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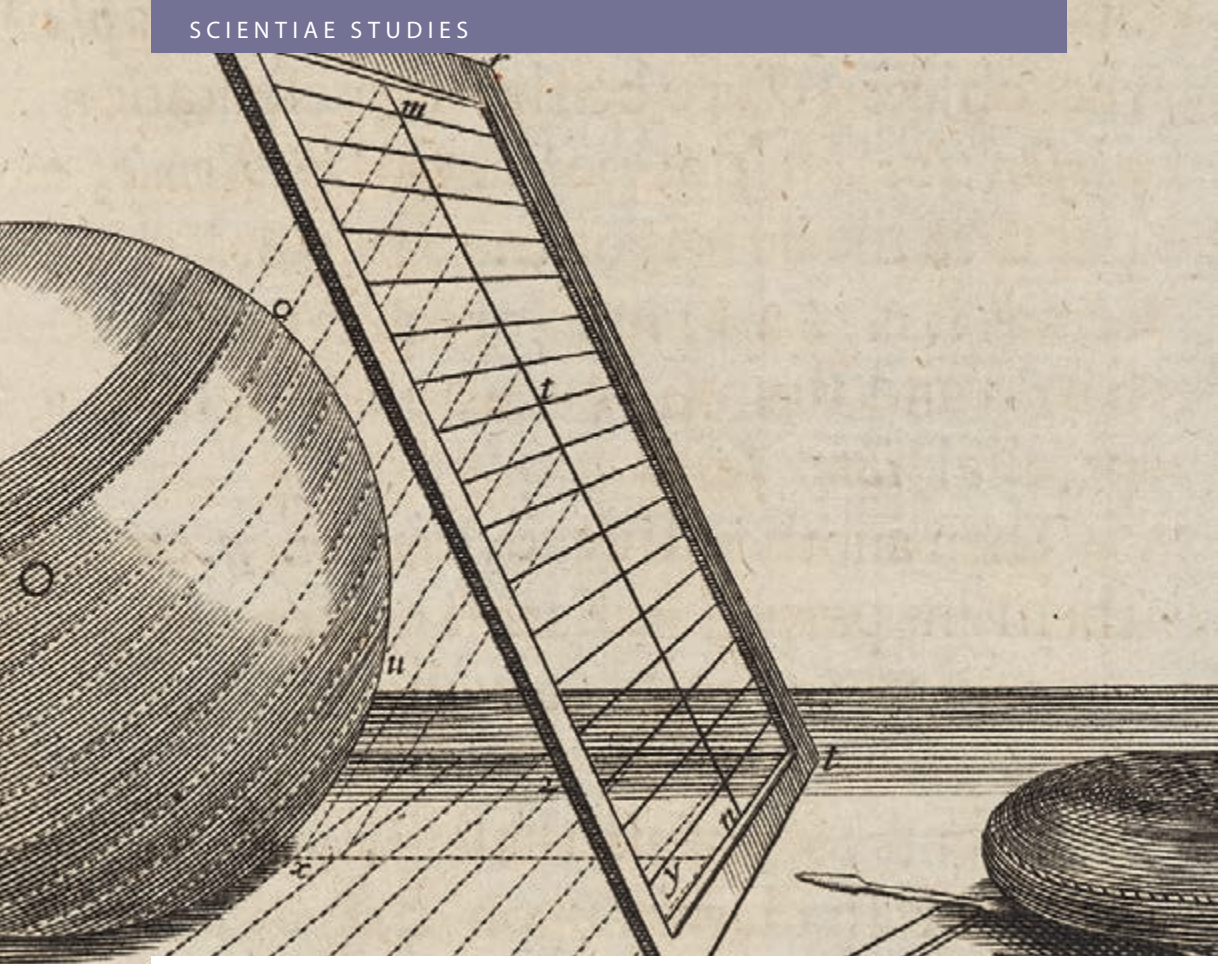

Meghan C. Doherty

Engraving Accuracy in Early Modern England

Visual Communication and the Royal Society

Amsterdam University Press

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Visual Communication and the Royal Society

Meghan C. Doherty

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Introduction

Accuracy is not a characteristic that is innate in an image. It does not simply reside there, perfect and unchanging. Instead it is made. Made by hand. Made by a person. In the case of early modern scientific illustrations, it was often made with a burin. The engraver used a burin to carve lines into a prepared copper plate. These lines were then inked and printed onto dampened paper. As the paper moved through the press, the rollers pressed the damp paper into the carved lines. The ink was soaked up into the paper and an intaglio print was made. Whether accuracy was achieved depended on many variables: who made it, how he made it, where it appeared, how the surrounding text described it, what other images the viewer had seen. These variables could be controlled and needed to be to produce the effect of accuracy.

Early modern scholars and artisans worked together and separately to preclude the introduction of errors at every step. This is not to say that all the images then looked the same. On the contrary, accuracy implied careful methods of production, not visual consistency across instances of representation. Accuracy was constructed through a series of decisions by the author/artist and perceived by the reader through a series of judgments based on a reader's experience of the world, an image's relationship to other images, and the text accompanying it. The perception of an image's accuracy was the product of participation in a shared visual culture. Visual training was a precursor to the mutual acceptance of the accuracy of images. This training operated across a range of disciplines and through an unrecognized, but significant genealogy of image makers, consumers, and contexts. To understand how accuracy developed as a desired trait in an image, this book examines intaglio printed images produced by and for the Fellows of the Royal Society of London from 1660 to 1680.

"Claiming the Resemblance of Life"

Founded in 1660 for the promotion of experimental learning, the Royal Society brought together like-minded individuals intent on gaining a better

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understanding of nature through the collection of observations and the production of experiments.[1] Fellows published the results of their experiments and observations both in single-author works and in the *Philosophical Transactions*, which in this period were the unofficial corporate record of their activities. These books and journal articles included intaglio printed images to aid in the transmission of knowledge to a broad audience. Engravers were hired to carve a visual record of these experiments and observations into copper plates to create printed images that could circulate widely.

Engraving Accuracy investigates artists' manuals alongside scientific treatises to probe how accuracy was produced and, subsequently, how images could be useful for early modern natural historians and natural philosophers. Manuals for learning to draw and engrave are analyzed alongside a history of engraving to set the groundwork for understanding how images were made and, more importantly, how careful actions were stressed as necessary precursors to successful image-making, which builds on the increased scholarly attention to printmaking processes.[2] Not only were prints crucial for circulating discoveries, but they also underpinned the drawing practices of Fellows as they would have learned to draw by studying printed images. The eye of the would-be draftsman had to be trained first to recognize a good image before embarking on making new images.

The development of judgment then was necessary for the communication of knowledge. By focusing on the move from an apprenticeship model to one based on self-education through print culture, this book builds on Pamela Smith's work which stressed the importance of physical experience in learning about nature.[3] It also builds on the work done by Susan Dackerman and her emphasis on prints as "tools or guides" as opposed to sources that were used "exclusively for predetermined facts."[4] Studying the images included in Robert Hooke's *Micrographia* (1665), Francis Willughby's *Ornithology* (1676), and the articles published in the *Philosophical Transactions* from 1665 to 1678 allows me to trace the myriad ways in which print intersected with the research agenda set by the Royal Society. Although two of the three texts chosen have single authors associated with them, the publication of both *Micrographia* and *Ornithology* were entwined with the activities of the Society as a whole.[5]

1 This phrase is taken from the title of Marie Boas Hall's book; she in turn takes it from the statutes of the Royal Society. Hall, *Promoting Experimental Learning*.

