

THE AUDIENCE IS LISTENING: READING WRITING ABOUT LEARNING BY DOING.¹

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1745 saw the publication of the second edition of the late Jean Theophilus Desaguliers' *A Course of Experimental Philosophy*, a work which sought to explain Newtonian philosophy without recourse to Newton's complex, and often intractable, mathematics. Now a full two volumes, the book represented a considerable evolution from the somewhat slimmer *Physico-Mechanical Lectures* of 1717.² One of the leading exponents of the experimental lecture, an approach to disseminating natural philosophical knowledge pioneered by John Keill at Oxford, Desaguliers explained his rationale:

The Thoughts of being oblig'd to understand Mathematicks have frighted a great many from the Newtonian Philosophy: [...] tho' its Truth is supported by Mathematicks, yet its Physical Discoveries may be communicated without. [...] since machines have been contriv'd to explain and prove experimentally what Sir Isaac Newton has demonstrated mathematically, and several of his own Experiments are shewn in publick Courses; a great many Persons get a considerable Knowledge of Natural Philosophy by Way of Amusement;³

Demonstration, therefore, was to replace the mathematics of Newton's *Principia mathematica* (1687) and *Opticks* (1704) for the layman.⁴ The fashion for experimental philosophy reached the highest echelons of society over the course of the century, creating a thriving industry of instrument makers, demonstrators and lecturers. Performed in lecture theatres, coffee houses, and the lecturers' own

1 My thanks go to Matthew Dimmock, Annie Janowitz, Laura Miller, Tim Parnell and Cathy Relf for the provision of their proof-reading, draft-correcting, avenue-suggesting and sounding-board services, without which this essay would have been much the poorer.

2 J. T. Desaguliers, *Physico-Mechanical Lectures. Or, An Account of what is explain'd and demonstrated in the course of mechanical and experimental philosophy given by J. T. Desaguliers, etc.* (London: Printed for the Author, and Sold by him at his house in Channel-Row, Westminster, by Richard Bridger, 1717). For more on Desaguliers, see Larry Stewart, *The Rise of Public Science: Rhetoric, Technology and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge: Cambridge University Press, 1992), pp. 119–41.

3 J. T. Desaguliers, *A Course of Experimental Philosophy*, 2 vols (London: Innys, Longman et al, 1745), II, A4r–v.

4 On reading the *Principia*, Gilbert Clarke, Cartesian natural philosopher and mathematician, wrote that 'I confess I doe not as yet well understand so much as your first three sections,' before noting that he practically 'despaire[d] of understanding' it (quoted in Mordechai Feingold, *The Newtonian Moment: Isaac Newton and the Making of Modern Culture* (New York and Oxford: New York Public Library, Oxford University Press, 2005), p. 32).

homes, the lectures were not cheap, with Hauksbee and Whiston charging two and a half guineas, and the companion texts encouraged further purchasing:

All the above-mention'd Instruments, according to their Latest and Best Improvements, are made and Sold by Francis Hauksbee, (the Nephew of the late Mr. Hauksbee, deceas'd) in Crane-court, near Fetter-Lane in Fleetstreet, London.⁵

For Benjamin Martin, the companion text could prevent the lecture itself from being 'little more than a sublime and rational Amusement, for the instant Hours',⁶ and he and Desaguliers seem to expect the text to be used independently of the lecture, as they were 'Designed for the Use of all such as have seen, or may see Courses of Experimental Philosophy'.⁷ These books all contained plates of the apparatus, but the quantity of supporting material differed greatly. While Desaguliers' 1745 text contained detailed descriptions and mathematical formulae, suggesting that it was designed to allow the reader to carry out detailed study in the comfort of his own library, Hauksbee and Whiston provided only cursory explanatory material, suggesting that its primary use was alongside the machines, effectively as part of the demonstrator's apparatus.

With regards the attendance of women, Desaguliers and Martin perhaps protest too much, the former writing that 'I have with great Pleasure seen the Newtonian Philosophy so generally received among Persons of all Ranks and Professions, and even the Ladies, by the Help of Experiments', while the latter comments on his own work that

In the last place, it was not the least part of my Design, to render this Course of Lectures plain and easy to be understood by all Capacities in general, and in particular by the Fair Sex: For why should not the Ladies understand and study the Sciences of Humanity, of which Philosophy holds the First Place? Knowledge is now become a fashionable Thing, and Philosophy is the Science a la Mode.⁸

The majority of books, however, were bought by men, and it seems likely that the experimental lectures themselves were a primarily masculine affair: one assumes there were no women present, for example, at the lecture given by Desaguliers when Peter Shaw requested that Thomas Topham, a strongman employed by Desaguliers to help demonstrate the advantages of mechanical apparatus, demonstrate naked to ensure that there was no trickery involved.⁹ Desaguliers' use of

5 Francis Hauksbee and William Whiston, *A Course of Mechanical, Optical, Hydrostatical and Pneumatical Experiments* (London: 1715), p. [3], advertisement. This course ran over 26 days.

6 Benjamin Martin, *A Course of Lectures in Natural and Experimental Philosophy* (London: 1743), p. ii.

7 Desaguliers, *Physico-Mechanical Lectures*, LTP.

8 Martin, p. ii.

9 Stewart, p. 126. For example, George Adams Junior's 1794 *Lectures on Natural and Experimental Philosophy*, had 956 names on the subscription list, of whom a mere 4% were ladies, a number equalled by subscribers from the nobility, and well beaten by the clergy (who amounted to 10% of the total). A full 52.8% hailed from the London area (see John R. Millburn, 'An analysis of the subscribers to George Adams Junior's *Lectures on Natural and Experimental Philosophy* (1794)' (Aylesbury: for the author, 1985)).

experiments in the place of mathematics may have served to 'vastly increase the appeal of natural philosophy',¹⁰ and Martin may have attempted to render Newtonian philosophy more attractive to the 'fair sex' by promoting its modishness, and describing the experiments as 'amusements', but the attention they pay to women in their works is more likely an indication of their absence than any significant attendance. Certainly neither women nor children generally possessed the independence of means or motion to attend such lectures, but it is the publishers who provide the real evidence in the form of titles such as *The Newtonian System of Philosophy Adapted to the Capacities of Young Gentlemen and Ladies* (London: John Newbery, 1761) and *Sir Isaac Newton's Philosophy Explain'd for the Use of the Ladies* (London: E. Cave, 1739). These popular and enduring books simply filled a gap in the market.

The books written by Desaguliers et al were designed to illustrate and explicate Newtonian Philosophy with or without the experimental demonstrations which underpinned the lecture texts themselves. Bursting with complex explanations, detailed illustrations and even mathematical equations, they assumed an audience comfortable with the medium of the technical manual. *The Newtonian System* (or to use its more popular name, *Tom Telescope*), and *Newton's Philosophy Explain'd for the Use of the Ladies* (or *Newton for the Ladies*) were written directly for an audience lacking the ability to comprehend the experiments on a technical level, and so they replaced the technical jargon with fictionalised versions of these same experiments.

REASON AND IMAGINATION

In 1748, the Earl of Chesterfield dispensed some fatherly advice to his son:

Women, then, are only children of a larger growth; they have an entertaining tattle, and sometimes wit; but for solid, reasoning good sense, I never in my life knew one that had it, or who reasoned or acted consequentially for four-and-twenty hours together. Some passion or humour always breaks in upon their best resolutions.¹¹

This view of women was anything but controversial, as the Renaissance commonplace that both women and children were unable to engage the faculty of reason endured, even while some few entered the realms of science. 'Children's Minds are narrow and weak [...]', wrote John Locke, '[the] natural Temper of Children disposes their Minds to wander. Novelty alone takes them; whatever that presents, they are presently eager to have a Taste of'.¹² Mary Wollstonecraft largely agreed:

Women, in general, as well as the rich of both sexes, have acquired all the follies and vices of civilisation, and missed the useful fruit [...] their senses are inflamed, and their understand-

10 Stewart, p. 123.

11 *Letters Written by the Late Right Honourable Philip Dormer Stanhope, Earl of Chesterfield*, ed. by E. Stanhope, 4 vols (Dublin: E. Lynch et al, 1775), II, p. 21.

