it, appears now to have been a Divine Signal for the End of over-bearing Persecution in two of the ten idolatrous and persecuting Kingdoms, which arose in the fifth Century, in the *Roman*

Text of Figure 7, continued]

the Place to which the Parallel you use does belong. And if you carry a Square along the Path, till the Perpendicular side cuts the same Hour and Minute there and in any Parallel, that is the Middle of the y^{e} Eclipse there. Of all which you have examples in the Scheme. Only Note that the Center of the Penumbra at 21′ after 7 and at 3′ after 12, which are the beginning and ending of the General Eclipse, extends beyond the Copper Plate, and is to be supply'd by the Pen at y^{e} intersection of y^{e} proper Lines there to directed.

The Breadth of the intire Penumbra or partial Eclipse upon this Perpendicular Plain, appears by the Construction to be no less than 1965 minutes or Geographical Miles on each side of y^{e} Moons Path, or 3930 Miles in all; w^{ch} correspond to many more on y^{e} Spherical Surface of y^{e} Earth: Nor is it all confin'd, as you may see here, to y^{t} Surface, but reaches off a great way into y^{e} empty Space beyond it, Northward. The Lines which distinguish that breadth on each side into 12 Parts denote so many Digits of y^{e} Sun's Eclipse, (besides $\frac{1}{3}$ for y^{e} Total shade) & y^{t} places both as to Long: and Lat: where y^{e} Sun will at any Time be so much Eclipsed: And indeed I would willingly have procured a general Map here to have shew'd over what Countries and Places the intire Shadow would pass, as Doctor Halley has given us a particular Map of England for the Passage of the Total Shadow over it. But the nature of the Construction does not admit of that Projection: (Such a Thing cannot be truly represented any other way than by the Copernicus; where there is a real Globe of the Earth, capable of a Diurnal motion, during the time of the Eclipse) the impossibility of which in all Perspective Projections of the Sphere renders that design otherwise impracticable: Nor can I determine by this Construction whether the Eclipse will be Total at London or not, because the Circles of the Sun and Moon at the Southern Limit seem here exactly coincident. But if we go by a Construction according to our Calculation ye Digits Eclipsed at London will be hardly more than $11\frac{3}{5}$ and the Shadow will go full 30 Miles more Northward than in D^{r}. Halleys Map.

Engrav'd and Sold by Iohn Senex at y^{e} Globe in Salisbury Court near Fleet Street. And Will: Taylor at y^{e} Ship in Paternoster Row. Where are sold M^{r} Whistons Astronomical Lectures, his Taquet's Euclid, and y^{e} Scheme of y^{e} Solar System. Also y^{e} Newest Globes and Maps.

The Copernicus, or Universal Instrument, being now finish'd, is sold by y^{e} Author M^{r} Whiston, at his House in Cross street Hatton Garden.

Empire, the *Britains* and the *Saxons*."[50]

However, in the two broadsides published in anticipation of the event, Whiston uncharacteristically ignored political or other non-astronomical implications of the eclipse, focusing instead on providing astronomical information and promoting other commercial opportunities presented by the event.[51] The print advertised along with Halley's *Description*, Whiston's *A Calculation of the Great Eclipse of the Sun ... with its Construction for London, Rome, and Stockholme* (Figure 7), sacrificed religio-political prognostication for geometric projection. The top half of the print was dominated by a geometric construction of the path of the Moon above the surface of the Earth as seen from the centre of the Sun, based on data taken from the tables of the Astronomer Royal, John Flamsteed, "as corrected according to S^r^. Isaac Newton's Theory of y^e^ Moon in y^e^ Astronomical Lectures".[52] Armed with a pair of compasses and following the instructions detailed in the text of the print, the careful user could determine from the projection the times and extent of the eclipse as viewed from any parallel in Europe.

Just as Whiston's print emphasized the technical aspects of eclipse prediction to a much greater degree than Halley's, so it also revealed the eclipse as an occasion for collegial competition and commercial opportunities. In his text, Whiston mentioned the competing predictions of the eclipse's parameters offered both by Halley and Flamsteed. Whiston took particular note of Halley's published map and its prediction, noting that his own calculation of the path of the eclipse, accomplished with the aid of his "Copernicus, or Universal Astronomical Instrument", moved the bounds of the path published in Halley's *Description* 30 miles to the north, added eleven minutes to Halley's predictions of the times for the beginning, middle, and end of the eclipse at London, and cautiously predicted that the Moon would only eclipse $11\frac{3}{5}$ digits of the Sun as viewed from London, thereby making it just short of total. Whiston further asserted that his calculation was superior to that of Halley's because it relied on the "Copernicus", a three-dimensional device invented specially to aid in the determination of solar and lunar eclipses, which (Whiston claimed) allowed its user to account for the diurnal motion of the Earth, a variable not incorporated in calculations based exclusively on a projection of the Earth's sphere. At the bottom of this print, Whiston noted that those who wished to reproduce his calculations could purchase a "Copernicus" from him.[53]

From both the informative and the commercial standpoints, it seems likely that this broadside was less successful than Halley's; recall that that the newspaper advertisement quoted above calls the print published in April of 1715 a "new edition" of Halley's print, suggesting that Senex may have published two editions of the map. The apparent commercial success of Halley's broadside testifies to the simplicity of its presentation of the eclipse: using the map of England, a potential observer could locate himself and easily determine whether his location would provide (according to Halley's prediction) a good view of the eclipse, or how far he might have to travel to get one. Thus Halley's print took best advantage of the medium, by providing an attractive illustration that placed the eclipse in a context

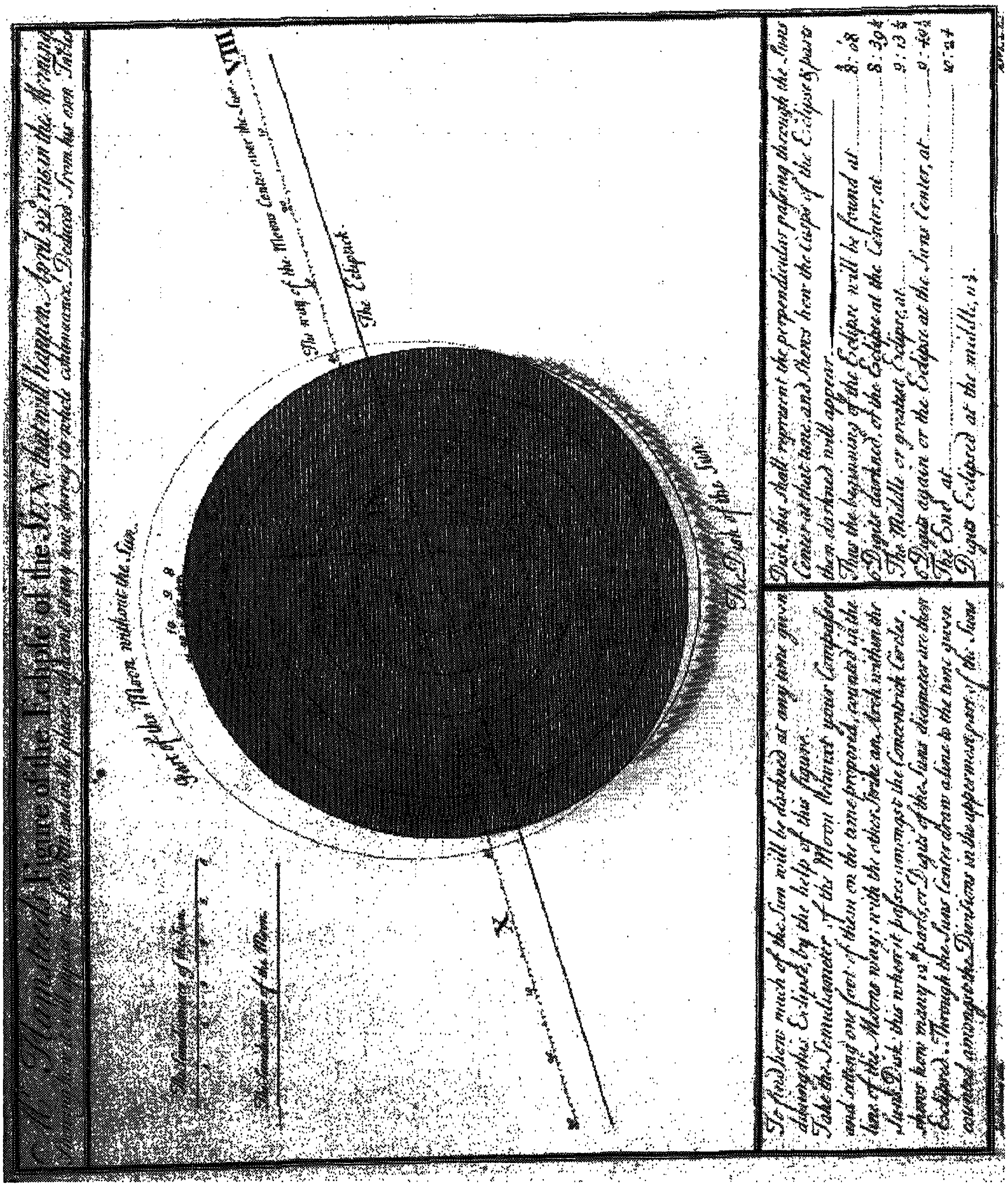

FIG. 8. Flamsteed's *Figure of the Eclipse of the Sun, that will happen April 22^{d} 1715*. Houghton Library, Harvard University. 35 × 40 cm.

everyone could understand and relate to.