2 See for example: Stinjman, *Engraving and Etching* and Griffiths, *Print Before Photography*.

3 Smith, *Body of the Artisan*.

4 Dackerman, *Prints and the Pursuit of Knowledge*, 32.

5 As Sachiko Kusukawa has shown the only truly Society sponsored book from this time period was Francis Willughby's *Historia Piscium*. Kusukawa, "*Historia Piscium*," 179–197.

From its founding, the Royal Society worked to improve the state of knowledge about the natural world through experiment and observation. The Fellows of the Royal Society broke with past reliance on ancient opinions regarding the workings of nature and instead relied on their own experiences.[6] As Thomas Sprat wrote in his *History of the Royal Society* (1667):

> I shall lay it down, as their *Fundamental Law*, that whenever they could possibly get to *handle* the subject, the *Experiment* was still perform'd by some of the *Members* themselves. The want of this *exactness*, has very much diminish'd the credit of former *Naturalists*.[7]

Profession of this "Fundamental Law" set the Royal Society apart from scholars entrenched in the university system at the time and from many earlier naturalists, who as Sprat noted lacked the same commitment to "exactness."[8] Even if Sprat's *History* is more polemical than factual, this passage lays out the importance of ocular verification for the early Fellows.

One approach Fellows took to improve their own visual education was the active pursuit of a history of trades, which was based on Francis Bacon's call for improved methods of history in his *Advancement of Learning*.[9] In 1668 John Evelyn (1620–1706), a founding Fellow, published a translation of Roland Fréart's *Idée de la Perfection de la Peinture*, as part of the Society's larger project to create a history of trades.[10] The review of Evelyn's translation of Fréart's text in the *Philosophical Transactions*, in addition to giving an account of the book, encouraged readers to learn to draw, paint, and engrave for themselves stating that the book "will doubtless animate many among

6 Purver, *Royal Society*, esp. chap. 3, "A New System of Natural Philosophy II, The Royal Society." The literature on the place of experiment in the workings of the Royal Society is extensive. A few major titles include: Hall, *Promoting Experimental Learning*; Shapin and Schaffer, *Leviathan and the Air-Pump*; and Hunter, *Establishing the New Science*.

7 Sprat, *History of the Royal Society*, 83.

8 Purver notes that it should come as no surprise that the men who would eventually found the Royal Society began meeting at the University of Oxford and worked to enact reform from within the university system as this was the seat of the most concerted resistance to change. Purver, *Royal Society*, 63.

9 For an early account of the history of trades program see: Houghton, "The History of Trades," 33–60. For a more updated account see: Ochs, "The Royal Society," 129–158.

10 For Evelyn's participation in the history of trades programs, see: Hanson, *English Virtuoso*, 75–80. Evelyn, *Idea of the Perfection of Painting*. Evelyn made other contributions to the history of trades as well, for example: Evelyn, "A Letter…Concerning the Spanish Sembrador," 1055–1065; Evelyn, *Sculptura*; Evelyn, *Parallel of the Antient Architecture*. Sachiko Kusukawa has also discussed Evelyn's work on the Society's history of trades program: Kusukawa, "Early Royal Society," 360.

us to acquire a perfection in Pictures, Draughts and Chalcography, equal to our growth in all sorts of Optical Aydes, and to the fullness of our modern Discoveries."[11] The reviewer saw the study of artistic practices as a necessary adjunct to new discoveries. The study of art was put on a par with the use of telescopes, microscopes, and other optical instruments used in the study of nature. The importance of image making for the pursuits of Fellows of the Royal Society was stressed as the reviewer wondered: "what Art can be more helpful or more pleasing to a Philosophical Traveller, an Architect, and every ingenious Mechanician? All which must be lame without it."[12] The myriad lines of inquiry pursued by the Fellows were enhanced by a simultaneous attention to art. Within its role at the center of print production and the underlying emergence of accuracy that I trace in these pages, I argue that the engraver's burin, or graver, should be considered among the pantheon of instruments that fundamentally changed how nature was studied and subsequently understood in the seventeenth century.

Painting and sculpture were positioned as "the politest and noblest of Antient Arts, true, ingenuous, and claiming the Resemblance of Life, the Emulation of all Beauties, the fairest Records of all Appearances, Divine or Humane."[13] Yet, "claiming the Resemblance of Life" was not a simple task, nor is it clear from this passage what "resemblance" precisely meant. True and ingenuous hardly seem like synonyms. Are we to understand the truth-value of images to be based on the notion of their innocence and frankness? Or on their nobility and ties to the liberal arts?[14] This lack of guile and plenitude of honesty should immediately be called into question. In this period, ingenuous could also mean witty or cunning and "associations with dissimulation were always lurking beneath the surface."[15] Even if we accept the possibility that an image could be an unbiased "record of all Appearances," resemblance and emulation imply a gap between reality and representation. It is this gap in the mimetic functions of these images and others like them that this book explores. This gap is a productive space for

11 "Chalcography" was used in the period to refer specifically to engraving on copper plates, as in the title of Evelyn's history of engraving. *Oxford English Dictionary*, s.v. "Chalcography." "Account of Some Books," 785.

12 "Account of Some Books," 785.

13 "Account of Some Books," 785.

14 Although the *Oxford English Dictionary* states at the end of the entry for ingenuous that in the seventeenth century it was often misused in place of ingenious, the sources given in the *Oxford English Dictionary* for definition 2b of "ingenuous" ("Of animals or things: Of high or excellent quality or character; 'noble'.") are taken from the writing of John Evelyn.

15 Marr, et al., *Logodaedalus*, 213.

investigating what it meant to produce the effect of accuracy, and, further, how accuracy was read and used in the context of the early Royal Society of London.

"The Best in the World in this kind"

As has been shown by Pamela Smith and the authors involved in Lissa Robert's *The Mindful Hand* essay collection, to name but a few, scholars and artisans worked together to produce knowledge about the natural world.[16] *Engraving Accuracy* examines how these connections in Restoration London established protocols by which scholars and artisans could agree on the accuracy of an image. To explore the conditions in which producing images led to contrasting versions of accuracy in this period, I begin with two engravings by William Faithorne, a sought-after London engraver. The first is a portrait of Barbara Villiers, Lady Castemaine, and the second is the first plate in Samuel Collins' *A Systeme of Anatomy, Treating of the Body of Man, Beasts, Birds, Fish, Insects and Plants*.[17] (Fig. I.1 and I.2) Examining them together shows how the viewer's perception of technical skill and resemblance to life converged to create a concept of accuracy in scientific images for the Fellows of the Royal Society during its first thirty years, 1660–1690. The production of accuracy depended on the work of the hands and eyes of natural philosophers and engravers. This pair of images exemplify the rich visual culture of Restoration London and highlight the deep web of connections between artisans and natural philosophers that this book examines.