12 John Locke, *Some Thoughts Concerning Education*, thirteenth edition (London: A. Miliar et al, 1764), pp. 244-45.

ings neglected, consequently they become the prey of their senses, delicately termed sensibility, and are blown about by every momentary gust of feeling [...] all their thoughts turn on things calculated to excite emotion, and feeling, when they should reason, their conduct is unstable, their opinions are wavering.¹³

Wollstonecraft considered this skittishness the result of faulty education rather than any innate deficiency, but the fact remained that women were prey to their feelings: reason took a back seat.¹⁴

Flighty and with roving imaginations, women and children might therefore invite reasonably similar, if not identical, methods of instruction, and yet this pair of texts seem to take markedly different approaches. In this essay, I shall argue that each text aims to recreate for its particular audience the *experience* of witnessing: *Tom Telescope* combines lecture with demonstration by presenting a fictional lecturer using familiar objects from childhood – it was subtitled *The Philosophy of Tops and Balls* – while *Newton for the Ladies* aims to harness the reader's imagination through the manipulation of poetic conceits. Both works write their audience *into* the experimental lecture, allowing them to *perceive* experiments they could not possibly *understand*: they were not designed for use *alongside* the apparatus, but to function *as* the apparatus.

The virtual witnessing these texts aim for is first created through the inclusion of an internal, literary audience (the characters within the book, who 'witness' the experiments in the first place), and then through the creation of images for the reader. In *Tom Telescope*, these images are embedded within the text through a combination of narrative and illustration, while in *Newton for the Ladies*, they are created by the narrator within the imagination of his fictional audience, and thus simultaneously within the readership.

13 Mary Wollstonecraft, *A Vindication of the Rights of Woman* (London: J. Johnson, 1792), K1r-v.

14 Education, Wollstonecraft argued, failed to cultivate women's understanding, as 'novels, music, poetry, and gallantry, all tend to make women the creatures of sensation, and their character is thus formed during the time they are acquiring accomplishments' (Wollstonecraft, K1v), a state of affairs she blamed on purposeful neglect: 'kind instructors! What were we created for? To remain, it may be said, innocent; they mean in a state of childhood' (Wollstonecraft, K2r). French educational theorist Francois Fenelon was espousing similar views a hundred years previously, though without the emphasis on intentional mis-education, writing 'Young Women without Instruction and Application, have always a roving Imagination. For want of solid Nourishment, their Curiosity violently turns them toward vain and dangerous Objects' (Francois Fenelon, *Instructions for the Education of a Daughter* (London: Jonah Bowyer, 1707), p. 11), while Locke ascribed the same malleability to children: 'I imagine the Minds of Children as easily turned this way or that, as Water itself' (Locke, A5v). See also Richard A. Barney, *Plots of Enlightenment: Education and the Novel in Eighteenth-Century England* (Stanford, California: Stanford University Press, 1999), p. 55.

THE PROBLEMS OF WITNESSING

The problem of how to report an experiment or phenomenon when observation is impossible has troubled scientists since the days of Francis Bacon. The Royal Society, in many ways Baconian in conception, followed the principle of 'show, don't tell' wherever possible, counting many experimental lecturers amongst its fellows, and employing Desaguliers as its official demonstrator.¹⁵ But often such demonstration was impossible, and issues of authentication and authority reared their heads. Recent reconstructions of eighteenth century experiments, such as those by Peter Heering with the solar microscope, have noted similar problems:

it is impossible to give an adequate written account of the impressions the images made on the viewer. Moreover, neither printed pictures nor even projections of these pictures can be used to communicate the experience of the projected images, since they provide only meagre and unsatisfactory reproductions of what could be seen in the darkened chamber.¹⁶

It is perhaps for this reason that these texts attempt to create within the reader, through identification, the feeling of witnessing. Bacon's approach was simplicity and clarity:

in every new or slightly more subtle experiment, though (it seems to me) certain and proved, I shall subjoin a clear account of the way I performed it, so that after revealing its every detail, people can see if any latent fault clings to it, and push themselves to find (if any there be) more reliable and accurate proofs.¹⁷

Since Bacon's time, however, mathematics had emerged as the premium mode of demonstrating phenomena through virtual witnessing, but with neither mathematics nor physical demonstration to draw from, the writers and editors of *Newton for the Ladies* and *Tom Telescope* relied upon writing to recreate the sensation of 'being there' – the former harnessing of the power of the imagination and the latter, increasingly, through the imitation of the experimental lectures delivered by Desaguliers et al. Both texts evolve in such a way as to accentuate these properties, as a comparison between different editions of each text clearly shows.

15 See S. Shapin and S. Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1995); Steven Shapin, *A Social History of Truth* (Chicago: University of Chicago Press, 1995).

16 Peter Heering, 'The enlightened microscope: re-enactment and analysis of projections with eighteenth-century solar microscopes', *BJHS*, 41 (2008), 345–368 at 352. See also Elizabeth Calvecci, 'A Witness Account of solar microscope projections: collective acts integrating across personal and historical memory', in *BJHS*, 41 (2008), 369–84, in which she analyses her experience of witnessing Heering's Solar Microscope in operation relative to Schaffer and Shapin's account of collective witnessing.

17 Graham Rees, ed., *The Oxford Francis Bacon*, 15 vols (Oxford: Clarendon Press, 2004), XI, p. 41. See also Bacon on magisterial and initiative learning in Spedding, Ellis and Heath, eds, *The Works of Francis Bacon*, 7 vols (London: Longman et al, 1872), IV, p. 449.

PUBLICATION HISTORY

Both *Tom Telescope* and *Newton for the Ladies* were published in editions that might fairly be termed 'adaptations' – *Newton for the Ladies* three years after the first English translation, *Tom Telescope* thirty years after the first edition – in which the editorial changes seem to have been undertaken in order to reinforce and enhance the initial strategy of the recreation of the sensation of witnessing in the audience.

First published, and most likely authored, by John Newbery in 1761, *Tom Telescope* went through six editions in duodecimo between 1761 and 1798, eventually undergoing radical changes in 1820.¹⁸ Newbery himself, however, died in 1767, his business consequently being fought over by his son and step-son on one side, and his nephew on the other. It took the retirement of Francis the son, the death of Francis the nephew, and finally the death of the step-son to unify the imprimatur in 1788 under the stewardship of Elizabeth Newbery, the nephew's wife – and she sold the business in 1802. With Elizabeth's stewardship began a series of editorial changes, with two editions published in the 1790s – in 1794 and 1798, under the imprimatur of Ogilvy et al.¹⁹ – which contained subtle but significant changes that increased their similarity to the 'grown-up' books of experimental lectures: *Tom Telescope* was edited 'according to their latest and best improvements'.²⁰

First published in 1737 in handsome folio, *Il Newtonianesimo per le dame* was ostensibly an attempt by its Italian author, Francesco Algarotti, to do for Newton what Fontenelle's *On the plurality of worlds* had done for Descartes.²¹ The first English edition, translated by Elizabeth Carter, was published in 1739 by Edward Cave.²² Hot on the heels of Carter's much admired translation was another edition, however, one published by G. Hawkins 'at Milton's Head' in 1742,

18 See James A. Secord, 'Newton in the Nursery: Tom Telescope and the Philosophy of Tops and Balls, 1761–1838', *History of Science*, 23 (1985): 127–51. These changes are broad enough to suggest that it is less a new edition than a new work inspired by *Tom Telescope* – in a new century, with a new publisher, Tom literally grows up.

19 See S. Roscoe, *John Newbery and his Successors 1740–1814, A Bibliography* (Hertfordshire: Five Owls Press, 1973), pp. 2, 253.

20 Hauksbee and Whiston, advertisement; cf. Desaguliers, *A Course*, I, 'I have endeavour'd to improve, by the Addition of new Propositions and Experiments, and by altering and changing my Machines' (a1v-r).

21 Francesco Algarotti, *Newton Explain'd for the Use of the Ladies*, trans. by Elizabeth Carter (London: E. Cave, 1739), A5v. See Massimo Mazzotti, 'Newton for ladies: gentility, gender and radical culture', *BJHS*, 37 (2004): 119–146.