In contrast to Halley's straightforward approach, Whiston squandered the potential advantages of the broadside as a medium for astronomical instruction by providing too much technical information (the geometric projection, along with the data on which it was based and an explanation of how it was calculated), and very little information of use to the casual eclipse observer. A brief comparison of Whiston's print with a broadside that took a similar approach to illustrating the eclipse, *M^r. Flamsteed's Figure of the Eclipse of the Sun* (Figure 8), suggests Whiston's mistake; rather than attempting to provide a predictive projection encompassing all of Europe, along with the astronomical data and the calculation from which the projection was derived, this print's data provided just the times and illustrated the eclipse as it would appear "at London and in the places adjacent". [54] In short, by attempting to encompass too much information in his broadside, Whiston produced a product that likely appeared incomprehensible and intimidating to many.

Whiston corrected these flaws in his second effort, the one-shilling *Compleat Account of the great Eclipse of the Sun* (Figure 9), which took better advantage of the possibilities of the medium. Dated by Whiston April 22 1715 (old style), the *Compleat Account* was larger, more expensive, and more comprehensive than either of the prints advertised concurrently in the *London Gazette*. Targeting a broader audience than he had in his previous print, Whiston limited his calculation of the

---

Text of Figure 8]

M^r. Flamsteed's *Figure of the Eclipse of the Sun*, that will happen April 22^d 1715, in the Morning. Shewing how it will appear at London and in the places adjacent, at any time during its whole continuance. Deduced from his own Tables.

To find how much of the Sun will be darkned at any time given during this Eclipse, by the help of this figure.

Take the Semidiameter of the Moon betwixt your Compasses and setting one foot of them on the time proposed, counted in the line of the Moons way; with the other Strike an Arch within the Suns disk: this where it passes amongst the Concentrick Circles, shews how many 12^th parts, or Digits of the Suns diameter are then Eclipsed. Through the Suns Center draw a line to the time given and counted amongst the Divisions in the uppermost part of the Suns Disk; this shall represent the perpendicular passing through the Suns Center at that time, and Shews how the Cusps of the Eclipses & parts then darkned will appear.

Thus the beginning of the Eclipse will be found at	8^h: 08′
6 Digits darkned, or the Eclipse at the Center, at	8: 39½
The Middle or greatest Eclipse, at	9: 13½
6 Digits again or the Eclipse at the Suns Center, at	9: 49½
The End at	10: 24
Digits Eclipsed at the middle, 11¾	

Jos. Crosthwait delin.
M. V.^dr Gucht Scul.

eclipse, and the data used to accomplish it, to a section at the bottom of the print amounting to less than a quarter of its total area. Instead of highlighting the technical aspects of the eclipse, Whiston used most of the space of the *Compleat Account* to offer useful information to the novice observer. For example, in a section of the print titled "Directions for the easie Observation of the Eclipse", Whiston cautioned his readers not to look at the eclipse directly, either with the naked eye or an unshaded telescope. As alternatives to these unsafe practices, Whiston listed four possible means of effectively observing the Sun during the eclipse: by looking at the Sun through either a pin-hole aperture (not a method recommended today) or a smoked glass, or by projecting the Sun's image using either a pin-hole camera or (preferably) a telescope, the last method producing results "sufficiently exact for the purposes of even the Astronomers themselves". [55]

To assist would-be observers in preparing for the eclipse, Whiston also included directions for finding the true meridian, and a celestial map (presumably for the latitude of London) of those sections of the ecliptic and lunar orbit in which the Sun and Moon were to be located around the time of the eclipse. With the proper observational set-up, observers could determine several characteristics of the eclipse: the local times of its beginning and ending, the duration of total darkness (to the nearest second), and the change in Sun's colour and intensity. Whiston also noted that eclipse offered an opportunity to observe, among other astronomical phenomena, "the Sun's Milky Way" (the solar corona), and the planets Jupiter, Venus, and Mercury — the latter "so very rarely seen, that excepting such an unusual opportunity as this is, few here have any occasion of seeing him in their whole Lives". He expressed his hope that careful observation during the eclipse might enable observers to determine whether or not the Moon had an atmosphere, and, quite possibly, lead to the discovery of a new comet or planet very near to the Sun. In conclusion, Whiston requested that "the Curious" send the results of their observations to him, as he intended "to Publish another such a Print with an Account of the Eclipse it self as it shall really Appear, together with its Circumstances, and the Natural consequences from those Observations, for the intire satisfaction of the Inquisitive".[56]

To facilitate the observation and recording of the kind of data that would make up such a publication, it appears that Whiston contributed one more item to the collection of ephemera marking this eclipse, *The Method of the Observations to be made at the Solar Eclipse, April 22d, 1715*. Sold for 2 pence, this unsigned sheet included four parallel columns, two listing the times predicted for the course of the eclipse and the phenomena that were likely to be visible, and two providing space for the observer to note his or her own time measurements and observations. Whiston's involvement in its publication is suggested by the initial instruction, "Set each *Copernicus* to the time; and keep it right all along the Eclipse", and by the predicted times for the beginning, middle, and end of the eclipse, which correspond to those published by Whiston in his *Complete Account*. Like the latter broadside, *The Method of the Observations* also indicated that the observer should be able to view various astronomical phenomena such as the "Sun's Milky Way", as

TABLE 2. Broadside predictions of the 1715 solar eclipse, for observations from London.

	Halley[1]	Whiston I[2]	Whiston II[3]	Flamsteed[4]	Actual[5]
Begin	8:07	8:18	8:07:30	8:08	8:06
Middle	9:13	9:24	9:14	9:13:30	9:09
End	10:24	10:35	10:24:30	10:24	10:20

1. From Halley, *A Description of the Passage of the Shadow of the Moon over England* (ref. 20).
2. From Whiston, *A Calculation of the Great Eclipse of the Sun* (ref. 51).
3. From Whiston, *A Compleat Account of the great Eclipse of the Sun* (ref. 51).
4. From *Mr. Flamsteed's Figure of the Eclipse of the Sun* (ref. 54).
5. From Halley, "Observations of the late Total Eclipse of the Sun..." (ref. 14).

well as Jupiter, Venus, and Mercury.[57]

Whiston's *Compleat Account* offered a more comprehensive — and comprehensible — interpretation of the eclipse than any other broadside published in 1715. But, it also likely saved Whiston from some embarrassment. In both of his prints, Whiston had pointedly compared his predictions to those of Edmond Halley (as published in his *Description*) and the Astronomer Royal, John Flamsteed. However, though Whiston declared in his *Compleat Account* that his "former Scheme or Construction ... agrees with the present Calculation", the predicted times given for the eclipse in his *Compleat Account* differed significantly from those his *Calculation*, while they came to within one minute of the figures predicted by Halley and Flamsteed (Table 2). Ultimately, Whiston's correction proved fortunate; Halley's observations and timing of the eclipse put it to within five minutes of the final predictions offered by the three astronomers.[58]

The revised predictions offered by Whiston in the *Compleat Account* raise questions as to the fate of Whiston's "Copernicus"; though it featured prominently in the *Calculation*, no mention was made of it in the later broadside. Perhaps it was felt that the inaccuracies of the *Calculation* tainted the reputation of the device featured so prominently in the broadside; or perhaps the "Copernicus" did not sell well, and so Senex was unwilling to devote more advertising space to it.