William Faithorne's portrait of Barbara Villiers, Lady Castlemaine, published in 1666, exemplifies the part of his oeuvre that is best known and written about most frequently.[18] Villiers was King Charles II's mistress beginning in 1660 soon after his return to London with his Restoration to the throne and ending roughly in 1672 with her displacement in favor of Louise de Kéroualle, Duchess of Portsmouth.[19] This engraving appeared

16 Smith, *Body of the Artisan* and Roberts, *The Mindful Hand*.

17 The spelling and punctuation of the primary sources have been maintained throughout. Unless otherwise noted, the italics are in the original.

18 For biographical information on Faithorne see: Griffiths, "Faithorne, William,"; Walpole, *Catalogue of Engravers*, 106–128; Godfrey, "William Faithorne," 208–213; Alexander, "Faithorne, Loggan Vandrebanc and White," 297–316. For a discussion of Faithorne's drawings see: Sloan, "Sir Hans Sloane's Pictures," 381–415.

19 MacLeod and Alexander, *Painted Ladies*, 116.

Figure I.1: William Faithorne, *Portrait of Barbara Villiers*, Engraving, 1666. Chazen Museum of Art, University of Wisconsin-Madison, Gift of Herbert Sewell, 1983.47.

on the London market at the height of Villiers's favor with the King and of the public's interest in her. Faithorne modeled his portrait on a painting by Sir Peter Lely of her as the penitent Magdalen.[20] This attribution was

20 Multiple copies of this painting exist, but Julia Marciari Alexander in her catalogue entry argues for the version now in the collection of the National Trust at Knole as the original and dates it to ca. 1662 (inv. no. 129855). MacLeod and Alexander, *Painted Ladies*, cat. no. 33, 118.

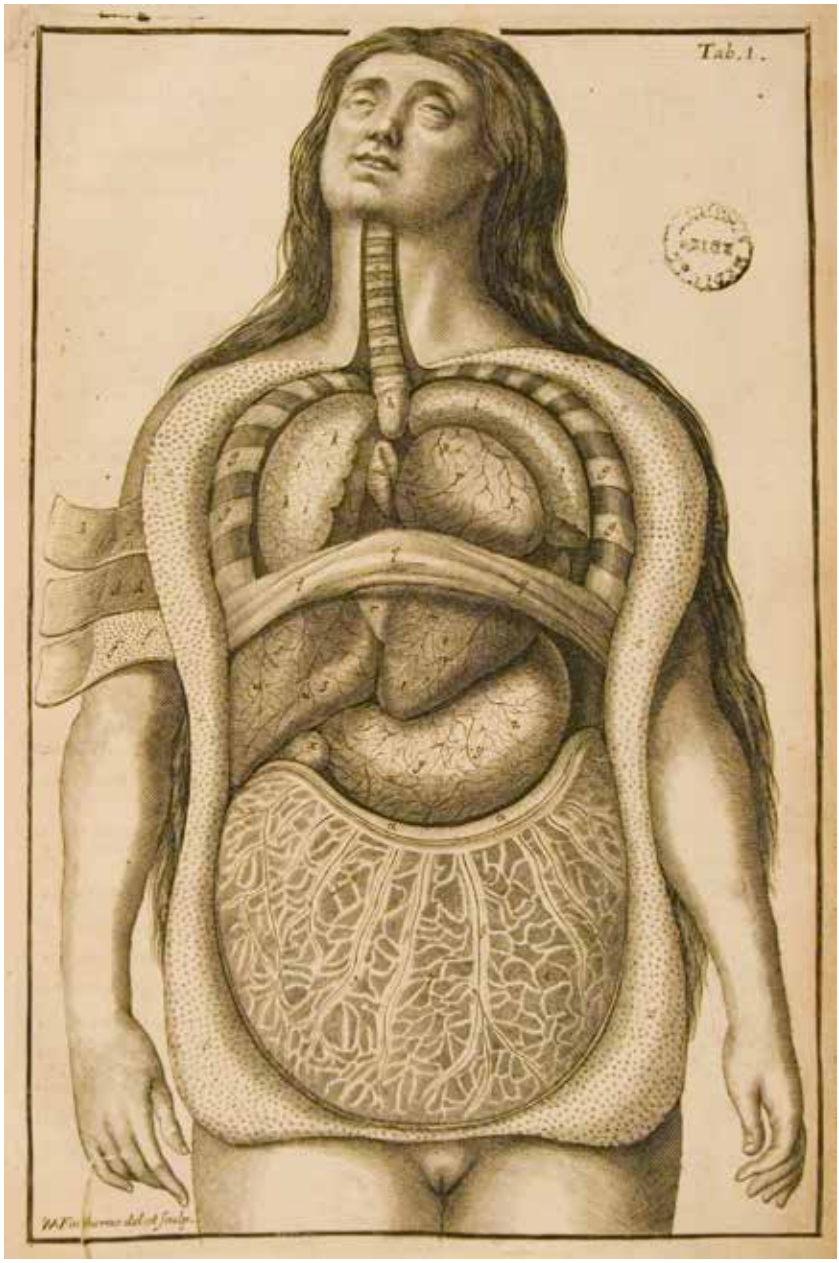

Figure I.2: William Faithorne, *A Human Body Opened*, Tab. 1. 2nd volume, Engraving, from Samuel Collins, *A Systeme of Anatomy, Treating of the Body of Man, Beasts, Birds, Fish, Insects and Plants*, 2 volumes (London: Printed by Thomas Newcomb, 1685). Courtesy of Ebling Library's Rare Books & Special Collections, University of Wisconsin-Madison, Historical Vault Oversize WZ 250 C713S 1685.

not, however, one that Faithorne made publicly. Unlike portraits where he clearly acknowledged his sources or others where he noted the piece was done from his own drawing of the sitter, in this one he maintained silence on its source.[21]

Faithorne was quite capable of capturing her luminous beauty by rendering the softness of her skin and the delicacy of her features with his burin. Lady Castlemaine gazes idly out at the viewer, acknowledging the viewer's presence without staring intently. She delicately rests her head on her graceful hand allowing the light to fall gently on her cheek and highlight the luster of her large pearl earring. Faithorne closely attended to every detail of her head: her eyelashes, the curve of her eyebrows, the plumpness of her lips, the ripples of her hair as it cascades down her shoulder and the overall smoothness of her skin. Her elegant costume is also rendered with great skill as the gemstones and pearls compete with the lustrous fabric for the viewer's attention. These minute details add up to a recognizable portrait of a renowned beauty even though Faithorne was working from another's painting, not his own observations of Lady Castlemaine.

Faithorne brought this same attention to the portraits he produced based on his own drawings of the sitter as, for instance, in his portrait of Robert Boyle.[22] (Fig. I.3) Boyle's hair gently flows over his shoulder and the lustrous drapery behind him glistens as the light hits it. Setting aside the generic difference between a portrait of a court beauty and a learned author, both portraits capture the details of the sitters' bodies and the material objects which signify their status. Boyle was not alone among the Fellows of the Royal Society to have his portrait drawn and engraved by Faithorne.[23] Many of the portraits he drew of Fellows became the frontispieces to their

21 For example, his portrait of John Ogilvy bears the text "P. Lilly Pinxit." An image of the Ogilvy portrait is available on the website of the National Gallery of Art, Washington, D.C., Ailsa Mellon Bruce Fund, 1974.116.16.