22 Carter was unsuccessfully courted by Thomas Birch, one-time secretary to the Royal Society, who wrote in the copy she presented to him 'Tho. Birch / Mais 31st. 1739 / Ex dono interpretis / doctissime & eleganter / tissime Elizab. Carter' (BL Shelfmark 535.b.10). *S.V.* DNB. Bound with this copy is the letter Carter sent to her publisher, which is itself interesting: Sr / I have sent you by the bearer / of this note 2 sets of Algarotti. One I desire you / to give to M^r Birch with my compliments, the other / is for signore Algarotti himself. When I can get some / more bound I shall have a sett at M^r Johnsons service.'

which Laura Miller describes as 'an embellished piracy of Carter's translation, inspired by imaginative literature as well as science', noting that in addition to stealing wholesale from Carter, it also included parts translated from a 1738 French edition by Adrien Duperron de Castera.²³ Neither text begins with Newton, instead imagining themselves into the environment of their audience, making the readership feel comfortable with their bibliographical instructors. *Newton for the Ladies* sees a chevalier and a marchioness whiling away the hours in a country house by indulging in a series of dialogues which shift from poetry to Newtonianism.²⁴ He then leads her on a whistle-stop tour of the various universal systems, leading her to become a fervent devotee of first Descartes, and then Malebranche, before she sees the error of her ways as they reach Newton, 'who brings you Light and Truth, who speaks with Candour'.²⁵

While also being set in a great country house, *Tom Telescope* makes use of a far greater range of characters, taking an initially more theatrical, and ostensibly more moralistic, approach. When a group of children are deciding how to fill up their day, one suggests that they play at cards. Up jumps young Tom, and lambasts them, as 'Playing at cards for money, says he, is so nearly allied to covetousness and cheating that I abhor it [...] Parents, continued he, might almost as well teach their children to thieve as well as game; for they are kindred employments',²⁶ his views echo those of Locke:

This has been that, which has given *Cards, Dice and Drinking*, so much Credit in the World: And a great many throw away their spare Hours in them through the Prevalency of Custom, and Want of some better Employment to fill up the Vacancy of leisure, more than from any real Delight is to be found in them [...] I think the safest and best Way is never to learn any Play upon them.²⁷

This moral priggishness resurfaces at several points within the book, but by then Tom's design, being effectively to save his companions 'from the insidious pastime of card playing' through his delivering a series of lectures on Newtonian Philosophy, has perhaps been forgotten.²⁸ The lectures are accompanied by demonstrations which, naturally for a work 'adapted to the Capacities of young

23 Catherine Talbot wrote to Miss Carter saying 'I must tell you of a Dutch Latin compliment made to you and your Algarotti, by Brucker in some new book, but I cannot transcribe it' (Talbot to Carter, Cuddesden, July 29, 1757 – in *A Series of Letters between Mrs Elizabeth Carter and Miss Catherine Talbot, 1741–1787*, 2 vols (J. Rivington: London, 1808), I, p. 416); Miller also points out that the 1742 edition, because of its French heritage, affords somewhat more space to Descartes than does Carter's translation (see Laura Miller, 'Publishers and Gendered Readership in the English Editions of *Il Newtonianesimo per la Dame*', forthcoming).

24 Mazzotti, p. 120. The shift is occasioned by the chevalier's reading of poem, written and published by Algarotti in 1732, which celebrated Laura Bassi's graduation from the University of Bologna.

25 *Newton for the Ladies* (1742), II, B10r.

26 [John Newbery] *The Newtonian System of Philosophy* (London: John Newbery, 1761), A3v.

27 Locke, pp. 312–13.

28 Secord, p. 135.

Gentlemen and Ladies, and familiarized and made entertaining by Objects with which they are intimately acquainted', use 'familiar objects' such as cricket balls and spinning tops, perhaps following the teachings of Locke and Rousseau, that 'Learning might be made a Play and Recreation to children; and that they might be brought to desire to be taught'.²⁹

Through its use of familiar objects – it was subtitled the 'philosophy of tops and balls'³⁰ – *Tom Telescope* asks the reader to consider the necessity of complicated or specialised apparatus. Julia Douthwaite suggesting that 'it is the elaborate collection of paraphernalia that initially attracts Tom Telescope to the Marquis of Setstar's home, where he stages all his little lessons',³¹ but in fact this movement is due to the Countess:

The Countess was very desirous of knowing what sort of diversion could be made of Natural Philosophy; and finding her young visitors in the same disposition, she conducted them to the Marquis of Setstar's, that they might have the use of proper instruments.³²

For a text which seems to be wishing to recreate the sensation of witnessing it is perhaps inevitable that within it a debate should occur about with regards the efficacy of various instruments, and *Tom Telescope* is unclear, initially at least, where it stands on the subject. When, for example, Lady Caroline challenges Tom to prove that air has the property of 'spring', the Duke intervenes, saying 'That he cannot do, without the use of proper instruments'. Yet Tom points to a pop-gun on the window-sill: 'almost anything will do.'³³ While Tom and the Duke seem to disagree at this point, the text inexorably moves towards the position of the adults. It is almost as if the children grow up, intellectually, as the lectures progress. *Tom*

29 Locke, pp. 222–23; In *Emile*, Rousseau encourages the use of hand-made instruments and familiar objects to allow children to discover scientific principles (Julia V. Douthwaite, *The Wild Girl, Natural Man and the Monster* (Chicago: University of Chicago Press, 2002), p. 99). Interestingly, Tom lectures almost exclusively for boys, using very gendered toys for his demonstrations. Yet, of the seven copies at the British Library which bear inscriptions, the text definitely owned by a boy, and the one probably (shelfmarks c.119.15 and RB.23.A.21247), trumpet their status as gifts, whereas there are four copies owned by girls, and each is simply claimed by its owner. One, shelfmark CH.760, is actively claimed by her, as she writes 'Elizabeth Dickens | Her Book | March 12th 1805' on the first leaf, one (C.113.a.19), owned by Charlotte Mason, has 'This book belonged to dear mother' written on the LTP, while the other two, shelfmarks 12809.a.5 and 8704.a.7 have the names Maria Wilkinson and Elizabeth Kipping on their respective LTPs. Three of these copies have picture or floral boards. It may be of note also that the copy given to 'Mas. N. Belcher' in 1814 was an 1806 edition, while Elizabeth's copy is a 1761 edition, claimed in 1805.

30 *Tom Telescope* (1761), contents page (no sig.).

31 Douthwaite, p. 100. cf. Benjamin Martin's *Young Gentleman's and Lady's Philosophy*, in which Douthwaite notes the characters' 'infatuation' with 'proper' scientific instruments (Douthwaite, p. 100).

32 *Tom Telescope* (1798), B2r. Interestingly, the plate which faces the second lecture in 1761, namely Lecture II 'Of the Universe, and particularly of the Solar System' (*Tom Telescope* (1761), C3r), namely the plate of the Marquis of Setstar's Observatory, is moved in 1798 to become the frontispiece.

33 *Tom Telescope* (1798), E5v.

Telescope seems to be asking whether there is any useful way in which it can imitate the experimental lectures of Desaguliers et al. The editorial changes of the 1790s enhance this feeling, as the texts become more realistic, dispensing with sensationalist language and accentuating philosophical and historical accuracy.

EDITING THE TEXT

The original dedication, 'The Substance of Six lectures read to the Lilliputian Society, By TOM TELESCOPE, A.M.', slowly vanishes. In 1794 the lectures are 'read to a select company of friends', while the 1798 edition removes the entire line. Both texts, however, trumpet their revised status on their respective letterpress title pages, with authorship now ascribed to William Magnet, F.L.S: 1794 is 'A NEW EDITION, | Revised and enriched by an Account of the late new | Philosophical Discoveries,'; 1798 reads 'A new improved Edition, | With many Alterations and Additions, to explain | the late new Philosophical Discoveries.'³⁴

While it is edited in order to take account of new natural philosophical discoveries and historical landmarks, the most telling change to *Tom Telescope* is the gradual toning down of passages which sought to engage the reader emotionally. The 1790s editions also show a book more aware of its own status: in 1761 it thinks it is a lecture, but by the 1790s it knows it is a *report* of a lecture.³⁵ These changes all work to accentuate the lecture's 'reality': it is less a fictional account than a true report of the type of demonstration the reader might imagine being given around the country.

The 1790s also saw increased usage of specialised apparatus, such in the second lecture, 'Of the Universe, and particularly of the Solar System', where Tom introduces the orrery, in order to 'illustrate our solar system':

There are seven primary planets; and there are marked on the Orrery as follows: Mercury *b*, Venus *c*, the Earth *d*, Mars *e*, Jupiter *f*, Saturn *g*, and the Georgium Sidus (which being of such recent discovery, is not represented in this Orrery.)³⁶

Tom here not only accentuates the use of modern, grown-up apparatus, but also subtly reinforces the state-of-the-art nature of his lecture, and therefore the book itself, as he shows how even the instrument makers have yet to catch up with this 'new' discovery (made by Herschel in 1781).³⁷

34 cf. *Tom Telescope* (1761; 1794; 1798), LTP.

35 Tom is quoted as saying 'which I mentioned in my second Lecture (page 26), and 'which I described in my first Lecture (p. 11)' (*Tom Telescope* (1798), 11v, 14r). In 1761, Tom does mention 'my next course of lectures', three times, but does not give page numbers (*Tom Telescope* (1761), H4v, 11r, 11v), but these lines are omitted in the 1798 edition.

36 *Tom Telescope* (1798), C6v.

37 It isn't until the edition of 1794 that *Tom Telescope* notes this new discovery, however – he protests a little too much on this point.