While Whiston's efforts to publicize his predictions for the eclipse of 1715 offer insight into pedagogical strategies for the popularization of astronomy in the early eighteenth century, the account of those efforts that he recorded in his *Memoirs* suggests the tangible benefits that flowed from the production of such media. Writing of his activities around the eclipse of 1715, Whiston noted

> I myself by my lectures before, by the sale of my schemes before and after; by the generous presents of my numerous and noble Audience; who at the Recommendation of my great Friend the Lord *Stanhope*, then Secretary of State, gave me a guinea apiece ... [I] gained in all £120 by it. Which in the circumstances I then was, and have since been, destitute of all preferment, was a very seasonable and plentiful supply: and as I reckoned, maintained me and my family for a whole year together.[59]

Gifts from patrons constituted at least £25 of the £120 Whiston earned on the eclipse in 1715; profits from lecturing and the eclipse prints he produced thus summed to

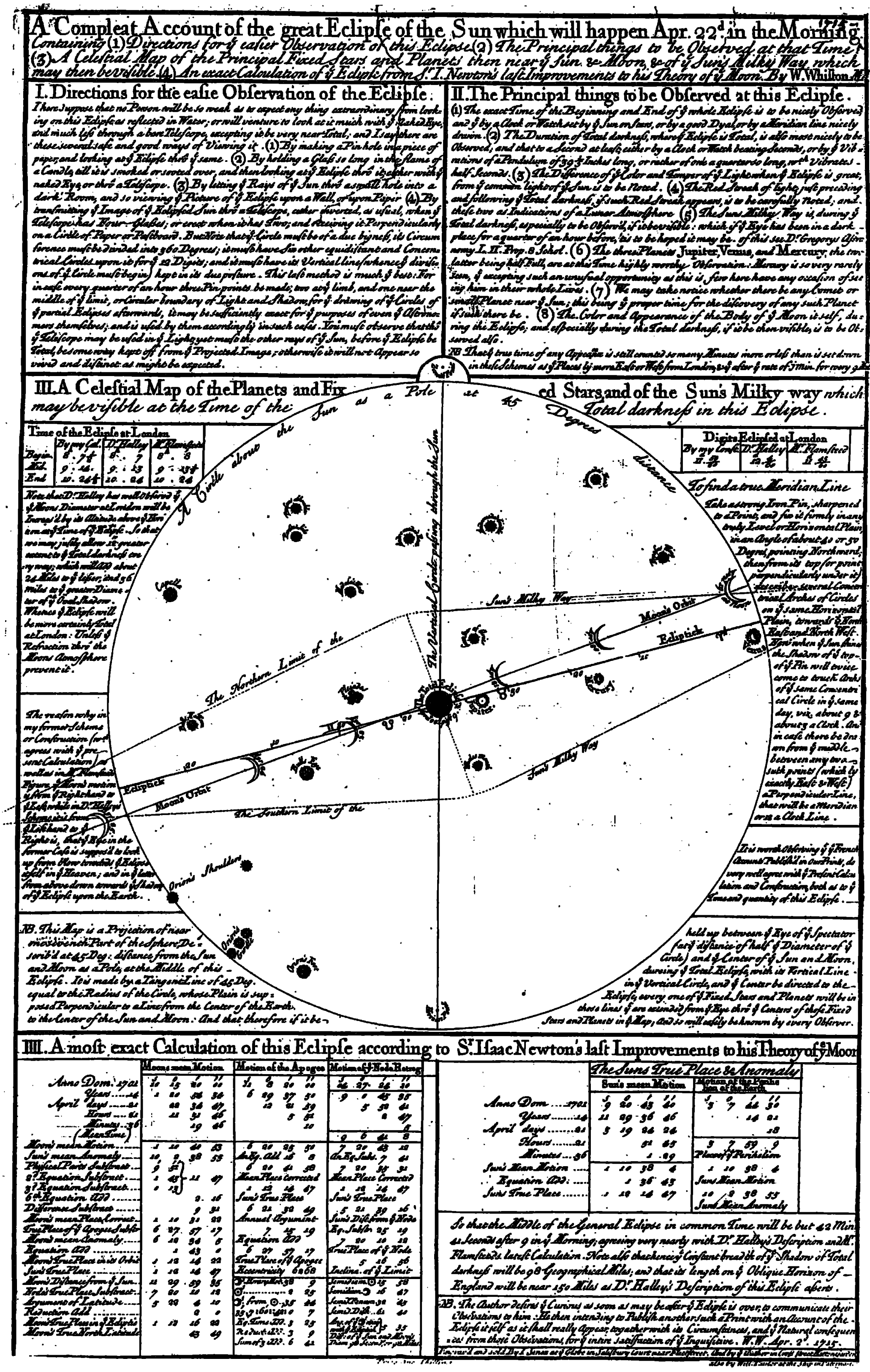

FIG. 9. Whiston's *A Compleat Account of the great Eclipse of the Sun* (1715). Science Museum Library, London. 42 × 27 cm.

Text of Figure 9]

A Compleat Account of the great Eclipse of the Sun which will happen Apr. 22d in the Morning. Containing (1) Directions for y^{e} easier Observation of this Eclipse. (2) The Principal things to be Observed at that Time. (3) A Celestial Map of the Principal Fixed Stars and Planets then near y^{e} Sun & Moon, & of y^{e} Sun's Milky Way which may then be visible. (4) An exact Calculation of y^{e} Eclipse from S^{r}. I. Newton's last Improvements to his Theory of y^{e} Moon. By *W. Whiston* MA

I. Directions for the easie Observation of the Eclipse.
I here suppose that no Person will be so weak as to expect any thing extraordinary from looking on this Eclipse reflected in Water; or will venture to look at it much with y^{e} Naked Eye; and much less through a bare Telescope, excepting it be very near Total; and I say there are these several safe and good ways of Viewing it. (1) By making a Pin hole in a piece of paper, and looking at y^{e} Eclipse thrô y^{e} same. (2) By holding a Glass so long in the flame of a Candle, till it is smoked or sooted over, and then looking at y^{e} Eclipse thrô it, either with y^{e} naked Eye, or thrô a Telescope. (3) By letting y^{e} Rays of y^{e} Sun thrô a small hole into a dark Room, and so viewing y^{e} Picture of y^{e} Eclipse upon a Wall, or upon Paper (4) By transmitting y^{e} Image of y^{e} Eclipsed Sun thrô a Telescope, either inverted, as usual, when y^{e} Telescope has Four Glasses; or erect when it has Two; and receiving it Perpendicularly on a Circle of Paper or Pastboard. But Note that y^{e} Circle must be of a due bigness, its Circumference must be divided into 360 Degrees; it must have Six other equidistant and Concentrical Circles upon it for y^{e} 12 Digits; and it must have its Vertical line (whence y^{e} divisions of y^{e} Circle must begin) kept in its due posture. This last method is much y^{e} best: For in case every quarter of an hour three Pin points be made; two at y^{e} limb, and one near the middle of y^{e} limit, or Circular boundary of Light and Shadow, for ye drawing of y^{e} Circles of y^{e} partial Eclipses afterwards, it may be sufficiently exact for y^{e} purposes of even y^{e} Astronomers themselves; and is used by them accordingly in such cases. You must observe that thô y^{e} Telescope may be used in y^{e} Light, yet must the other rays of y^{e} Sun, before y^{e} Eclipse be Total, be some way kept off from y^{e} Projected Image; otherwise it will not Appear so vivid and distinct as might be expected.

II. The Principal things to be Observed at this Eclipse.
(1) The exact Time of the Beginning and End of y^{e} whole Eclipse is to be nicely Observed, and y^{t} by a Clock or watch set by y^{e} Sun or Stars, or by a good Dyal, or by a Meridian line nicely drawn. (2) The Duration of Total darkness, where y^{e} Eclipse is Total, is also most nicely to be Observed; and that to a Second at least; either by a Clock or Watch beating Seconds, or by y^{e} Vibrations of a Pendulum of 39$\frac{1}{5}$ Inches long, or rather of one a quarter so long, w^{ch} Vibrates half Seconds. (3) The Difference of y^{e} Color and Temper of y^{e} Light when y^{e} Eclipse is great from y^{e} common light of y^{e} Sun is to be Noted. (4) The Red Streak of light, just preceding and following y^{e} Total darkness, if such Red Streak appears, is to be carefully Noted; and these two as Indications of a Lunar Atmosphere (5) The Suns Milky Way is, during y^{e} Total darkness, especially to be Observ'd, if it be visible: which if y^{e} Eye has been in a dark place for a quarter of an hour before, 'tis to be hoped it may be. of this see D^{r}. Gregorys Astronomy L. II. Prop. 8 Schol. (6) The three Planets *Jupiter*, *Venus*, and *Mercury*, the two latter being half Full, are at this Time highly worthy Observation: Mercury is so very rarely seen, y^{t} excepting such an unusual opportunity as this is few here have any occasion of seeing him in their whole Lives. (7) We may take notice whether there be any Comet or small Planet near y^{e} Sun; this being y^{e} proper time for the discovery of any such Planet if such there be. (8) The Color and Appearance of the Body of y^{e} Moon itself, during the Eclipse; and especially during the Total darkness, if it be then visible, is to be Observed also.