22 Bell and Poole list twenty-seven portraits that Faithorne signed "*ad vivum*." This list consists of "the signed and dated or named drawings and the engravings, where these are described as '*ad vivum*' or after originals by" Faithorne. Bell and Poole, "English Seventeenth-Century Portrait Drawings," 52–54. Faithorne's drawing of Boyle is in the collection of the Ashmolean Museum.

23 Faithorne is known to have drawn portraits from life of nine Fellows of the Royal Society. The Fellows who sat for Faithorne are: John Aubrey, Robert Boyle, Edmund Castell, Francis Glisson, Edmond King, Charles Leigh, Henry More, John Ray, and John Wallis. This list is based on Bell and Poole's list of portraits that were done from life. Bell and Poole, "English Seventeenth-Century Portrait Drawings," 53–54. Their list has been cross-referenced with the Royal Society's online database of Fellows.

Figure I.3: William Faithorne, *Portrait of Robert Boyle*, Graphite on vellum, probably 1659–1665. ©Ashmolean Museum, WA.Suth.B.2.676.31.

books attesting to the value they placed on having a likeness of themselves prefaced to their published thoughts.[24]

Faithorne's ability to create a likeness of Barbara Villiers was noted in the period. Samuel Pepys, a Fellow of the Royal Society, wrote in his diary about seeing Faithorne's version of Lely's portrait and being compelled

24 See for instance Faithorne's portrait of John Ray, which was engraved by William Elder and used as the frontispiece for his *Synopsis Methodica* (*1693*), *Stirpium Europearum* [. . .] *Sylloge* (*1694*), *Wisdom of God* (*1701*), *and Three Discourses* (*1732*). The drawing for it is in the collection of the British Museum (Registration ID 1994, U.5). Croft-Murray and Paul Hulton, *Catalogue of British Drawings*, vol. 1 (London: The British Museum, 1960), 315–316.

to buy multiple copies. On December 1, 1666, Pepys was at Faithorne's "buying three of my Lady Castlemaynes heads, printed this day; which endeed is, as to the head, I think a very fine picture, and like her."[25] Pepys judged the value of the print by the similarity between the head as depicted in the engraving and as he knew the painting and the woman in life.[26] An avid collector of prints, Pepys amassed a huge collection during his lifetime, which included nearly 2,000 portrait prints.[27] This passage shows that he appreciated the image as both the work of a renowned artist and as a record of a lady's beauty.

Pepys was so taken by Faithorne's version of Lely's portrait that he attempted to buy the preparatory drawing a month before buying three copies of the print.[28] He recorded this visit to Faithorne's shop in his *Diary* and noted his preference for the "red chalke and other colours" that Faithorne used in creating his drawing after Lely's painting. However, Faithorne refused to sell the drawing as he needed to "keep it awhile to correct his Copper plate by," highlighting how the usefulness of the drawing to the process of creating a likeness outweighed the immediate rewards of selling his drawing.[29] Making the drawing served not simply as an intermediate step in the process, but also as a record of the painting against which Faithorne could "correct" his engraving. This note in Pepys's *Diary* shows that Faithorne took a great deal of care in creating an engraving and that a likeness could only be produced through a careful process of correction. Accuracy in this instance was constructed through skillful and careful actions.

As well as creating an image that resembled Lady Castlemaine, Faithorne was also capable of creating images that were useful to the communication of natural knowledge in the period. A physician looking to record a different type of likeness valued Faithorne's attention to careful working practices. In 1685 Samuel Collins, a noted anatomist and physician, published *A Systeme of Anatomy, Treating of the Body of*

25 *Diary of Samuel Pepys*, vol. 7, 393 (1 December 1666).

26 Pepys had seen Lely's original painting and vowed "I must have a copy." *Diary of Samuel Pepys*, vol. 3, 230 (20 October 1662). Pepys also saw Lady Castlemaine in the flesh in London in July 1660. MacLeod and Alexander go so far as to say that Pepys's "personal obsession with her bordered on the irrational." MacLeod and Alexander, *Painted Ladies*, 116. Among many other instances, Pepys records sitting near her at the theater. In this passage, he refers to her by her married name, Palmer: "...we seated ourselfs close by the King and Duke of Yorke and Madam Palmer (which was great content; and endeed, I can never enough admire her beauty)." *Diary of Samuel Pepys*, vol. 1, 174 (7 September 1661).

27 Latham, "Forward by the General Editor," ix.

28 *Diary of Samuel Pepys*, vol. 7, 359 (7 November 1666).

29 *Diary of Samuel Pepys*, vol. 7, 359 (7 November 1666).

Man, Beasts, Birds, Fish, Insects and Plants. Collins was physician to King Charles II and his *Systeme of Anatomy* was dedicated to Charles' successor, James II.[30] *A Systeme of Anatomy* stretches to 1,263 pages of text and was the product of many years of dissections of the full range of bodies listed in the title.

Beginning on the title page the importance of images to Collins' project is clear, the presence of the plates is noted immediately following the title of the work as the sub-title stated the book was "Illustrated with many Schemes."[31] The word "schemes," which in the period was used as a synonym for figure or plate, is printed in red with all capital letters.[32] These seventy-four plates are further described as "Consisting of Variety of Elegant Figures, drawn from the Life," and are collected at the end of the second volume of the book with their own dedication and preface. In the "Preface to the Tables," Collins stressed the "Care and Fidelity" he had taken in performing the dissections shown in the plates and established his own credentials as a capable anatomist.[33] After narrating his decision to make his private dissections public, Collins was not shy about heralding the qualifications of his choice of engraver; Faithorne was described as "an Excellent Artificer (if not the Best in the World in this kind)."[34] These qualifiers served both to honor Faithorne's work and to highlight Collins' good judgment. Many of the drawings made by Faithorne and used by him to produce the plates show clear signs of having been used for the engraving process as the outlines have been incised.[35] The seventy-four plates that Faithorne engraved for Collins were not based on someone else's design, like his portrait of Lady Castlemaine; rather they were based on Faithorne's own witnessing of Collins' dissections and were "Designed from the Life."[36]

Collins' "Preface to the Tables" set up his credentials and those of his artist and stressed that Faithorne was present at the dissections that he represented in print. As Steven Shapin and Simon Schaffer have shown in their work on the controversy between Robert Boyle and Thomas Hobbes, it

30 Cooper, "Collins, Samuel."

31 Collins, *Systeme of Anatomy*, title page.

32 Collins, *Systeme of Anatomy*, title page.

33 Collins, *Systeme of Anatomy*, "The Preface to the Tables," Sig ¶[1]1.

34 Collins, *Systeme of Anatomy*, "The Preface to the Tables," Sig ¶[1]1.

35 These drawings are preserved in the British Library as part of Add. MS 5260. The drawings are all laid down in an album so their versos cannot be examined to determine if chalk was applied to aid in the transfer process. However, the lines have been incised in the following folios: 1–12, 15–16, 18, 29, 32, 40, 45, 48, 50, 52–53, 75.