Fig. 1: *The Marquis of Setstar's Observatory* (Tom Telescope, 1798, frontispiece).
Credit: author's own library.

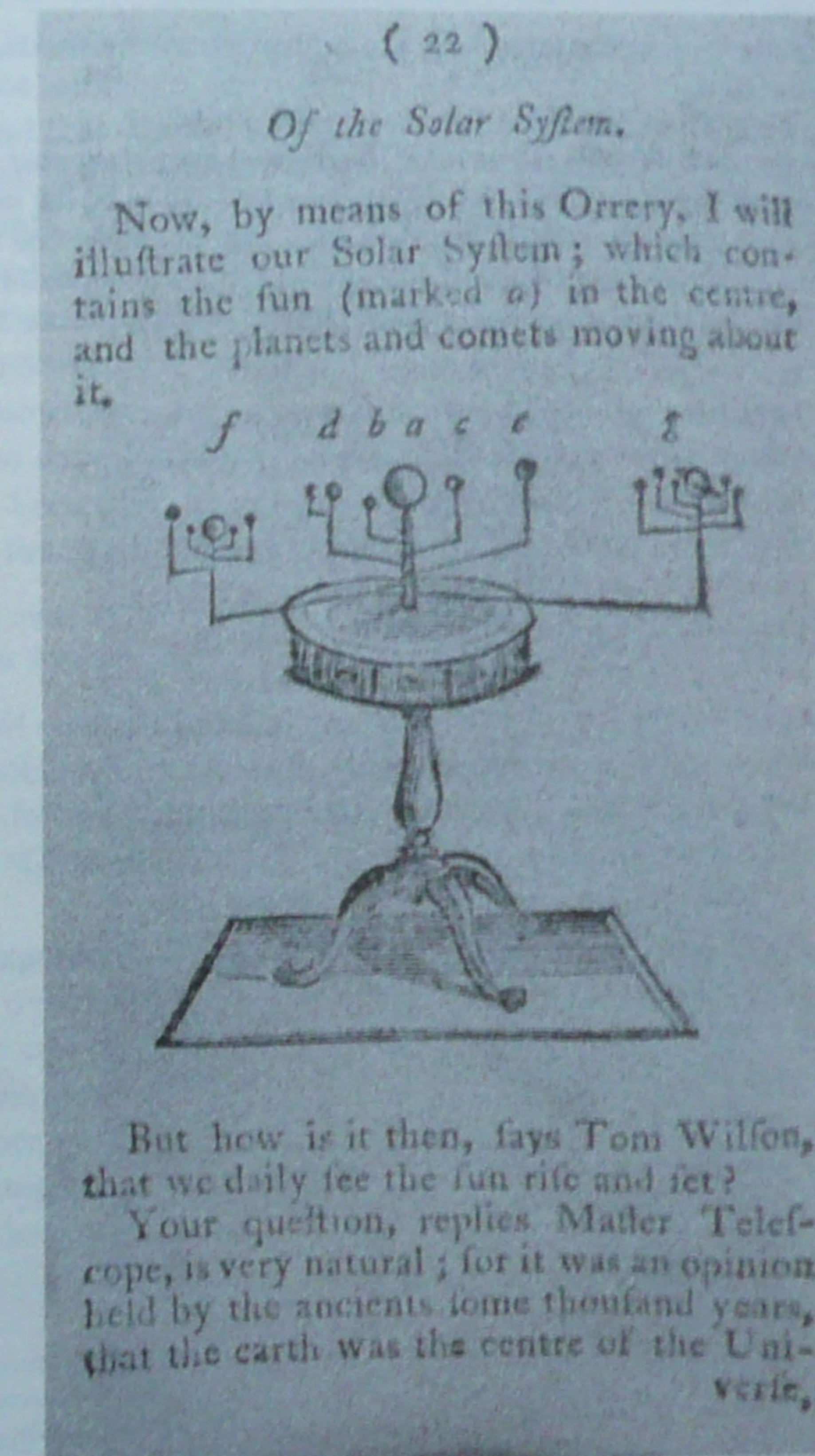


Fig. 2: *The Orrery* (Tom Telescope, 1798, p. 22). Credit: author's own library.

Having demonstrated using the orrery, and perhaps rather strangely pointing the reader and internal audience to the plain 2D map of the solar system, Tom goes on to demonstrate both solar and lunar eclipses. Here, he not only changes the demonstration, but, rather tellingly, the narrative point of view. In 1761, Tom explains the phenomenon using a cricket ball, an orange, and a spinning top:

We will suppose this orange to be the sun, this cricket-ball the earth, and this top the moon; now if you place them in a strait line, with the ball in the middle, and then put your eye to the top, you'll find that the ball will entirely hide the orange from your view, and would prevent

the rays of light (which always proceed in right lines) from falling upon it, whence would ensue a total eclipse.³⁸

In 1798 Tom once again demonstrates via his home-grown methods, though now subtly changed:

But I will endeavour to explain this to you more clearly, says our philosopher, taking an ivory ball suspended by a string, in his hand; we will suppose this ball to be the moon, the candle the sun, and my head the earth. When I place the ivory ball in a direct line betwixt my eye and the candle, it appears all dark, because the enlightened part is opposite the candle; but if I move the ball a little to the right, I perceive a streak of light, which is like the New Moon.³⁹

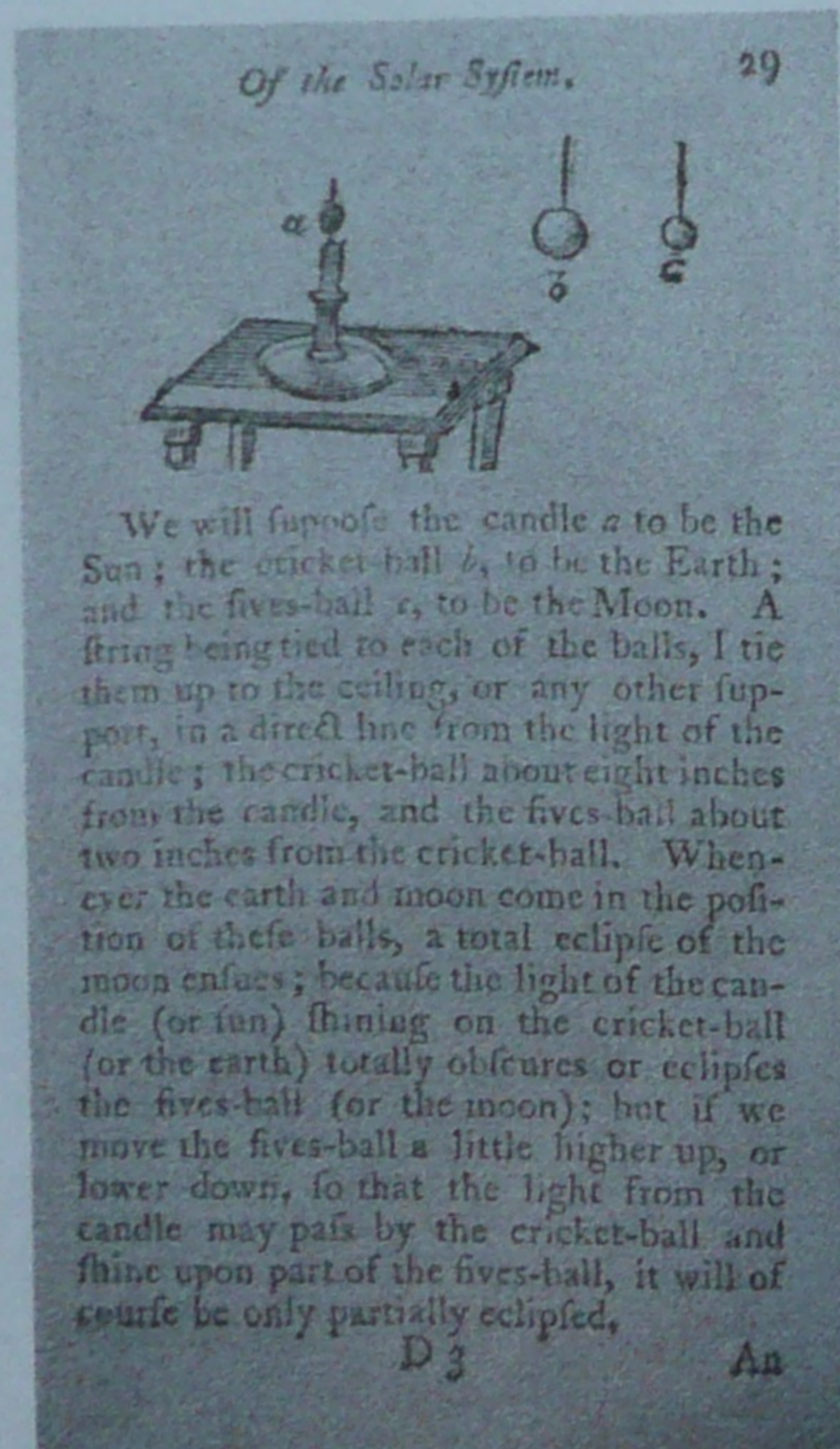


Fig. 3: Demonstration of the eclipse (Tom Telescope, 1798, p. 29).
Credit: author's own library.