NB That y^{e} true time of any Appearance is still counted so many Minutes more or less than is set down in these Schemes as y^{e} Places ly more East or West from London, & y^{t} after y^{e} rate of j Min. for every 9 Miles.

III. A celestial Map of the Planets and Fixed Stars of the Sun's Milky way which may be visible at the Time of the Total darkness in this Eclipse.

Time of the Eclipse at London

	By my Cal.	D^{r}. Halley	M^{r}. Flamsteed
Begin.	8^h $7\frac{1}{2}'$	8^h $7'$	8^h $8'$
Mid.	9^h $14'$	9^h $13'$	9^h $13\frac{1}{2}'$
End	10^h $24\frac{1}{2}'$	10^h $24'$	10^h $24'$

Text of Figure 9, continued]

Digits Eclipsed at London

By my Const.	D^r. Halley	M^r. Flamsteed
11^d. 59/60	12^d. 4/60	11d. 45/60

Note that D^r. Halley has well Observd yt y^e Moons Diameter at London will be Increas'd by its Altitude above y^e Horizon at y^e Time of y^e Eclipse. So that we may justly allow 12″ greater extent to y^e Total darkness every way; which will Add about 24 Miles to y^e lesser, and 36 Miles to y^e greater Diameter of y^e Oval Shadow. Whence y^e Eclipse will be more certainly Total at London: Unless y^e Refraction thro the Moon's Atmosphere prevent it.

To find a true Meridian Line
Take a strong Iron Pin, sharpened to a Point, and fix it firmly in any truly Level or Horizontal Plain, in an Angle of about 40 or 50 Degres, pointing Northward; then from its top (or point perpendicularly under it) describe several Concentrical Arches of Circles on y^e same Horizontal Plain, towards y^e North East and North West. Now when y^e Sun shines the Shadow of y^e top of y^e Pin will twice come to touch Archs of y^e same Concentrical Circle in y^e same day, viz. about 9 & about 3 a Clock. And in case there be drawn from y^e middle between any two such points (which ly exactly East & West) a Perpendicular Line, that will be a Meridian or 12 a Clock Line.

The reason why in my former Scheme or Construction (w^{ch} agrees with y^e present Calculation) as well as in Mr. Flamsteeds Figure y^e Moon's motion is from y^e Right hand to y^e Left, while in Dr. Halley's Scheme it is from y^e Left hand to y^e Right is, that y^e eye in the former Case is suppos'd to look up from below towards y^e Eclipse itself in y^e Heaven; and in y^e latter from above down towards y^e Shadow of y^e Eclipse upon the Earth.

It is worth Observing yt y^e French Accounts Publish'd in our Prints, do very well agree with y^e Present Calculation and Construction, both as to y^e Time and quantity of this Eclipse.

NB. This Map is a Projection of near one seventh Part of the Sphere, Describ'd at 45 Deg: distance from the Sun and Moon as a Pole, at the Middle of this Eclipse. It is made by a Tangent Line of 45 Deg. equal to the Radius of the circle, whose Plain is supposed Perpendicular to a Line from the Center of the Earth to the Center of the Sun and Moon: And that therefore if it be held up between y^e Eye of y^e Spectator (at y^e distance of half y^e Diameter of y^e Circle) and y^e Center of y^e Sun and Moon dureing y^e Total Eclipse, with its Vertical Line in y^e Vertical Circle, and y^e Center be directed to the Eclipse, every one of y^e Fixed Stars and Planets will be in those lines y^t are extended from y^e Eye thrô y^e Centers of those Fixed Stars and Planets in y^e Map; And so will easily be known by every Observer.

IIII. A most exact Calculation of this Eclipse according to S^r. Isaac Newton's last Improvements to his Theory of y^e Moon

[Table: "Moon's mean Motion", "Motion of the Apogee", "Motion of y^e Node Retr.", and Whiston's calculation of the Eclipse]

[Table: "The Sun's True Place and Anomaly" for April 22 1715]

So that the Middle of the general Eclipse in common Time will be but 42 Min 41 Seconds after 9 in y^e Morning; agreeing very nearly with D^r. Halley's Description and M^r. Flamsteeds latest Calculation. Note also that hence y^e Constant breadth of y^e Shadow of Total darkness will be 98 Geographical Miles; and that its length on y^e Oblique Horizon of England will be near 150 Miles as D^r. Halley's Description of this Eclipse asserts.

NB. The Author desires y^e Curious as soon as may be after y^e Eclipse is over, to communicate their Observations to him: He then intending to Publish another such a Print with an Account of the Eclipse it self as it shall really Appear, togather with its Circumstances, and y^e Natural consequences from those Observations, for y^e intire satisfaction of y^e Inquisitive. W.W. Apr. 2^d. 1715.

Engraved and sold By I. Senex at y^e Globe in Salisbury Court near Fleetstreet. And by y^e Author in Cross Street Hatton Garden. also by Will. Taylor at the Ship in Paternoster.

perhaps £95 — an amount just less than the £100 stipend attached to the Lucasian chair.[60] Most of that sum was probably earned through lecturing — a single night's lecture on a specific scientific topic probably cost around five shillings.[61] But, Whiston's mention of his two prints suggests that the sale of these, along with whatever he earned through the sale of its copyright to Senex, contributed a significant sum to this year's income.[62] In short, Whiston's comments make clear that the production and sale of broadsides such as those described here provided an important means of generating income for their producers, both as commodities in and of themselves, and from money made by other businesses and astronomical products advertised by them.

Like Halley, Whiston reawakened his business interest in eclipses in anticipation of the eclipse of 1724, publishing *The Transit of the Total Shadow of the Moon over Europe* (Figure 10). Perhaps the most striking aspect of this broadside is its similarity to Halley's *Description of the Passage of the Shadow of the Moon over Europe* (Figure 5); both depicted the course of the shadow of the eclipse superimposed over a map of Europe, and, not only were the prints the same size, but their maps of Europe were drawn to nearly the same scale. Both also mentioned the utility of eclipses for determining the longitude of those places where the eclipse was observed; and both solicited observations from (in Whiston's words) "inquisitive Observers". Whiston's provides more information about the eclipse than Halley's, including the times of the eclipse for locations from Galway to Milan, as well as a prediction of those areas that would be covered by the shadow of totality. And, as noted above, Whiston's predictions for the path of the eclipse and its times also vary from those of Halley.

Whatever their similarities and differences, Halley's broadside enjoyed two big advantages in the broadside market: the name of its author, who, as Astronomer Royal, had reached the top of his profession, and the marketing and distribution network to which Senex, as a bookseller, had access. In contrast, although Whiston's broadside advertised those of his works published by Senex, it was almost certainly not published by Senex, but by Whiston himself (who, as publisher, may have paid Senex or one of his workmen to engrave it). The reason for Senex's failure to publish Whiston's 1724 print is simple. In 1715, Whiston had produced broadsides that complemented and extended the illustration of the eclipse offered in Halley's *Description of the Passage of the Shadow of the Moon*; Senex could therefore reasonably expect that anybody who purchased one might purchase another. In 1724, Whiston's decision to produce an eclipse map virtually guaranteed that Senex would not publish it; indeed, publishing Whiston's broadside would have represented a very poor business decision on the part of Senex, since its resemblance to Halley's broadside would likely have undercut sales of the latter.

Though Whiston's adoption of the map format for his 1724 eclipse print likely meant that he had to sacrifice his access to Senex's book-trade distribution network, it made some commercial sense from Whiston's point of view, since he still had copies of his 1715 broadsides for sale; taken together, the three broadsides he