36 Collins, *Systeme of Anatomy*, "The Preface to the Tables," Sig ¶[1]1.

was not necessary to have many witnesses for the results of an experiment to be accepted; there just had to be a few credible witnesses.[37] Credibility in this instance is not only something gentlemen possess, but also artisans. Collins' reporting of Faithorne's presence at the dissections worked to add authority to Faithorne's engravings and to close the distance between line and life. This closeness, as was the case in the portrait of Lady Castlemaine, derived from Faithorne's working practices.

Looking at the first plate in *A Systeme of Anatomy* reveals a dramatic contrast with the portrait Lady Castlemaine. (Figure I.2) This plate depicts a woman with her torso opened to reveal her internal organs. In the lower left corner, Faithorne has signed the plate "W. Faithorne del: et sculp." indicating that he both drew the design for the plate and engraved it. Although this plate was not signed *ad vivum*, we are led to believe that Faithorne was working from his own observations of Collins' dissections based on Collins' assertion in the "Preface to the Tables" that Faithorne worked "from the Life." This was not the only instance of Faithorne being present at a dissection. Faithorne was noted as attending dissections of a rattlesnake by Edward Tyson at the Royal Society around this same time.[38] Edward Tyson was very involved in Collins' project as well as the dissections at the Royal Society.[39] Furthermore, an article in the December 1685 issue of the *Philosophical Transactions* by John Brown begins with a description of the image of a dissected liver "as it was accurately taken by Mr Faithorn [*sic*]."[40] The accuracy of Faithorne's drawing was based on his attendance at the dissection and the approbation of the other witnesses mentioned in the article, William Dawkins, William Briggs, and Edward Tyson, all of whom were Fellows of the College of Physicians.[41] The viewer of Collins's book is then led to assume that Faithorne brought the same careful hand and eye he used to create his celebrated portraits to his anatomical drawings and engravings.

The marked visual differences in these two images of women are not due to some lack of ability on Faithorne's part to render the human body but, rather, result precisely from his careful working habits and close observations of his objects of study. That is, the grey pallor of the woman and her oddly

37 Shapin and Schaffer, *Leviathan and the Air-Pump*, 55–60.

38 The account of Tyson's dissection was published in the *Philosophical Transactions*. Tyson, "Vipera Caudi-Sona Americana," 25–58.

39 Birch, *History of the Royal Society*, vol. 4, 176. Kim Sloan discusses these drawings in: Sloan, "Sir Hans Sloane's Pictures," 412.

40 Brown, "Remarkable Account," 1266.

41 Brown, "Remarkable Account," 1267.

elongated neck are not distorted renderings of a court beauty; they instead represent the face of a dead woman who was likely hanged before being dissected.[42] In contrast to Lady Castlemaine's lustrous skin and bright eyes, the tone of this anonymous woman's skin is built up with short, overlapping stokes that give her a greyish pallor. Her eyes roll back slightly in their sockets and look upward in an unfocused manner. The deep bags under her eyes are highlighted by the angle at which her head sits. Faithorne was not using the same conventions to depict these two female bodies.

These conventions were both situational and formal: situational in that wealthy women were often accompanied by visual indicators of their status, such as the lustrous fabrics and jewels that adorn Lady Castlemaine. The formal differences between these two images of women extend beyond their very different compositions. The lines Faithorne used to indicate the texture of Lady Castlemaine's skin are long and flowing, whereas those delineating the tone of the cadaver's skin are coarser and her face is more heavily shaded. Faithorne's careful working habits yielded very different images. Both were understood by their audiences to achieve the effect of accuracy. Scholars and artisans worked to meet the expectations of their readers/viewers by creating images that acknowledged the audience's shared experiences of the three-dimensional world being portrayed with the engraved line.

Faithorne's cadaver looks neither like his portrait of Lady Castelmaine, nor like previously published anatomical images. What sets it apart is an attention to conforming to the shared experiences of the artist and the reader. Andreas Vesalius's images of dissected women in his *De Humani Corporis Fabrica* did not resemble recently hanged humans. (Fig. I.4) Instead the dissected anatomy of a woman was placed into the torso of a classical statue. Although Vesalius's anatomical investigations greatly improved scholars' understandings of the inner workings of the human body, the images of female bodies were not showing anatomists what they might expect to see while dissecting.[43] What Vesalius' plates provided were fantasies: headless, armless, legless torsos were containers for representations of

42 By the end of the seventeenth century, there was a long-standing precedent for using the bodies of condemned criminals for anatomical dissections, as this was common practice as early as 1300. Andreas Vesalius tells his readers that the dissected woman described in his book, *De Humani Corposis Fabrica*, was a criminal and that she had been hanged. For an in-depth discussion of Vesalius's dissection see, Park, *Secrets of Women*, 207–215. In the case of England, Ruth Richardson writes, "Since Henry VIII's time, the sole legal source for corpses for dissections had been the gallows." Richardson, *Death, Dissection, and the Destitute*, xv.

43 For an analysis of Vesalius's use of images see: Kusukawa, *Picturing the Book of Nature*.

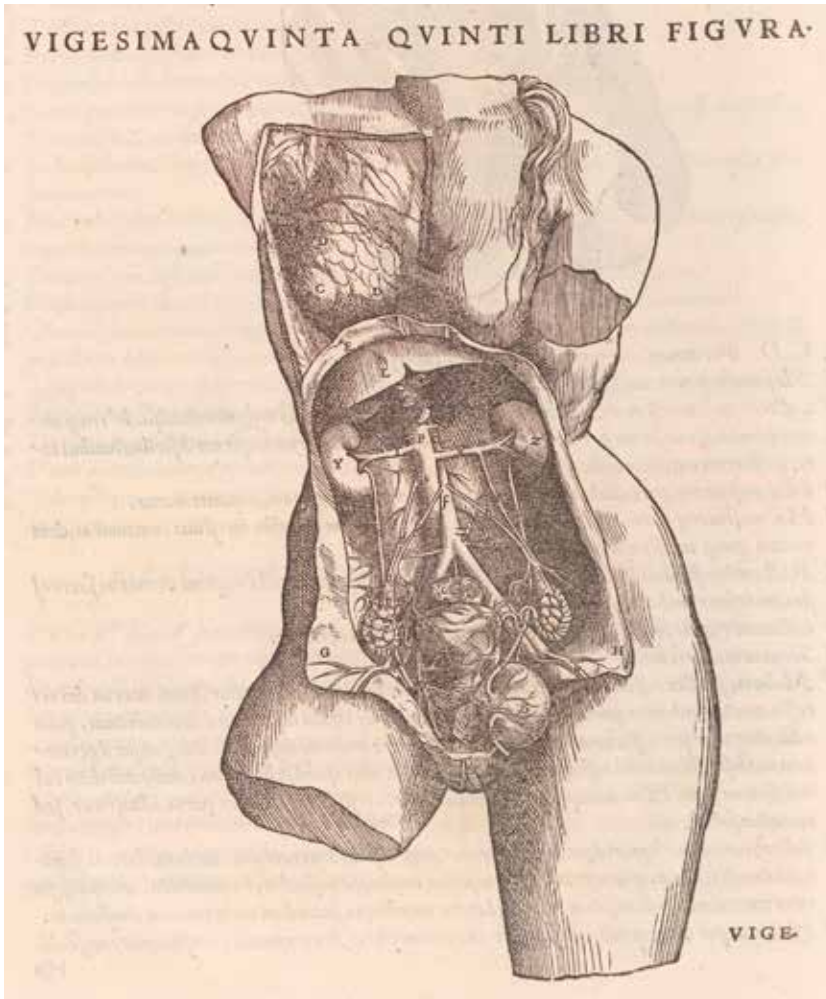

Figure I.4: Jan Stephan van Calcar, *Anatomy of Female Torso*, page 478, Woodcut, from Andreas Vesalius, *De Humani Corporis Fabrica* (Basel: Oporinus, 1543). Basel University Library via e-rara.ch.

internal organs, not dissected bodies. While Faithorne's image of a female cadaver was clearly edited to clarify the relationship of the internal organs to one another, the body that contains them more closely resembles what an anatomist might expect to find lying on the table before him.