Printed with the addition of two new illustrations, one of the orrery and the other of the re-imagined eclipse, this passage subtly privileges modern technologies

38 Tom Telescope (1761), D1v–D2r.

39 Tom Telescope (1798), D2r.

over the home-spun – though in this case the deficiencies in the audience lead Tom to resort to more home-spun methods – while accentuating Tom's activity as lecturer. More than this, however, the 1798 text has done something very interesting with the audience. In 1761, Tom writes 'if you place them in a strait line [...] you'll find that the ball will entirely hide the orange from your view',⁴⁰ while by 1798 he no longer talks of 'you' but 'I', and the experiment is now visible to the lecturer only. The audience in 1761 is part of the lecture, and Tom himself acknowledges his kinship with his audience. In 1798, however, Tom has taken a very different stance, and changes in his language show how he has assumed a much more authoritative position – he is now showing his audience, rather than sharing his knowledge with them. Tom is gradually growing up, gradually turning into a de facto experimental lecturer. This feeling is enhanced further by the back matter of the books. In the editions up to 1792, these pages are taken up with advertisements for children's books, prefaced by a publisher's note:

Mention is made of the *Pocket Dictionary* (Page 95.) not because the Terms are better defined in that book than any other, but because it is sold only for three Shillings Bound.⁴¹

From the 1794 edition onwards, the reader finds that rather than trying to sell their books, the publisher is trying to sell experimental machines. From 1794, Tom Telescope is followed by a price list of experimental instruments, the bottom of which reads 'Orders sent to the Publishers of this Work, will be duly attended to'.⁴²

This engagement with experimental culture is there from the first edition, but does change over time, with a good example being its management of one of the most popular and impressive pieces of experimental apparatus then available, the air pump immortalised by Joseph Wright of Derby. The 1790s texts once more take a far more technical approach than the fictive feel of 1761. Both text and illustration change, the former being increased by 50%, from 29 to 43 lines, while the latter became more technical, and linked by numbers directly to the text.

40 Tom Telescope (1761), D1v–D2r (my emphasis).

41 Tom Telescope (1761), M3r. In the 1761 edition the dictionary mentioned is, perhaps unsurprisingly, published by Newbery himself: And now, Lady Caroline, prepare to hear a few hard words and I will finish this Lecture. Because I cannot deliver what I am going to say, Madam, without making use of the terms of art, says he, and those I must desire your Ladyship, and the rest of the good company, to learn from Mr. Newbery's pocket dictionary, or some other book of that kind. (Tom Telescope (1761), I6r.)

The 1798 text not only references another work but allows, once more, for a greater interaction between audience and lecturer:

And now, Lady Caroline, prepare to hear a few hard words and I will finish this Lecture. But why must it be finished in an unintelligible manner? Says the Lady. Because I cannot deliver what I am going to say, Madam, without making use of the terms of art; and those I would recommend your Ladyship, and the rest of the good company, to learn from Jones's Pronouncing and Explanatory Dictionary; which is a work no young reader should omit having in his library' (Tom Telescope (1798), K6r).

42 Tom Telescope (1798), N4r.

A List of the Optical and Philosophical Instruments mentioned in this Book; with the Prices at which they are made and sold, by the Philosophical Instrument Makers.

	£.	s.	d.
A Pocket Terrestrial Globe, in a case	0	8	0
A Reflecting Telescope, one foot, in brass	5	5	0
A Refracting ditto, from 10s. 6d. to	3	3	0
A Planetarium, according to the wheel-work, from 1l. 1s. 10	—	—	10 10 0
An Accurate Map of the Moon	—	0	1 0
An Armillary Sphere, on card paper	—	0	5 0
A Nine Inch ditto, all in brass, completely and elegantly made	—	9	9 0
A Pair of Twelve Inch Globes, best sort	5	5	0
A Triple Weather-glass [described in page 44.]	—	—	3 13 6
Air-Gun, for experiments only	—	16	16 0
Air-Pump, with Receiver, from 4l. 14s. 6d. to	—	—	6 6 0
Apparatus to ditto, from 1l. 1s. 10	—	—	10 10 0
Electrical Machines, from 1l. 12s. 6d. to	—	—	8 8 0
Misc. Scope, with Apparatus	—	—	1 6 0
Glass Prism	—	—	0 8 0

Orders sent to the Publishers of this Work, will be duly attended to.

Fig. 4: Experimental price list (Tom Telescope, 1798). Credit: author's own library.

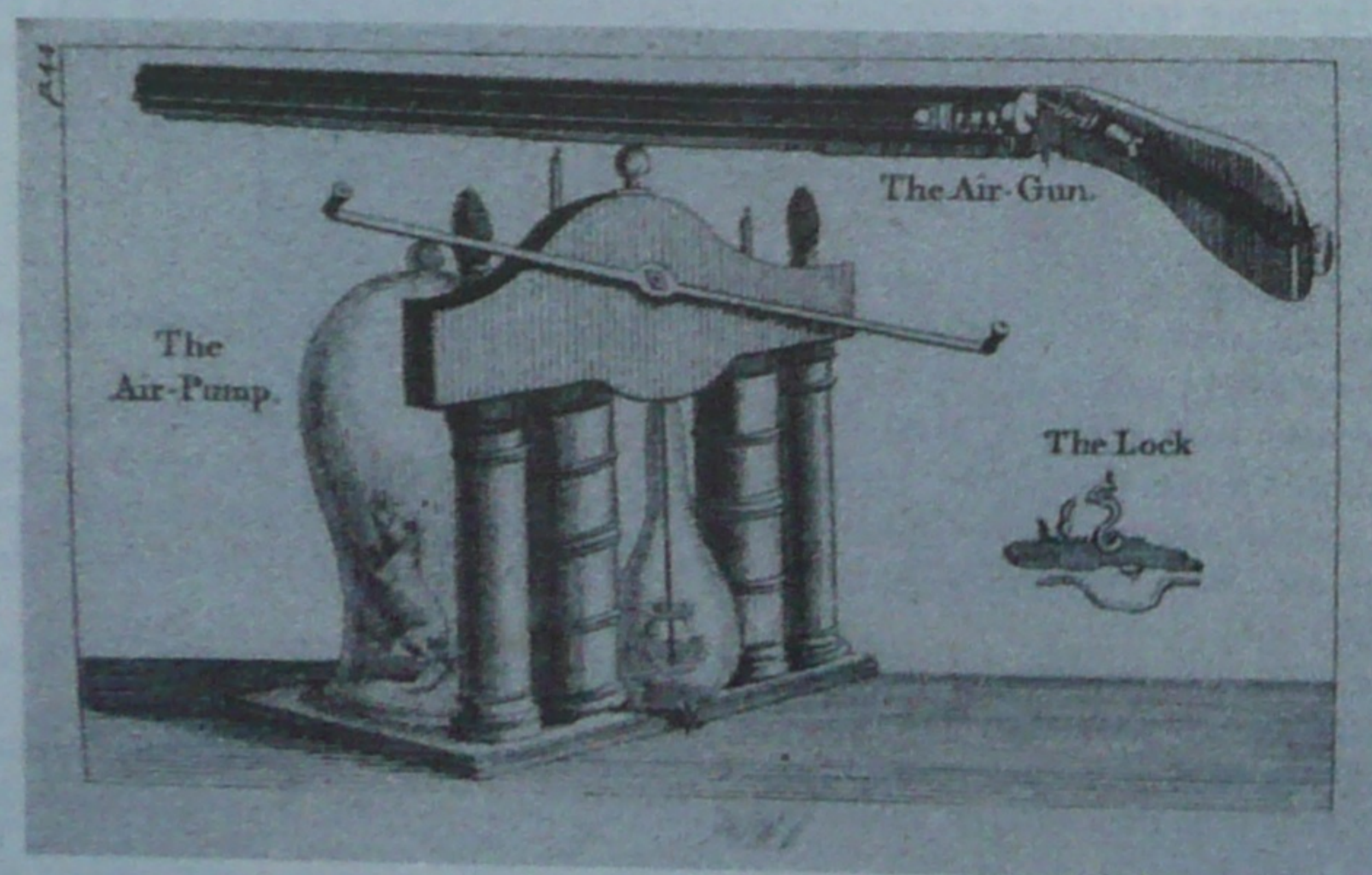


Fig. 5: The air pump (Tom Telescope, 1761, insert between p. 44/45). Credit: British Library.