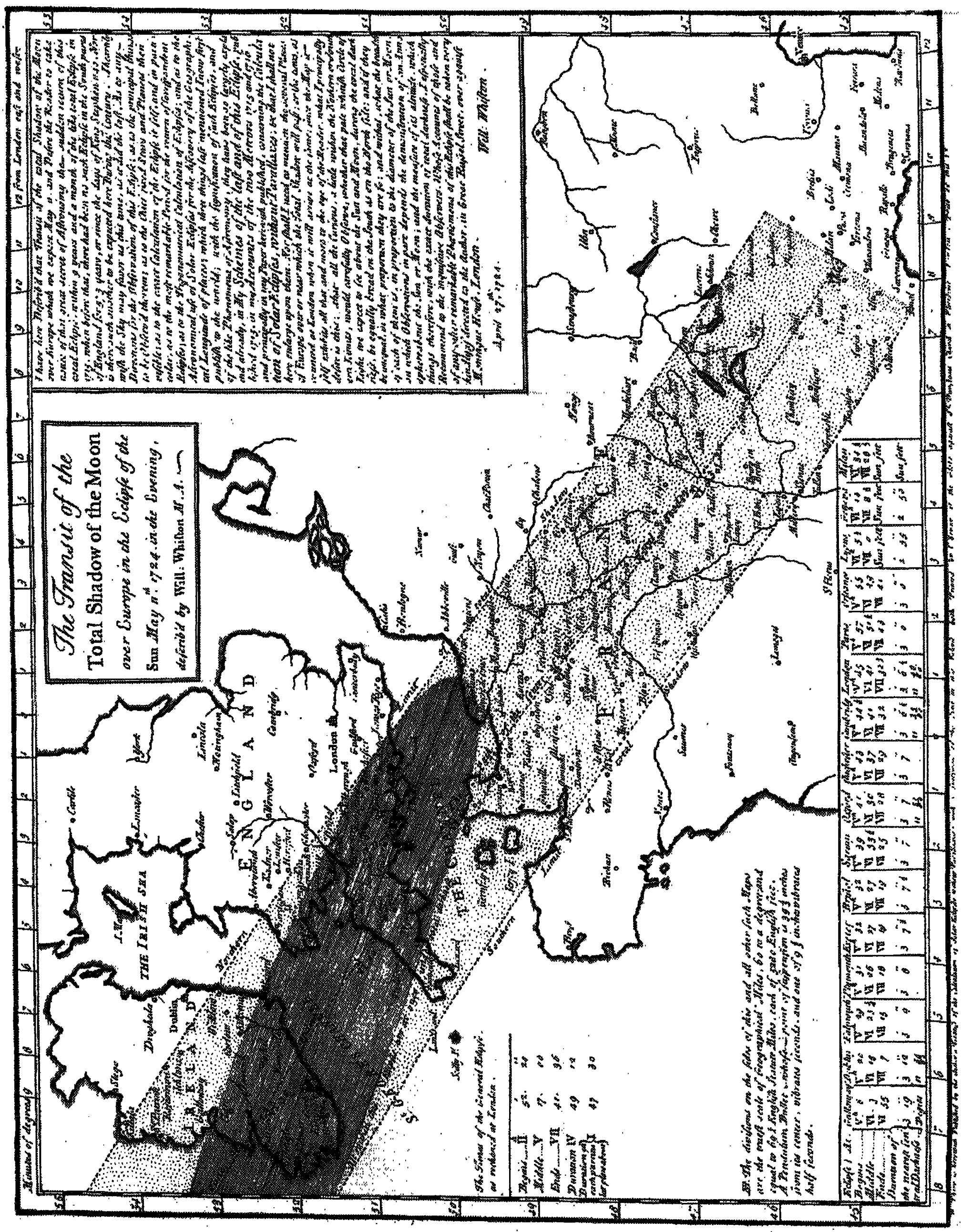

FIG. 10. Whiston's prediction of the 1724 eclipse of the Sun. Houghton Library, Harvard University. 37 × 47 cm.

Text of Figure 10]

The Transit of the *Total Shadow of the Moon* over Europe in the Eclipse of the *Sun* May 11th 1724 in the Evening, describ'd by Will: Whiston *M.A.*

I have here Describ'd that Transit of the total Shadow of the Moon over Europe which we expect May 11 and Desire the Reader to take notice of that great secret of Astronomy the sudden return of this total Eclipse, within 9 years and a month of the like total Eclipse in 1715, when before that, there had been no such Eclipse in the South parts of England for 575 years, or since the days of King Stephen 1140. Nor is there such another to be expected here During this Century. I heartily wish the Sky may favor us this time, as it did the last. As to any Directions for the Observation of this eclipse; as to the principal things to be Observ'd therein; as to the Chief fixed Stars and Planets then visible; as to the exact Calculation of the Eclipse it self, and in particular, as to the most remarkable Period for the return of Corespondent Eclipses; as to the Trigonometrical Calculation of Eclipses; and as to the Astronomical use of Solar Eclipses for the discovery of the Geographical Longitude of places; which three things last mentioned I now first publish to the world; with the signification of such Eclipses, and of the like Phaenomena of Astronomy, they have been so largely explaind already, in My Schemes of the last and of this Eclipse, published 1715. in my Accounts of the two Meteors 1715 and 1716. and principally in my Paper herewith published, concerning the Calculation of Solar Eclipses, without Parallaxes; &c that I shall not here enlarge upon them. Nor shall I need to mention the several Places of Europe over or near which the Total Shadow will pass; or the times, as counted at London when it will arrive at the same; since the Map itself exhibits all that and more to the eye of the Reader. what I principally desire is this; that all the Curious, a little within the Northern or Southern Limits, would carefully Observe, whether that pale whitish Circle of Light we expect to see about the Sun and Moon, during the total darkness, be equally broad on the South as on the North side; and if they be unequal, in what proportion they are so: and withal, what the breadth of each of them is, in proportion to the diameter of the Sun or Moon. on which Observations in part depends the demonstration of an Atmosphere about the Sun or Moon; and the measure of its altitude. which things therefore, with the exact duration of total darkness, I especially Recommend to the inquisitive Observers. Whose Accounts of those and of any other remarkable Phaenomena of this Eclipse shall be taken very kindly if directed to the Author, in Great Russel Street, over against Montague House, London.

Will: Whiston
April 27th, 1724

The Times of the General Eclipse as reckoned at London

	h	′	″
Begins	II	52	24
Middle	V	17	00
Ends	VII	41	36
Duration	IV	49	12
Duration in each particular place about	I	47	30

NB. The divisions on the sides of this and all other such Maps are the truest scale of Geographical Miles, 60 to a degree; and equal to 69½ English Statute Miles, each of 5280 English feet. A Pendulum Bullet whose point of suspension is 39⅕ inches from its center, vibrates seconds: and one of 9_ inches vibrates half seconds.

Table along bottom:
[Beginning, Middle, End, Duration, and Digits eclipsed for the following locations:
Galloway, Dublin, Falmouth, Plymouth, Exeter, Bristol, Sarum, Oxford, Chichester, Cambridge, London, Paris, Orleans, Lyons, Geneva, and Milan]

Data for London (from table)

Begin	V^h	45′
Middle	VI^h	41′

1999HisSc..37....1W

produced for the 1715 and 1724 events provided a quite comprehensive overview of the astronomy of eclipses. Purchasers who wanted even more information about eclipses could turn to another of Whiston's works, a short text published that year by Senex and Taylor, *The calculations of solar eclipses without parallaxes*, which, as the subtitle noted, used the 1724 eclipse to illustrate the general theory outlined in the work:

> As to any Directions for the Observation of this eclipse; as to the principal things to be Observ'd therein; as to the Chief fixed Stars and Planets then visible; as to the exact Calculation of the Eclipse it self, and in particular, as to the Trigonometrical Calculation of Eclipses; and as to the Astronomical use of Solar Eclipses for the discovery of the Geographical Longitude of places; which three things last mentioned I now first publish to the world; with the signification of such Eclipses, and of the like Phaenomena of Astronomy, they have been so largely explaind already, in My Schemes of the last and of this Eclipse, published 1715 in my Accounts of the two Meteors 1715 and 1716 and principally in my Paper herewith published, concerning the Calculation of Solar Eclipses, without Parallaxes; &c that I shall not here enlarge upon them.[63]

Whiston's *Transit* demonstrates that he had learned an important lesson about presenting astronomical events to the public from the 1715 eclipse: the simpler, the better. His use of a map to depict his prediction of the 1724 event established what was virtually a standard format for the illustration of solar eclipses to the English public. In 1737, 1748, and 1764, astronomers and entrepreneurs produced various maps depicting the progress of the Moon's shadow over the globe, sometimes in broadside form, and sometimes supplemented by other information thought to be of use to the public. Indeed, in 1764, so many eclipse maps were on the market — each with a different prediction — that one commentator likened the competition between them and their producers to an event quite familiar to the English public: a horse race.[64]

The astronomical broadsides produced by Whiston, Halley, their contemporaries and their successors, constituted an important medium for the consumption of sanctioned scientific knowledge. Comparatively inexpensive, easily transportable, and well-illustrated, these prints could enlighten audiences displaced by income,

---

Text of Figure 10, continued]

End	VII^h	$32\frac{1}{2}'$
Duration of the nearest central darkness	$3'$	$6\frac{1}{2}''$
Digits	11 48/60	

NB There is herewith Published by the Author a Treatise of the Calculation of Solar Eclipses without Parallaxes: with a Specimen of the same in this Eclipse both Printed for I. Senex at the Globe against St. Dunstans Church in Fleetstreet London. Price of this 1s.

distance, or level of literacy from those who gained their astronomical knowledge from lectures or books.[65] By making eclipses commercially and intellectually accessible, they also helped to establish the cultural legitimacy of the new science among its ever-expanding public. As they mobilized public participation in the observation of an event like an eclipse, and even declared such participation of importance in refining eclipse theory, these prints emphasized the public, open character of the new science, increasing popular awareness of, and interest in, astronomy and the astronomical community.