At the beginning of the seventeenth century, Guilio Casseri (1552–1616) published his comparative study of the sensory organs and the parts of the body being dissected now appear connected to actual heads.[44] (Fig. I.5)

44 Casseri, *Pentaestheseion*.

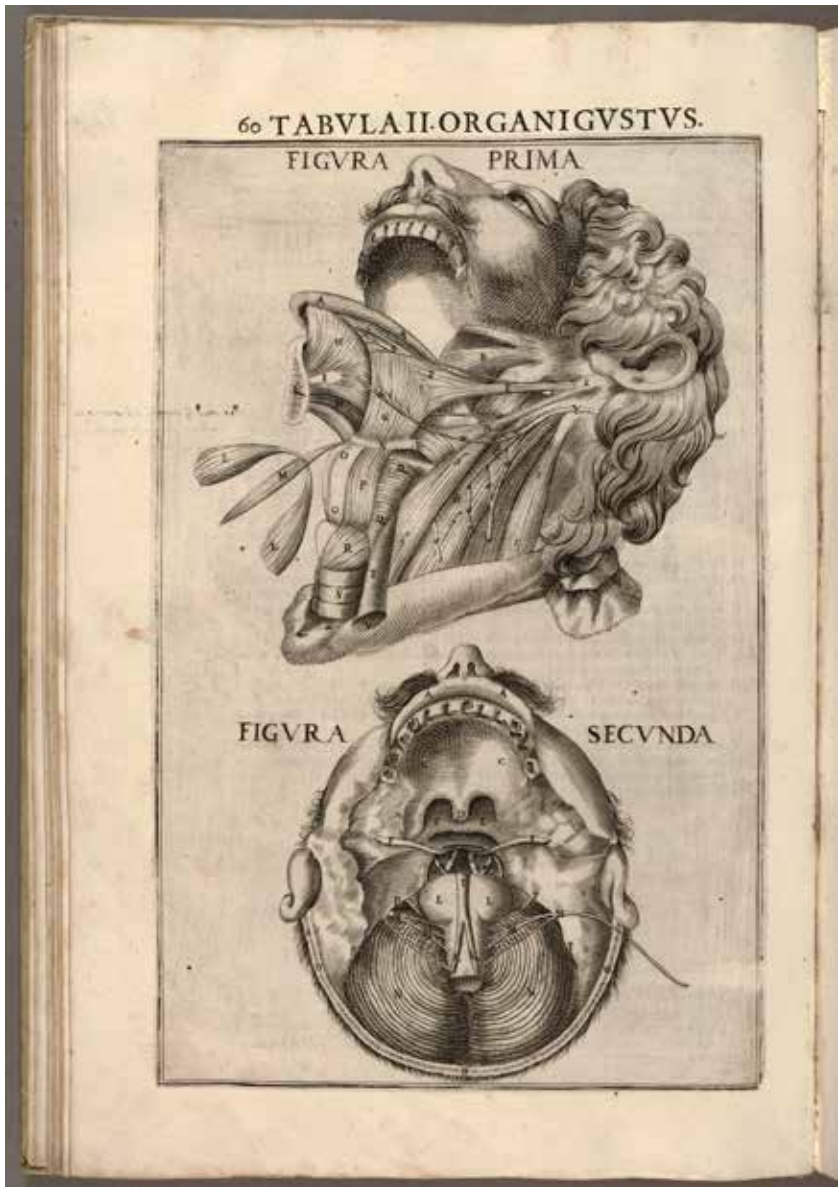

Figure I.5: Anonymous, *Oragani Gustus (Taste)*, plate two, page 60, Engraving, from Gulio Casseri, *Pentaestheseion, hoc est De qvinqve sensibvs liber* (Venice: Apud Nicolaum Misserinum, 1609). The Huntington Library, San Marino, California, RB 631661.

However, the heads appear to be perfect. Each hair is perfectly placed. The ends of the moustaches curl up neatly. These images present highly detailed renderings of the anatomy of the sensory organs attached to the heads of

perfectly coiffed Italian courtiers. Instead of resembling a court beauty, a classical statue or a handsome young man, Faithorne's image looks like a dead body.

Rather than referring to the life of the object of study, "from the life" refers to the life of the observer. Where Samuel Pepys was comparing Faithorne's portrait with his own experience of seeing Villiers at Court, anatomists looking at Collins's book would have compared Faithorne's plates with dissections they had witnessed. That is, they were judging the image not against their knowledge of a court beauty, but rather against that of a cadaver. Although these images *look* quite different, they both derive authority from the illusion that they are close to their referents, which in both cases have been altered to conform to standards of representation, the conventions of beauty in one case and those of anatomical dissection on the other.

In conforming to these two distinct sets of standards, Faithorne was further showing viewers that he was "the Best in the World in this kind" whether "this kind" was a portrait or an anatomical illustration. The viewer then needed to take the context in which the image was encountered into consideration when examining it. Accuracy in the seventeenth century then was not transhistorical or transdisciplinary but an illusion that functioned in a particular context and required the active work of viewers. Their own visual education and understandings of the image making process permitted them to analyze and accept this illusion.

"An accurate impression is in far higher esteem"

The acceptance of this illusion was predicated on the emergence of the habitus that developed in seventeenth-century England among scholars and artisans. As Pierre Bourdieu defined it, "The habitus is…laid down in each agent by his earliest upbringing, which is the precondition not only for the co-ordination of practices but also for practices of co-ordination, since the corrections and adjustments the agents themselves consciously carry out presuppose their mastery of a common code."[45] Sachiko Kusukawa's extensive research project on the role of images in the workings of the early Royal Society has uncovered myriad connections between Fellows of the Royal Society and artisans.[46] Their shared emphasis on visual practices

45 Bourdieu, *Outline of a Theory*, 81.

46 Kusukawa, "Early Royal Society," 350–394; Henderson, "Robert Hooke," 395–434; Reinhart, "Richard Waller," 435–484.

extended to the Continental correspondents of the Royal Society, such as Antoni van Leeuwenhoek as Sietske Fransen has shown.[47]

The common code shared by artisans and scholars was built upon the technologies of witnessing described by Steven Shapin and Simon Schaffer as well as the "tyranny of the rule," as William Ivins called the style of engraving that developed for reproductive prints in the sixteenth century.[48] For Ivins the "exactly repeatable pictorial statement" of the engravers whose primary output was reproductions of paintings marked the nadir of the printmaking and produced:

> what geometers call the 'net of rationality', a geometrical construction that catches all the so-called rational points and lines in space but completely misses the infinitely more numerous and interesting irrational points and lines in space. The effect of these rationalized webs on both vision and visual statement was a tyranny, that, before it was broken up, had subjected large parts of the world to the rule of a blinding and methodically blighting visual common sense.[49]

It is precisely this "blighting visual common sense" that allowed natural philosophers to accept the accuracy of engravings.[50] This tyrannical rule was how scholars learned to see and depict the three-dimensional world around them.