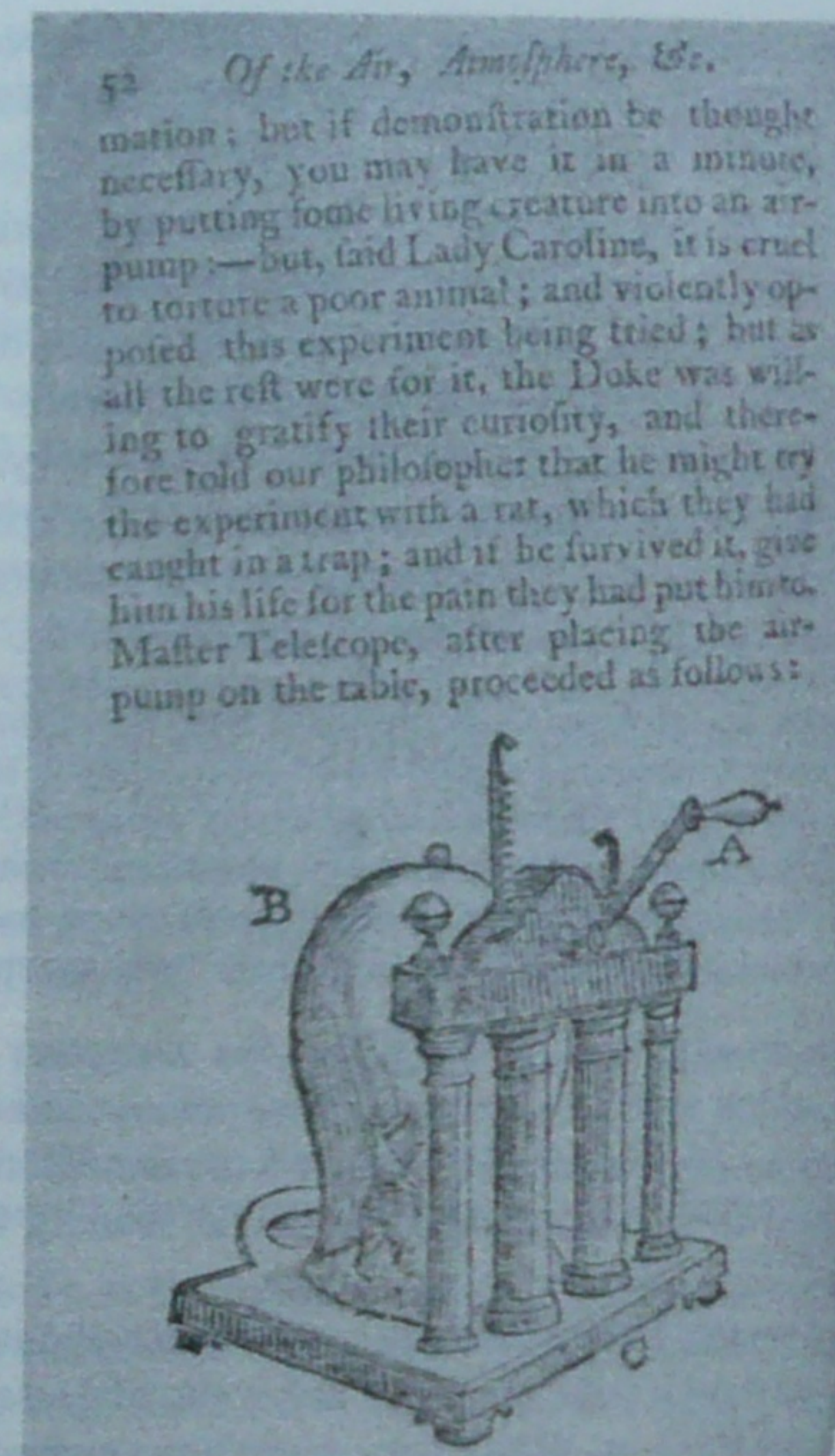


Fig. 6: The air pump (Tom Telescope, 1798, p. 52). Credit: author's own library.

Both the 1761 and the 1790s texts begin with the same discussion of air, and the demonstration of the emotional instability of women provided by Lady Caroline's outburst that 'it is cruel to torture a poor animal',⁴³ but after the Duke's suggestion that they 'try the experiment with a rat', the texts diverge. The 1761 text dives straight into the rat's sufferings: 'when the air was partly exhausted, he appeared in great agony, and convulsed; and more air being pumped out, he fell on his side for dead; but fresh air being immediately admitted, it rushed into his lungs.'⁴⁴ In 1798, however, the text begins with technical information:

Master Telescope, after placing the air-pump on the table, proceeded as follows:

By the help of this machine, all that I have spoken concerning the weight and elasticity of the air, is demonstrated in the most simple and elegant manner. For by working the handle (marked A) all the air that is contained within the glass receiver (marked B) is pumped out; and if any living animal is put within the receiver, all the air in its body is pumped out like-

⁴³ Tom Telescope (1798), F3r.

⁴⁴ Tom Telescope (1761), D6v-E1r.

wise: then, as mentioned before, air being the principle which preserves life, the animal dies, unless fresh air be immediately admitted, which may be done by turning a screw (at C). Our philosopher then put the rat into the receiver⁴⁵

The two texts then synchronise, the later one accentuating Tom's active involvement in the demonstration, and maybe a hardening of attitude towards the rat, now called 'it' rather than 'he': the 1790s sees a more balanced, more technical and less emotional look at the principles and apparatus involved. This movement is accentuated by the editing of some of the book's more showy, flowery passages into a somewhat harder, more utilitarian style, further fostering the impression that the narrator actually witnessed the experiments. For example, after the children have been led to the Duke's observatory, 1761 elaborates:

and the place itself is the best that can be conceived for enquiries of this kind, and for meditation. To see an extensive horizon thus shaded by the brow of night, and at intervals brightened up by the borrowed light of the moon dancing among the clouds, was to me inexpressibly pleasing. Nothing was heard but a gentle breeze whispering among the battlements; the dying murmurs of a distant cascade [...] night, the nurse of nature, hushed all things else to silence—But the silence was soon broke by our philosopher, who thus began his Lecture.⁴⁶

In 1798 this passage is replaced with 'When the company were seated, our Philosopher thus began his second Lecture'.⁴⁷ This removal of unashamedly literary language designed to convey atmosphere and the substitution of language of direct action is repeated in several parts of the work, lending the text a more direct, unmediated feel.⁴⁸

As well as changing the book's attitude to its reader, the increasingly precise technical description brings it ever closer to the work of Desaguliers et al. Now called 'A new improved Edition, With many Alterations and additions, to explain the late new Philosophical Discoveries', the text was updated by the addition of new philosophical discoveries as well as circumstantial information, making current what was, by the 1790s, somewhat dated. From 1761 to as late as 1784, the text stated that 'the noble city of Lisbon was lately destroyed', where finally, in the 1790s, these events are 'some years ago'.⁴⁹ Tom changes names, too, replac-

45 *Tom Telescope* (1798), F3r.

46 *Tom Telescope* (1761), C3v.

47 *Tom Telescope* (1798), C2r. cf. the debate on slavery, where the lines 'When the ambassador had sat down with a sigh, and lady Caroline had wiped the precious pearly drops from her cheeks, our philosopher arose and thus pursued his lecture' (*Tom Telescope* (1761), K5v) is replaced by 'When silence was restored, our Philosopher arose and thus pursued his lecture.' (*Tom Telescope* (1798), M4r).

48 Tom himself is also made more pleasant and authoritative, less hectoring: in 1761, Tom 'commanded silence'; in 1798 he 'requested' it (*Tom Telescope* (1761), A5v; (1798), B3v). His audience, too, interact more: where Tom once talked of 'Sam Jones's knife', in 1798 we read 'my knife, said Sam Jones' (*Tom Telescope* (1761), B2r; (1798), B6r).