ACKNOWLEDGEMENTS

It is a pleasure, as always, to thank John Heilbron for his advice and insight. Conversations with Frances Willmoth, Bill Burns, Tim Alborn, Jim Evans, and Liba Taub helped to clarify various points in this work, for which I am most grateful. Thanks are also due to Owen Gingerich, for drawing my attention to the Luttrell broadsides at the Houghton. A version of this paper was given at the 1997 History of Science Society meeting in San Diego, where the comments and criticisms of fellow panellists and members of the audience proved very helpful. Finally, I wish to thank the Adler Planetarium for providing the funds that enabled me to travel to Chicago to examine and make use of their history of astronomy collection, which includes many of the broadsides discussed here.

REFERENCES

1. On public science in eighteenth-century England, see Larry Stewart, *The rise of public science: Rhetoric, technology, and natural philosophy in Newtonian Britain, 1660–1750* (Cambridge, 1992), and Jan Golinski, *Science as public culture: Chemistry and enlightenment in Britain, 1760–1820* (Cambridge, 1992).
2. On public lectures, private consumption, and science in eighteenth-century England, see (among other works) Stewart, *op. cit.* (ref 1), esp. Part II; Golinski, *op. cit.* (ref. 1), esp. chap. 2; Alan Q. Morton and Jane A. Wess, *Public & private science: The King George III Collection* (Oxford, 1993); *The British journal for the history of science*, xxviii/1 (1995), which is devoted to scientific lecturing; Simon Schaffer, "The consuming flame: Electrical showmen and Tory mystics in the world of goods", in John Brewer and Roy Porter (eds), *Consumption and the world of goods* (London, 1993), 489–526; A. Q. Morton, "Lectures on natural philosophy in London: 1750–1765: S. C. T. Demainbray (1710–1782) and the 'Inattention' of his countrymen", *The British journal for the history of science*, xxiii (1990), 411–34; Simon Schaffer, "Natural philosophy and public spectacle in the eighteenth century", *History of science*, xxi (1983), 1–43; Roy Porter, "Science, provincial culture, and public opinion in Enlightenment England", *British journal for eighteenth-century studies*, iii (1980), 20–46; J. L. Heilbron, *Electricity in the 17th & 18th centuries* (Berkeley, 1979); Patricia Fara, *Sympathetic attractions: Magnetic practices, beliefs, and symbolism in eighteenth-century England* (Princeton, 1996); Alice N. Walters, "Conversation pieces: Science and politeness in eighteenth-century England", *History of science*, xxxv (1997), 121–54; James A. Secord, "Newton in the nursery: Tom Telescope and the philosophy of tops and balls, 1761–1838", *History of science*, xxiii (1985), 127–51; Roy Porter, Simon Schaffer, Jim Bennett, and Olivia Brown, *Science and profit in eighteenth-*

century London (Cambridge, 1985); John R. Millburn, *Benjamin Martin: Author, instrument maker, and 'country showman'* (Leyden, 1976); and *idem*, *Wheelwright of the heavens: The life and work of James Ferguson, FRS* (London, 1988). The cultural context within which science was commercialized is illuminated in John Brewer, *The pleasures of the imagination: English culture in the eighteenth century* (New York, 1997).

3. On the special place occupied by astronomy among the sciences consumed by the public, see Walters, *op. cit.* (ref. 2), 125–6.
4. On astrology in late seventeenth- and early eighteenth-century England, see Patrick Curry, *Prophecy and power* (Princeton, 1989); Bernard Capp, *English almanacs, 1500–1800: Astrology and the popular press* (Ithaca, 1979); Keith Thomas, *Religion and the decline of magic* (New York, 1971); and the essays in Patrick Curry (ed.), *Astrology, science, and society: Historical essays* (Woodbridge, Suffolk, 1987). On the astronomy of comets, and their interpretation, see Sara Schechner Genuth, *Comets, popular culture, and the birth of modern cosmology* (Princeton, 1997). On prodigies and their interpretation in the early eighteenth century, see William E. Burns, "An age of wonders: Prodigies in Restoration culture", unpublished typescript, esp. chap. 5. The challenges presented to natural philosophers by a similarly unusual event — the aurora — are detailed in Patricia Fara, "Lord Derwentwater's Lights: Prediction and the aurora polaris", *Journal for the history of astronomy*, xxvii (1996), 239–58.
5. *The True Figure of that Great Eclipse of the Sun ... September 13, 1699.* Houghton Library, Harvard University.
6. The history of astrological and astronomical broadsides from the fifteenth to the nineteenth century is addressed by P. Véron and G. A. Tammann, "Astronomical broadsheets and their scientific significance", *Endeavour*, n.s., iii (1979), 163–70; and Owen Gingerich, "Eighteenth-century eclipse paths", *Sky and telescope*, lxii (1981), 324–7, reprinted in his *The great Copernicus chase and other adventures in astronomical history* (Cambridge, 1992), 153–6. A recent book surveys the development of eclipse maps in eighteenth-century England, including several of the prints discussed here: Geoff Armitage, *The shadow of the Moon: British solar eclipse mapping in the eighteenth century* (Tring, 1997). On English astrological ephemera, see Thomas, *op. cit.* (ref. 4), 298–300.
7. Examples of eighteenth-century astronomical broadsides, including those illustrated here, may be found in the following collections: The Oxford Museum of the History of Science (OMHS); the Whipple Museum of the History of Science, Cambridge (WMHS); the Prints Collection of the Science Museum Library, London (SML); the Map Collection of the British Library; the archives of the Royal Astronomical Society, London (RAS); the History of Astronomy Collection of The Adler Planetarium, Chicago; and the Houghton Library at Harvard University (Harvard). The latter collection is dominated by broadsides acquired by Narcissus Luttrell (1657–1732), a collector of ephemera, who conveniently noted on his broadsides both the date he purchased an item and its price.
8. On the value of curiosity and curiosities in the eighteenth century, see Barbara M. Benedict, "The 'curious attitude' in eighteenth-century Britain: Observing and owning", *Eighteenth-century life*, xiv (1990), 59–98. Benedict particularly notes that "curiosity" signified, among other things, scientific learning and scientific collecting: see esp. pp. 59–60, 78–82.
9. In 1680, the Royal Society entertained a proposal to publish "philosophical gazettes", costing no more than 2d, that would have "contrasted with the rather bulkier and more expensive format of the *Philosophical transactions*". However, the idea was abandoned. See Michael Hunter and Paul B. Wood, "Towards Solomon's House: Rival strategies for reforming the early Royal Society", *History of science*, xxiv (1986), 49–108, esp. p. 59 (quote).
10. On Senex, see E. G. R. Taylor, *Mathematical practitioners of Hanoverian England, 1714–1840*

(Cambridge, 1966), 143; Sarah Tyacke, *London map-sellers, 1660–1720* (Tring, Hertfordshire, 1978), 142; and R. V. Wallis and P. J. Wallis, *Biobibliography of British mathematicians, Part II* (Newcastle upon Tyne, 1986), 21. Senex's role as a scientific entrepreneur is illuminated in Stewart, *op. cit.* (ref. 1), esp. pp. 95, 147, 173, 187, 190. The scientific and popular role of one of Senex's prints — William Whiston's *Transits of Venus and Mercury over the Sun* (1723) — is discussed in Harry Woolf, *The transits of Venus* (Princeton, 1959), 28–29.