The images considered in what follows are representations of objects. They attempt to depict what individual scholars saw when they looked at the world around them. Whether they were looking through a microscope, a telescope, or with the naked eye, they were trying to understand nature through observation. How Fellows of the Royal Society made sense of experiments was similarly dependent on visual evidence. By and large, Fellows were trying to communicate their understandings of objects, not spaces. These images created the illusion of three-dimensional objects and were not wedded to the rules of Albertian linear perspective.[51] In this, I am following Lorraine

47 Fransen, "Antoni van Leeuwenhoek," 485–544.

48 Shapin and Schaffer, *Leviathan and the Air-Pump*. Ivins, *Prints and Visual Communication*, chap. 4: "The Tyranny of the Rule: The Seventeenth and Eighteenth Centuries," 71–92.

49 Ivins, *Prints and Visual Communication*, 70.

50 Art historians have worked to break down Ivins' analysis of this development particularly in the Italian context. See for example: Bury, *The Print in Italy,* and Lincoln, *The Invention of the Italian Renaissance Printmaker.*

51 Pamela Smith nicely summarized the historiographical thread which focused on the links between "science" and linear perspective: Smith, "Art, Science, and Visual Culture," 88–89.

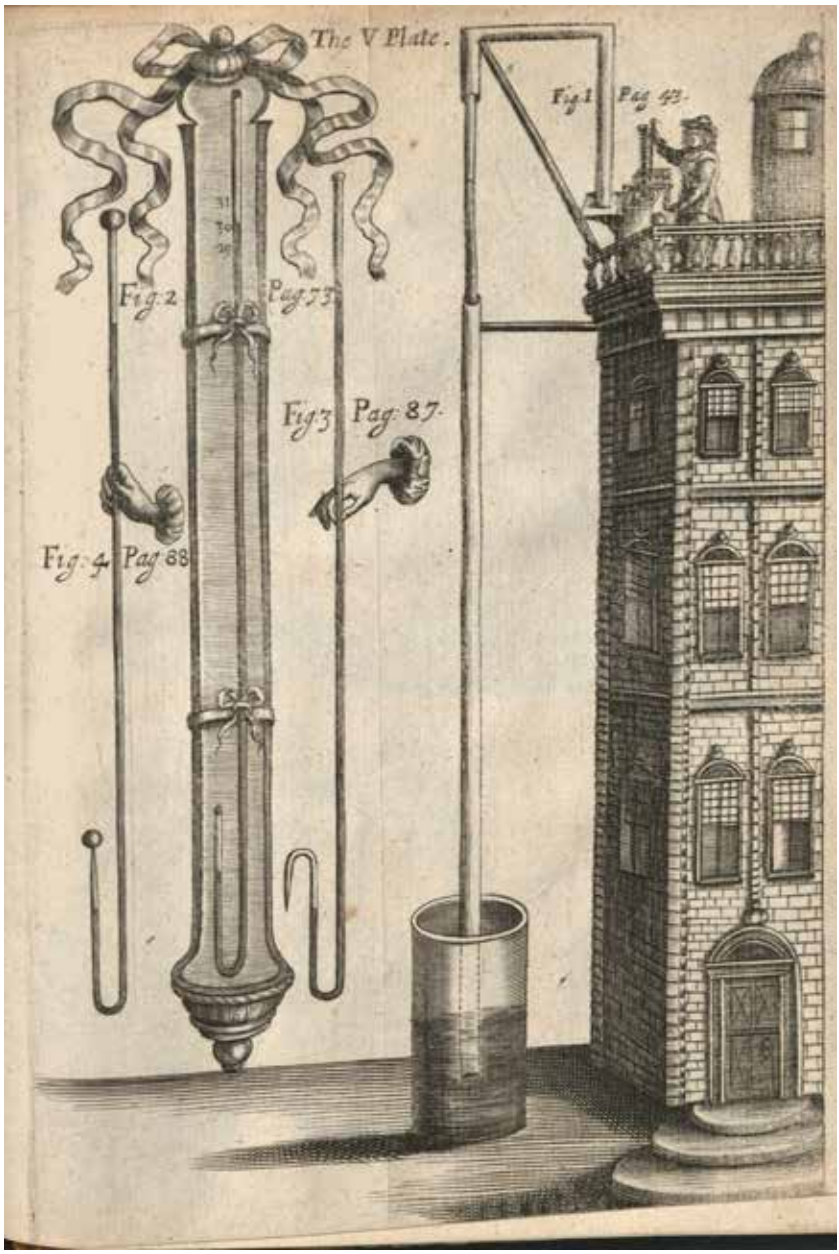

Figure I.6: Anonymous, *Plate five*, Engraving, from Robert Boyle, *A continuation of new experiments physico-mechanical* (Oxford: Printed by Henry Hall printer to the University, for Richard Davis, 1669). By courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin-Madison, Duveen D263.

Daston's definition of an epistemic image as "one made with the intent not only of depicting the object of scientific inquiry but also of replacing it."[52] As such these engravings provided readers access to other scholar's objects of study.

Instead of presenting images of laboratories that readers could *inhabit*, as in Albertian conceptions of space, Fellows presented images of objects that readers could *use*. My emphasis on the functionality of these images is similar to Susan Dackerman's argument "that prints were also important tools in the processes of inquiry, fabricated and activated by their makers to serve as dynamic matrices for argumentation and persuasion."[53] In a similar vein, Anthony Griffiths has noted that the Fellows of the Royal Society needed a "medium that could be studied outside the laboratory."[54] For instance, when Robert Boyle provided further details about how to construct and use the air pump, his images did not convey a perfect sense of habitable buildings set in an English landscape.[55] (Fig. I.6) What is clear in figure one of the plate is the relationship of the parts of the instrument and the building. That is, Boyle and his artist emphasized how the instrument works and connects to the structure. Further, this is not a rendering of a building in a landscape because the rest of the space on the plate is given over to representations of other instruments. These, too, are concerned with how the parts relate to the whole and how to manipulate the objects to conduct experiments. The "where" of the laboratory gives way to the "what" of the instrument and its components.

Focusing on observational and experimental practices shifts the focus away from an emphasis on linear perspective as the primary means of creating a "true" representation of the three-dimensional world. Even those critics such as Lyle Massey who question the insistence on perspective as the dominant feature in images of the three-dimensional world, continue to reinforce the dominant position of perspective in the literature on art and science.[56] Fellows of the Royal Society learned to produce and consume images that projected three-dimensional objects onto paper using engraved lines. The accuracy of these images was dependent on makers' and users' shared participation in a visual culture informed by the engraved line.

With the end of the Civil War and the subsequent restoration of the monarchy, London was awash in printed images. Royalist artists who had

52 Daston, "Epistemic Images," 17. For an overview of the, at times divergent, definitions of "epistemic images," see: Marr, "Knowing Images," 1006–1008.