49 cf. *Tom Telescope* (1761), E6r; (1794), F3r.

ing Lord Anson with Captain Cook as the circumnavigator of choice, and perhaps makes a political statement by mentioning 'English miles'.⁵⁰

The editing of *Tom Telescope*'s prose style and updating of its factual information, along with the subtly introduced self-awareness, work to produce a text more like a report than a literary representation of a lecture. It seems as if the editions of the 1790s are designed to *tell* rather than *show*. In his final lecture, on the 'Five Senses of Man, and of his Understanding', Tom's audience is augmented by 'a great deal of good company [...] on which account I could observe that Master Telescope took less pains to be understood by the young gentlemen and ladies; and addressed himself more particularly to those of greater abilities'.⁵¹

Tom is no longer discussing things that can be demonstrated, moving onto psychology, and perception, suggesting that 'all our ideas [...] are obtained either by sensation or reflection, that is, by means of our five senses [...] or by the operations of our mind'.⁵² Lady Caroline asks that Tom explain what is meant 'by the term Idea', and Tom replies 'That, I apprehend, is sufficiently explained by what was said about the looking glass [...] but if your Ladyship requires another definition, you shall have it'.⁵³ He continues:

By an Idea, then, I mean that image or picture, Madam, which is formed in the mind of any thing which we have seen, or even heard talk of [...] Now when an image is formed in the mind from a view of the object itself, it may be called an adequate or real idea: but when it is conceived in the mind without seeing the object, it is an inadequate or imaginary idea.⁵⁴

Tom's way of looking at the imagination is, it seems, at odds with that of Algarotti. Where *Tom Telescope* is continually updated in order to make the text more realistic, more like a de facto experimental lecture text, Algarotti sets out on an entirely different path. At first, however, he seems to criticise female intellectual weakness in terms that echo Lord Chesterfield,

I have endeavoured to set Truth, accompanied with all that is necessary to demonstrate it, in a pleasing Light, and to render it agreeable to that Sex, which had rather *perceive* than *understand*.⁵⁵

While, as we have seen, *Tom Telescope* is gently edited until it is a text which tells rather than shows, Algarotti is set on demonstration. He does this not through detailed technical descriptions of experimental apparatus, nor through illustrations, but in ways which Percy Bysshe Shelley would have understood. Shelley, in

50 See *Tom Telescope* (1761), B5r; (1798), B5r. See also *Tom Telescope* (1761), E6v; (1798), F5r, where Tom Wilson mentions Blanchard and Jefferies' crossing of the channel by balloon in 1785; *Tom Telescope* (1761), K3v; (1798), L3v, where 'nabob' changes to 'Tippo sahib'. The balloon interjection is also of interest because it does not follow the usual jeering course of Tom Wilson's questions, but is quite reasonable; Tom Wilson too, is growing up.

51 *Tom Telescope* (1798), L1v.

52 *Tom Telescope* (1798), L3v.

53 *Tom Telescope* (1798), L4v.

54 *Tom Telescope* (1798), L4v.

55 *Newton for the Ladies* (1739), I, pp. iv–v. This preface is cut from the 1742 edition.

his *Defence of Poetry*, writing some sixty years after Algarotti, theorises what Algarotti enacts:

All things exist as they are perceived: at least in relation to the percipient. "The mind is its own place, and of itself can make a heaven of hell, a hell of heaven." But poetry defeats the curse which binds us to be subjected to the accident of surrounding impressions. And whether it spreads its own figured curtain, or withdraws life's dark veil from before the scene of things, it equally creates for us a being within our being.⁵⁶

Shelley had begun his *Defence* considering the difference between reason and imagination, asserting that the imagination was the greater of the two faculties:

According to one mode of regarding those two classes of mental action which are called reason and imagination, the former may be considered as mind contemplating the relations borne by one thought to another, however produced; and the latter, as mind acting upon those thoughts so as to colour them with its own light, and composing from them, as from elements, other thoughts, each containing within itself the principle of its own integrity. The one is the *to poiein*, or the principle of synthesis, and has for its objects those forms which are common to universal nature and existence itself; the other is the *to logozein*, or principle of analysis, and its action regards the relations of things simply as relations [...] reason respects the differences, imagination the similitudes of things.⁵⁷

It was from the imagination that poetry sprung: 'Poetry', he wrote, 'may be defined as "the expression of the imagination"'.⁵⁸ Shelley's ideas are similar to those of Coleridge, whose *Biographia literata* of 1817 contained a more direct assertion of the power of the imagination:

The imagination the I consider either as primary or secondary. The primary imagination I hold to be the living power and prime agent of all human perception, and as a repetition in the finite mind of the eternal act of creation in the infinite I AM.⁵⁹

Where *Tom Telescope* uses an increasingly utilitarian style to reproduce the sensation of witnessing an experiment, relying on the reason of the reader for its effect, Algarotti specifically targets the imaginative faculty. As he has already pointed out, the imagination is stronger in women than reason, and it is because of this that the marchioness, in a crucial passage of *Newton For Ladies*, wants to see a crucial experiment, not to hear about one.

Just as Shelley equates poetry with truth, so Algarotti is demonstrating truth through the use of the imagination. According to Massimo Mazzotti 'the character of the marchioness functioned as a rhetorical device to naturalise the representation of certain attitudes and inclinations as specifically feminine', and that 'against this background of feminine deficiencies, the cognitive and moral virtues of the Newtonian philosopher became all the more apparent'.⁶⁰ Mazzotti only tells half of the story, however, as Algarotti accommodates this 'feminine deficiency', the

56 Percy Bysshe Shelley, *A Defence of Poetry* (1820) in *Romanticism: An Anthology*, ed. by Duncan Wu, 3rd edn (Malden: Blackwell, 2006), p. 1197.

57 *A Defence of Poetry*, p. 1184.

58 *A Defence of Poetry*, p. 1185.

59 Samuel Taylor Coleridge, *Biographia literata* (1817), in *Romanticism*, p. 1691.

60 Mazzotti, intro, p. 7.

chevalier manipulating the marchioness's superior imaginative faculty to re-create in her, and thus in the imaginations of the female readers of his work, the sensation of actually witnessing an experimental demonstration. The chevalier criticises merely the over-active use of the imagination, citing Descartes as an example,⁶¹ suggesting that he follows Fenelon in believing that it can be used to elicit positive results, as 'everything that reioyces or enlivens the Imagination, facilitates Study'.⁶² While the marchioness is keen to move from 'consequences and Verses' to 'Evidence and Explications',⁶³ this evidence is witnessed within her imagination, a feature of the text accentuated by the changes made to the 1742 'edition'.

Instead of presenting an educator who explicitly performs experiments for his textual audience in the manner of *Tom Telescope*, Algarotti works with what are effectively thought experiments, thought experiments for the benefit of a marchioness who explicitly states her ignorance of mathematics:

I must ingenuously confess, said the Marchioness, that though I have always regarded the Mathematicians with a singular Veneration, I do not yet understand what their Demonstrations are. However familiar they may at present be rendered, I do not comprehend them enough to find the solution of a Problem among the Patch-Boxes and Perfumes on my toilette.⁶⁴

While the Countess of Twilight leads the children to the Marquis of Setstar's observatory 'that they might have the use of proper instruments,' Algarotti's narrator proposes a different mode of demonstration: he asks the marchioness to construct an experimental laboratory in her imagination.

The textual changes of the 1742 edition are similar in effect to those made to *Tom Telescope* in that they present a subtly different marchioness, a marchioness who is more than a simple recipient of the chevalier's knowledge, a significant change from the 1739 translation: 'She is permitted the occasional interjection, such as "I see," said the marchioness, interrupting me,' while the narrator is teaching her. The 1742 edition is still a text that teaches Newtonian natural philosophy but the marchioness's response to the same prompt is "Hold, hold, dear sir!" said the marchioness, disappointing me'.⁶⁵

Within the text, Newton is spoken of in reverential tones as the Chevalier works towards the book's climax, the presentation of the *Experimentum crucis*, 'the very Thing necessary to prove not only the different refrangibility, but every other principle in *Natural Philosophy*'.⁶⁶ The chevalier warms to his task:

Till now you have only been conversant in the several Absurdities of those different Systems, which have successively owed their Rise to the Pride and vain Imagination of some Men, and

61 *Newton for the Ladies* (1739), I, B11v.

62 Fenelon, p. 53.

63 *Newton for the Ladies* (1739), I, B11r.

64 *Newton for the Ladies* (1742), II, C8r.