11. The standard work on Martin is Millburn, *Martin* (ref. 2), which together with two subsequent works by Millburn, *Benjamin Martin: Supplement* (London, 1986) and *Retailer of the sciences: Benjamin Martin's scientific instrument catalogues, 1756–1782* (London, 1986), provides a detailed portrait of this important figure in the dissemination and commercialization of science in eighteenth-century Britain.
12. This survey is based on a list of maps and prints included in Millburn, *Martin* (ref. 2), 208. Millburn lists nine prints, of which all but one, *A map of 20 miles round London*, are certainly astronomical. I have examined copies of six of these prints.
13. Aside from the lists of the prints published by Senex and Martin cited above, no comprehensive catalogue of eighteenth-century astronomical broadsides has been published. Since they present particular difficulties for the bibliographer, they are often hard to find; see, for example, the comments of Marjorie Hope Nicolson and G. S. Rousseau concerning their attempt to trace William Whiston's *Scheme of the solar system* in *"This long disease my life": Alexander Pope and the sciences* (Princeton, 1968), 147–8. More recently, the difficulties of locating often uncatalogued prints have been made evident by the Wallis's very useful *Biobibliography of British mathematics* (ref. 10), which includes those of Leadbetter (p. 85), Smith (p. 224), Witchell (p. 269), and Betts (p. 304), and some of Martin's (pp. 212–16), but which has missed several prints, often only initialled or anonymous. For insight into the challenges of locating and cataloguing such material, see R. C. Alston, "The eighteenth-century non-book: Observations on printed ephemera", in Giles Barber and Bernhard Fabian (eds), *Buch und Buchhandel in Europa im achtzehnten Jahrhundert* (Hamburg, 1981), 343–60.
14. Edmond Halley, "Observations of the late Total Eclipse of the Sun on the 22d of April last past...", *Philosophical transactions*, xxix (1714–16), 245–62, p. 261.
15. These placements for the paths of totality are based on Benjamin Martin's map, *The passage of the dark shadow of the Moon over England & other parts of Europe in the five great solar eclipses of the century* (OMHS). Almost certainly this is the map cited in Millburn, *Martin* (ref. 2), 208, as *An accurate map of 460 miles round London*, which was advertised in 1758.
16. On Harris's *Astronomical dialogues*, see Walters, *op. cit.* (ref. 2), 133.
17. On Moore's work, see Frances Willmoth, *Sir Jonas Moore: Practical mathematics and Restoration science* (Woodbridge, Suffolk, 1993), 195–207.
18. The first advertisement appeared in the *London Gazette* on 8–12 March; both advertisements are quoted in Tyacke, *op. cit.* (ref. 10), 103.
19. William Whiston, *Astronomical lectures, read in the publick schools at Cambridge* (London, 1715). Maureen Farrell, *William Whiston* (New York, 1981), 191–8, outlines the contents of the work, which was based on lectures originally given at Cambridge University between 1701 and 1703, and which was published in Latin in 1707.
20. Edmond Halley, *A Description of the Passage of the Shadow of the Moon over England, In the Total Eclipse of the SUN, on the 22d Day of April 1715 in the Morning*, Harvard. Luttrell's copy is dated 10 April, but it was likely published in March. On advertising in the scientific instrument and book trades, M. A. Crawforth, "Evidence from trade cards for the scientific instrument industry", *Annals of science*, xlii (1985), 453–554; Alice Walters, "Tools of enlightenment: The material culture of science in eighteenth-century England", Ph.D.

dissertation, University of California Berkeley, 1992, chap. 3.

21. Halley, *op. cit.* (ref. 20). Copies of this print are at the RAS, WMHS, and Harvard; Harvard's copy lists the price (in ms). The map is reproduced and discussed in Gingerich, *op. cit.* (ref. 6), 324; Armtiage, *op. cit.* (ref. 6), frontispiece, 6–9; Norman J. W. Thrower, "Edmond Halley and thematic geo-cartography", in Thrower (ed.), *The compleat plattmaker* (Berkeley, 1978), 195–228, pp. 225–7; Rodney W. Shirley, *Printed maps of the British Isles, 1650–1750* (London, 1988), 126–7; and Allan Chapman, "Edmond Halley's use of historical evidence in the advancement of science", *Notes and records of the Royal Society of London*, xlviii (1994), 167–91.
22. Nicholas Rogers, "Popular protest in early Hanoverian London", *Past and present*, no. 79 (1978), 70–100, esp. pp. 71–73; Stewart, *op. cit.* (ref. 1), 134.
23. Halley, *op. cit.* (ref. 20). See also Chapman, *op. cit.* (ref. 21), 183.
24. W. W., *The eclipse. A poem, in commemoration of the* Total eclipse of the Sun, *April 22, 1715* (London, 1715), 8. On other interpretations of the 1715 eclipse, see Burns, *op. cit.* (ref. 4), and Curry, *op. cit.* (ref. 4), 119–20; on the importance of such events in popular astrology, Curry, *ibid.*, 97. On similar astrological interpretations of the solar eclipse of 1652 (called "Black Monday" by contemporaries), see Thomas, *op. cit.* (ref. 4), 299–300; and William E. Burns, "'The terriblest eclipse that hath been seen in our days:' Black Monday and the debate on astrology during the interregnum", in Margaret J. Osler (ed.), *The canonical imperative: Rethinking the Scientific Revolution*, forthcoming. For a different perspective on the motivations of "élite writers" to "dismiss ... interpretations of providential intervention as superstition", see Fara, *op. cit.* (ref. 4), 242.
25. *Speculum mundi: or, An exact account of the great and formidable eclipse of the Sun, which will be visible, total, and central, in England, May 11, 1724.* (London, 1723), 20.
26. Halley, *op. cit.* (ref. 20).
27. Halley, *op. cit.* (ref. 14), 245. See also Colin A. Ronan, *Edmond Halley: Genius in eclipse* (Garden City, N.Y., 1969), 196–7.
28. Halley took a similar approach to the aurorae of 1716, though without using the broadside as a publication medium; Fara, *op. cit.* (ref. 4), 240–6.
29. Lorna Weatherill, *Consumer behaviour and material culture in Britain, 1660–1760* (London, 1988), esp. pp. 3–4, 26–27, 88, 168, 180. See also Morton and Wess, *op. cit.* (ref. 2), 47–48.
30. Halley, *op. cit.* (ref. 14), 254. John Flamsteed similarly bemoaned the poor equipment available, to a correspondent in Northamptonshire. In a letter to Dr Hill of Peterborough, dated 28 April 1715, and sent to thank him for the eclipse data he had sent to the Royal Observatory, Flamsteed wrote, "I could wish you have been furnisht with a good Pendulum clock for observeing the times more exactly and better instruments then a sun diall...". Flamsteed Correspondence, Cambridge University Library (RGO 1/36, f. 88–89). I am most grateful to Frances Willmoth, editor of Flamsteed's correspondence, for cheerfully deciphering his handwriting and sending me a copy of this letter.
31. Halley, *op. cit.* (ref. 14), 261–2; 255. See also Chapman, *op. cit.* (ref. 21), 185.
32. Edmond Halley, *A Description of the Passage of the Shadow of the Moon over England as it was Observed in the late Total Eclipse of the SUN April 22d 1715*, Harvard; also reproduced in Gingerich, *op. cit.* (ref. 6), 325; another copy is illustrated in Armitage, *op. cit.* (ref. 6), 11. The print is dated in ms. 1 September 1715.
33. Edmond Halley, *A Description of the Passage of the Shadow of the Moon over England In the Total Eclipse of the Sun on the 11th day of May 1724 in the Evening. Togather with the Passage of the Shadow as it was Observed in the last Total Eclipse of 1715*, Harvard. The print also makes note of Senex's new business address, "in Salisbury Court near Fleetstreet". It is dated in ms.

5 November 1723. See also Armitage, *op. cit.* (ref. 6), 23.

34. Edmond Halley, *A Description of the passage of the Shadow of the Moon over Europe, as it may be expected May 11th 1724 in the Evening*, WMHS and Harvard.
35. Gingerich, *op. cit.* (ref. 6), 324.
36. Gingerich, *op. cit.* (ref. 6), 324 (quote). A modern calculation of the path of the 1724 eclipse shows that its limits were in fact located "about midway" between those established by Halley and Whiston: *ibid*, 325.
37. Richard S. Westfall, *Never at rest* (Cambridge, 1980), 649–53. Schechner Genuth comments on religion and its impact on the relationship between Halley and Whiston, *op. cit.* (ref. 4), 192–3.
38. Stewart, *op. cit.* (ref. 1), 77–97.
39. Schechner Genuth, *op. cit.* (ref. 4), 173. On Halley's moderately-Tory politics, see Burns, *op. cit.* (ref. 4); and Margaret C. Jacob, *Scientific culture and the making of the industrial West* (New York, 1997), 69–70.
40. William Whiston, *Memoirs*, i (London, 1749), 222. The print is discussed in Farrell, *op. cit.* (ref. 19), 230–2, while its impact on Pope is noted in Nicolson and Rousseau, *op. cit.* (ref. 13), 147–8.
41. The first notes that Senex is "now Engraving and will speedily Publish a most correct Pair of Globes of about 30 Inches Dter. at a moderate price & for which none are desir'd to advance yr money beforehand"; the second edition reads "(Senex) has just finished in a most Elegant manner a pair of 28 Inches diamr. fitt to adorn Publick Librarys and the Library's of the most curious". It is very difficult to determine when these globes became available; they were still being advertised as "now Engraving" *c.* 1714, and were advertised as "now finish'd" in 1729. Copies of both of these prints are in the OMHS.
42. Copies of both the Bowles and Sayer edition of Whiston's *Scheme* and the West edition of *The Newtonian System* are in the Houghton Library at Harvard.
43. On the economics of copper-plate engraving in the globe industry, D. J. Bryden, "Cartography by subscription: An unsuccessful 18th century project to issue globes", *Revista da Universidade de Coimbra*, xxvii (1979), 281–91, esp. pp. 290–1; and Peter van der Krogt, "Seventeenth century Dutch globes: Navigational instruments?", *Der Globusfreund*, nos. 38/39 (1990), 67–76, esp. pp. 70–71.
44. On Bowles and Sayer, see Ian Maxted, *The London book trades 1775–1800: A preliminary checklist* (Folkestone, 1977), 26 and 199, resp. A good discussion of the print trade can be found in Brewer, *op. cit.* (ref. 2), esp. chap. 11.
45. These lectures, and responses to them, are discussed in Nicolson and Rousseau, *op. cit.* (ref. 13), 138–66; and in G. S. Rousseau, "'Wicked Whiston' and the Scriblerians: Another Ancients–Modern controversy", *Studies in eighteenth-century culture*, xvii (1987), 22–37. See also John Loftis, "Richard Steele's Censorium", *Huntington Library quarterly*, xiv (1950), 59–60.
46. William Whiston, *A Scheme of the Solar System with the Orbits of the Planets and Comets Belonging thereto.*
47. Schechner Genuth, *op. cit.* (ref. 4), 162–8, 189–95; Nicolson and Rousseau, *op. cit.* (ref. 13), 139–40, 173–4; Rousseau, *op. cit.* (ref. 45), 21–28.
48. Rousseau, *op. cit.* (ref. 45), 28–29 (quote). In 1736, Whiston linked an increase in the incidence of meteors and northern lights seen since 1714 to the Hanoverian succession; Stewart, *op. cit.* (ref. 1), 71; Fara, *op. cit.* (ref. 4), 242–4. For the natural philosophical context of these kinds of interpretations, see Simon Schaffer, "Newton's comets and the transformation of astrology", in Curry (ed.), *op. cit.* (ref. 4), 219–44. For the persistence of "high astrology" in the early eighteenth century, and Whiston's role in it, see Curry, *op. cit.* (ref. 4), chap. 6, esp. pp. 146–8.
49. James E. Force, *William Whiston, honest Newtonian* (Cambridge, 1985), 190, n. 74; Burns, *op. cit.*

(ref. 4); on the 1715 eclipse specifically, Nicolson and Rousseau, *op. cit.* (ref. 13), 156–61; Rousseau, *op. cit.* (ref. 45), 28.

50. William Whiston, *op. cit.* (ref. 40), 240. The passage continues: "As I look upon the numerous and remarkable Eclipses of the Astronomical Year 1736, to be the like divine Signals of the End of all Shadow of Persecution there." For another comparison of Halley's and Whiston's disparate approaches to the interpretation of natural events, see Rousseau, *op. cit.* (ref. 45), esp. p. 17.

51. William Whiston, *A Calculation of the Great Eclipse of the Sun, April 22 1715 in the Morning, from Mr. Flamsteed's Tables, as corrected according to Sir Isaac Newton's Theory of the Moon in the Astronomical Lectures, with its Construction for London, Rome, and Stockholme*, WMHS, Harvard (which lists the price in ms.); and *A Compleat Account of the great Eclipse of the Sun which will happen April 22 in the Morning*, SML, item 1986–358.

52. Whiston, *Calculation* (ref. 51). Though the eclipse occurred just prior to the resolution of the controversy over the unauthorized publication of Flamsteed's *Historia coelestis* (for which Newton and Halley were chiefly responsible), the acrimony does not seem to have tainted this literature. For an account of the dispute, see Westfall, *op. cit.* (ref. 32), 686–96.

53. Whiston described this instrument in a pamphlet published the same year: William Whiston, *The Copernicus Explain'd: or a Brief Account of the Nature and Use of an Universal Astronomical Instrument...* (London, 1715). According to this pamphlet, the instrument was composed of a nine-inch terrestrial globe mounted in several nested rings, to account for the motions of the Earth, Moon, and planets. It was made by Senex, and sold by him and Whiston for six guineas; Farrell, *op. cit.* (ref. 19), 214–17; Nicolson and Rousseau, *op. cit.* (ref. 13), 158–60; Whiston, *op. cit.* (ref. 40), 181–2, 241.

54. [John Flamsteed], *Figure of the Eclipse of the Sun, that will happen April 22 1715 in the Morning. Shewing how it will appear at London and in the places adjacent, at any time during its whole continuance. Deduced from his own Tables*, Harvard. The print sold for sixpence. As it was produced by Flamsteed's assistant, Joseph Crosthwait, and Gerard Van de Gucht, an engraver who later worked on the maps for Flamsteed's *Atlas coelestis*, the print was probably published with Flamsteed's knowledge and permission, though perhaps not at his instigation; Frances Willmoth, personal correspondence. See also Armitage, *op. cit.* (ref. 6), 13.

55. Whiston, *Compleat Account* (ref. 51).

56. Whiston, *Compleat Account* (ref. 51). A letter to Whiston from Richard Allin of Sidney Sussex College, Cambridge, providing an account of the eclipse, is quoted in Farrell, *op. cit.* (ref. 19), 219–20; although Allin does not specifically mention either of Whiston's prints, he does record that those with whom he observed the eclipse were able to see Jupiter, Venus, and Mercury, and one or two stars, but not the "sun's Milky Way" or any evidence of a lunar atmosphere. Whiston noted in his *Memoirs* that he subsequently published an "Account of that [the eclipse of 1715] and of the next total Eclipse of the Sun, May 11, 1724"; Whiston, *op. cit.* (ref. 40), 238–9. I have not located such a print, but, as should be evident by now, that does not mean it was not published or has not survived.

57. *The Method of the Observations to be made at the Solar Eclipse, April 22d, 1715*, Harvard (price noted in ms.).

58. Since Whiston does not address the differences in his two published predictions, it is difficult to say why his first prediction differed so much from his second or from those of Halley and Flamsteed. However, the astronomical data provided in the *Calculation* differ from that in the *Compleat Account*, which suggests that the new prediction in the latter was based on updated data. See also Armitage, *op. cit.* (ref. 6), 12; and Whiston, *op. cit.* (ref. 40), 239.

59. Whiston, *op. cit.* (ref. 40), 239; also quoted in Farrell, *op. cit.* (ref. 19), 213.

60. Westfall, *op. cit.* (ref. 32), 206; Heilbron, *op. cit.* (ref. 2), 153.

61. This estimate is based on the common-sense assumption that Whiston would have charged more for a single lecture than for a lecture course; at the time of the 1715 eclipse, Whiston and his partner Francis Hauksbee charged 3 guineas for a course of 28 lectures, or about 2 shillings 3 pence per lecture. It appears that 5 shillings was a standard charge for a single-evening event at the Censorium, a theatre run by one of Whiston's patrons, Richard Steele, which also hosted other lectures by Whiston. Loftis, *op. cit.* (ref. 45); Farrell, *op. cit.* (ref. 19), 207–14.
62. The fact that Senex's stock at his death included copies of Whiston's two 1715 prints strongly suggests that he published it, and acted as its wholesale distributor. As the engraver of the two prints, he had some stake in the original copyright, so he probably paid Whiston for his share of this copyright. A good place to start for an introduction to the complexities of early-eighteenth century copyrights is John Feather, *A history of British publishing* (London, 1988), esp. chap. 6.
63. William Whiston, *The Transit of the Total Shadow of the Moon over Europe in the Eclipse of the Sun May 11th 1724 in the Evening, described by Will. Whiston M.A.*, Harvard. The print is dated by Whiston 27 April 1724. See also Armitage, *op. cit.* (ref. 6), 13–14; and William Whiston, *The calculation of solar eclipses without parallaxes. With a specimen of the same in the total eclipse of the Sun, May 11, 1724* (London, 1724), which is discussed in Farrell, *op. cit.* (ref. 19), 225–6. The work sold for 1 shilling 6 pence. Whiston later complained "This Book has so many Mistakes, that 'till they are corrected, I do not desire to have it spread abroad any longer". Whiston, *op. cit.* (ref. 40), 315. On the other publications he lists, see Fara, *op. cit.* (ref. 4), 251; and Farrell, *op. cit.* (ref. 19), 160–1, 220–3.
64. *Eclipse races, (Addressed to the LADIES): being an impartial account of the celestial coursers and their riders...* (London, 1764). It was almost certainly written by Robert Heath, who also produced a more conventional pamphlet — with map — detailing the eclipse, *A General and Particular Account of the Annular Eclipse of the Sun...* (London, 1764). Copies of both are in the OMHS. Heath's competitors included George Witchell, Benjamin Martin, and Joseph Betts, among others.
65. Walters, *op. cit.* (ref. 2), 146.