65 Miller, p. 15.

66 *Newton for the Ladies* (1742), II, C2r.

their Reception to the Credulity of the People. Now *Newton* comes, who brings you Light and Truth, who speaks with Candour.⁶⁷

This subtle apotheosis, accompanied by the commonplace analogy of light and knowledge, works in tandem with Miltonic citation to create the appropriate mind-picture for the marchioness. Having had the Newtonian system explained to her, the marchioness states that she understands 'thoroughly', before demanding:

produce me some Proofs, I long for them [...] at first I inclined to Des Cartes's Opinion, then I fell into that of Malbranche, and now (what with your observation-scheme) I am left without any system at all.⁶⁸

No matter that she *understands*, she still wishes to be *shown*, just as Tom, having described an animal's reliance on air as 'self-evident', and 'needing no explanation' still places the rat in the air pump.⁶⁹ The chevalier replies: 'Madam, the Genius of Observation, depend on it, will soon make you ample Amends for your present chagrin.'⁷⁰ The way in which the chevalier makes the marchioness see demonstrates how much *Newton for the Ladies* differs from *Tom Telescope*'s utilitarian style, and a comparison between the 1739 and 1742 versions makes this all the more apparent. Carter's translation reads thus:

Imagine yourself to be in a Place of *Milton's* visible Darkness, or rather still darker a Place, if you will be absolutely deprived of all Light; and this shall be our Theatre of Reasoning and Observations.⁷¹

The 1742 text reads 'Be pleased to figure to yourself a Chamber entirely dark, a Chamber, in which, as *Milton* says, reigns *Darkness visible*. This shall be our Scene for the Search of Truth.'⁷² This accentuation of Milton, coupled with the removal the word 'reason', intimates that it will be the imagination that is called on to engage with the experiment. The darkened chamber was a familiar Newtonian concept,⁷³ and Newton himself had written on the power of the imagination to create realistic images in the mind's eye:

when the impresion of [Sun symbol] was not too strong upon my eye I could easily imagine severall shapes as if I saw them in the [Sun symbol]'s place, whence perhaps may be gathered that the tendere{st} sight argues the clearest fantasie of things visible. & hence something of the nature of madnesse & dreame{s} may be gathered⁷⁴

67 *Newton for the Ladies* (1742), II, B10r.

68 *Newton for the Ladies* (1742), II, B12r.

69 *Tom Telescope* (1798), F2r.

70 *Newton for the Ladies* (1742), II, B12r.

71 *Newton for the Ladies* (1739), II, C1v.

72 *Newton for the Ladies* (1742), II, B12r. Algarotti uses the same phrase in a letter to Lord Hervey in 1739, writing 'figure to yourself, my Lord, skeletons in rags' (Francesco Algarotti, *Letters from Count Algarotti to Lord Hervey*, 2 vols (Dublin: Saunders et al, 1770), I, p. 22).

73 See Newton's *Opticks*, Bk II, pt iv, p. 88.

74 *Questiones quaedam philosophiae*, add ms. 3996, CUL, p. 42.

<<http://www.newtonproject.sussex.ac.uk/view/texts/normalized/THEM00092>> (accessed 28-10-09).

The imagination, it seems, can create the effect of seeing, and Newton connects the phenomenon with dreams, an experience the marchioness understands well:

Philosophy and sound sleep do not agree very well together. My interrupted Dreams have transported me into the Region of optics, where I saw nothing but Prisms, Lenses, Rays differently refracted, coloured Images, in short, all those Experiments, and all the philosophical Apparatus which you described, arose successively in my Imagination like Visions and Fantomes. Whatever Charms these Things may have in themselves, I could never have imagined they would employ my Thoughts so strongly at a Time when it is not very customary to think of Philosophy.⁷⁵

Algarotti draws on this imaginative power in both marchioness and reader, making the marchioness become the room within which Newton carried out his experiments with the prism: the 'genius of observation' is to take place entirely virtually, and verbally.

It is the phrase 'darkness visible' that sets off this imaginative chain of events, conjuring associations in the mind of his readership, who would have recognised phrase, poem and context. *Paradise Lost*, designed that Milton might discover the truth of God's universe, justify the ways of God to men, begins with this poetic rendering of chaos:

A dungeon horrible, on all sides round
as one great furnace flamed, yet from those flames
no light, but rather darkness visible
served only to discover sights of woe⁷⁶

As Shelley realised in *A Defence of Poetry*, Milton's chaos connects thinking and being. When Satan comments that 'The mind is its own place, and in itself / Can make a Heav'n of Hell, a Hell of Heav'n',⁷⁷ in many ways foreshadows Newton's comments on the imagination, as well as reminding the reader of the biblical view of creation appropriated by Pope: 'And God said, Let there be Light: and there was light'.⁷⁸ Milton is clear that the importance of his argument necessitates his creating a new kind of poetry, 'things unattempted yet in prose or rhyme',⁷⁹ inviting the reader to create an internal, poetic world in which his argument can find itself.

It is this passage that fires the marchioness's imagination into transforming herself into a demonstrative stage, a stage of discovery that she will share with the reader. The darkness serves as a place of discovery as Newton, the actual light, and the light of knowledge are simultaneously allowed to enter, literally and figuratively enlightening her, as she imagines the experimental chamber, the light, the prism, the colours of the spectrum, and finally feels the sensation of witnessing Newton's great experiment.

75 Algarotti (1742), II, E2r-v.

76 John Milton, *Paradise Lost*, ed. by John Leonard (Harmondsworth: Penguin, 2000), I, ll. 61-4.

77 *Paradise Lost*, I, ll. 255-56.

78 Genesis, 1.3.

79 *Paradise Lost*, I, l. 16.

The marchioness functions both as her character and as surrogate reader, for as she figures this darkened chamber, so do we – the reader is effectively inserted into the text, and the experiment is thus witnessed, albeit virtually. The marchioness originally requested that she ‘see some Experiment, which cannot possibly be explained by any other System than the *Newtonian*, and that I believe would satisfy me’.⁸⁰ She does not say ‘I want you to tell me about’, but ‘I want to see’, and by telling within the realms of the imagination, what is merely description is made real by the imagination. By *telling* in this specifically poetic fashion, the narrator re-constructs the experiment as surely as the experimental lecturers did, and thus ends up *showing* the experiment.

CONCLUSION

The changing nature of these two texts raises questions concerning their status and purpose. While *Tom Telescope* seems to have been edited in order to accentuate its resemblance to a ‘real’ experimental lecture series, *Newton for the Ladies* seems to have been edited in order to accentuate its poetic nature, a nature designed to conjure images in the imagination of its readers.

While the companion texts of Desaguliers et al were designed either to be read alongside demonstrations, or at least with the memory of a demonstration witnessed fresh in the mind, or to be read independent of the need for these machines, these two fictionalised texts work at conjuring the same powerful images through the use of the imagination in order that their audiences, who seem rarely to have been afforded the honour of witnessing these experimental demonstrations, can recreate, or even create, them within their heads. It may seem superfluous of Algarotti’s narrator to authenticate his own narrative, saying that ‘these effects must happen according to Sir Isaac Newton’s System; and these in reality do happen, as I myself have often had the Pleasure of seeing’,⁸¹ but if the marchioness is acting as a surrogate for the reader, the reader must surely understand that this is the author talking to them.

Both texts explore the complex relationship between writing, the imagination and reality, with Algarotti’s narrator stating that poetry and Natural Philosophy both rely on observation, and observation leads us directly to Newton:

we may affirm then, replied the Marchioness, that as every Thing which *Midas* touched was transformed to Gold, so every Thing that Sir Isaac Newton handled became Demonstration.⁸²

In using poetry, and especially the sublime poetry of Milton, to allow the marchioness to explore the nature of light, Algarotti is also perhaps working alongside the increasingly popular poetic commonplace of the mind launching itself into space, the nocturnes and philosophic poems such as John Hughes’ *The*

⁸⁰ *Newton for the Ladies* (1739), II, C3r–v.

⁸¹ *Newton for the Ladies* (1739), II, B12v.

⁸² *Newton for the Ladies* (1739), II, C8v.

Ecstasy or Samuel Bowden’s *A Poem Sacred to the Memory of Sir Isaac Newton*, which imagined themselves journeying through space, making a metaphor of the search for knowledge.⁸³ Algarotti is certainly foreshadowing Shelley and Coleridge’s later aesthetic discourse in suggesting that poetry is akin to an act of creation, and it is the imagination which drives poetry. By harnessing the imagination, Algarotti negates the need for physical demonstration. *Tom Telescope* uses a different approach, that of increasingly technical description, but with the same end in sight, the re-creation of the experiment in the internal world of the reader through specific narrative strategies. The two texts differ in one simple but vitally important regard: *Tom Telescope* is designed to appeal to an audience which, as it grows, progressively acquires reason, and thus as it evolves as a text, it increasingly calls on the audience to engage their reason; *Newton for the Ladies*, on the other hand, appeals solely, and increasingly, to the audience’s imagination. In both texts, however, the use of the internal audience, the audience within the narrative with which the reader identifies, means that the reader is in one sense left reading writing about learning by doing, and in another, very real sense, experiencing the experiments for themselves.

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⁸³ My thanks to Prof Annie Janowitz for this suggestion. See also William Powell Jones, ‘Newton Further Demands the Muse’, *Studies in English Literature, 1500–1900*, 3 (1963): 287–306.

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