53 Dackerman, *Prints and the Pursuit of Knowledge*, 33.

54 Griffiths, *Print in Stuart Britain*, 267.

55 Boyle, *Continuation*.

56 Massey, *Picturing Space*.

fled to the Continent during the war returned to their trades invigorated by their exposure to the thriving print market in Paris and the Low Countries. At the same time there was an influx of Continental artists who emigrated to London. As a result, Antony Griffiths has identified this moment as "a watershed in British history" particularly with respect to printmaking.[57] These artists brought with them an awareness of and competency in engraving after others' designs. They were some of the "busy spiders of the exactly repeatable pictorial statement" to use William Ivins' phrase.[58]

The engraver's burin was a key instrument in the production of accuracy. Despite the additional cost and the need for a second press to include an engraving rather than a woodcut in a book, by the middle of the seventeenth century most printed images used in the pursuit of natural knowledge were engravings and etchings.[59] Intaglio prints were valued for their fine lines. In an undated essay on "chalcography," John Beale, a Fellow of the Royal Society, noted his preference for them stating that they "hath already gotten so much credit, that to all ingenious person an accurate impression is in far higher esteem, than the most gaudy paintings of vulgar note."[60] Precise lines from a burin were valued over the bright colors applied by the brush. Beale's comment followed the lines of the argument Giorgio Varsari made regarding the value of Florentine *disegno* in contrast to Venetian *colore*, where *disegno* was aligned with the more intellectual aspects of drawing an image with line and *colore* with the production of an image through the layering of paint.[61] Richard Haydocke's translation of Lomazzo's *Trattato dell'arte della pittura* brought the English-speaking world into direct contact with the Italian debate.[62] Through this allusion to the Italian debate, Beale imbued the burin with a sense of rationality as opposed to the more emotional work of the brush thereby making it easier to accept the images produced by it as serving the goals of natural philosophers.

By combining engraving and etching, printmakers rendered the minute detail in a fly's eye, the iridescence of a hummingbird's feathers, a comet's broad tail passing through the solar system, among myriad other objects of study for natural historians and natural philosophers. Although they are

57 Griffiths, *Print in Stuart Britain,* 23.

58 Ivins, *Prints and Visual Communication*, 70.

59 For a discussion of the relationships between letter press printers and copperplate printers, see: Gaskell, "Printing House," 213–251.

60 Beale, "Of Chalcography on humble motion," Archives of the Royal Society, CLP/2/22, quoted in Hunter, *Wicked Intelligence*, 128–129.

61 Pace, "Disegno e colore."

62 Pace, "Disegno e colore."

now often discussed and studied separately, in the early modern period etching and engraving were used simultaneously in many images and both were referred to as "graving."[63] Whether the burin was cutting the line directly into the copper or an acid bath was doing that work, lines cut into copper were essential to the circulation of knowledge. Similarly, Alina Payne has argued that perspective and painting worked as instruments alongside the telescope.[64] Much like how the telescope "made the act of seeing physically apprehensible," the burin made seeing apprehensible for others beside the viewer.[65] Producing accuracy with lines required careful actions and excellent tools.

In the seventeenth century, as Steven Shapin has argued, both standards and the truth were socially contingent concepts based on agreement between gentlemen, and it is at this very moment that the term accuracy comes into use.[66] In the context of histories of time, Stefan Hanß has pointed out the ways in which "historiography's fetish of accuracy" has imposed modern obsessions onto historical actors.[67] This book is not bringing a modern sense of accuracy to the seventeenth century, but rather is unpacking what the word meant for the early Fellows of the Royal Society.

The *Oxford English Dictionary* defines "accurate" as "conforming exactly with the truth or with a given standard."[68] By presenting standard and truth as if they were equivalent, the very definition of accurate elides the difference between a standard and the truth. There is, however, a significant and productive gap between the two. A standard, further, is "an authoritative or recognized exemplar of correctness, perfection, or some definite degree of any quality."[69] "Accurate" is here tied to authority and exemplarity implying that consensus has been achieved within a group. The truth, however, is defined as "conformity with fact; agreement with

63 My research indicates that engraving was used as a generic term in the period and engraving and etching were seen as complementary processes and were often used together in a single image. For example, William Faithorne places "graveing" before etching in the title of his engraving manual, *The Art of Graveing and Etching*, even though three quarters of the text is dedicated to the chemical intricacies that must be mastered with etching. In addition, the section on etching is titled "The Art of Graving with Aqua fortis." Faithorne, *Art of Graveing*, 30. Throughout this book, in keeping with period usage, I will use "engraving" as the generic term for the intaglio processes prevalent in the seventeenth century.

64 Payne, *Vision and its Instruments*, 2–3.

65 Payne, *Vision and its Instruments*, 2.

66 Shapin, *Social History of Truth*.

67 Hanß, "Fetish of Accuracy," 267.

68 *Oxford English Dictionary*, s.v. "accurate," definition 3.

69 *Oxford English Dictionary*, s.v. "standard," definition II, 10, a.

reality; accuracy or correctness in a of statement, thought, etc." and is often assumed to exist outside of the social.[70] While the modern definition discussed above focusses on conformity, the early modern definition, noted by the *OED* as being obsolete, was "executed with care, careful."[71] The *OED* also notes that this definition is "now merged with" the definition discussed above. This book traces how the careful production of images was a key step in this semantic shift.

It is telling that the word accurate and its derivatives came into the English language around the same time as the founding of the Royal Society and that Fellow's writings are used as evidence of the words' occurrences.[72] When the terms entered the English language, they were still close to their Latin root, "curare" (to care for), relating to being performed with care.[73] This points to an increase in the importance of careful actions for the production of experimentally based knowledge. The same emphasis on careful action also emerges in the writings of artisans of the time. This shared interest is key to the habitus explored in this book. In the context of the visual culture of the early Royal Society, images carved into copper by artisans were produced through a series of careful actions, on the part of the artisans and the Fellows, and it was these actions that allowed the images to conform to a standard and ultimately be considered accurate. Accuracy then should be understood as a cultural construct.

Accuracy provided a fundamental, central, and transferrable criterion that grounded the emerging disciplines of natural philosophy. In the context of the Royal Society of London, these developments grew out of their Baconian program, and consequently, I take accuracy to be one of the wellsprings of modern science. What we now recognize as science in many ways grew from the drive for accuracy.[74] At its crux, this book explores how printed images achieved authority in the context of the early Royal Society. The

70 *Oxford English Dictionary*, s.v. "truth," definition III, 10, a.

71 *Oxford English Dictionary*, s.v. "accurate," definition 1.

72 *Oxford English Dictionary*, s.v. "accurate," "accuracy," "accurately," and "accurateness."

73 *Oxford English Dictionary*, s.v. "accurate," etymology.

74 In this book, I do not want to enter into the overworked territory of whether or not there was a Scientific Revolution, nor do I intend to rehearse the historiography of the topic. Lorraine Daston and Katharine Park in their introduction to the Cambridge History of Science volume on *Early Modern Science* chose to forego using the phrase at all and instead use "early modern science" to demarcate the period under consideration in their volume. They go so far as to say that the "Scientific Revolution" is in fact a mythology. Daston and Park, eds., *Cambridge History of Science*, vol. 3, 15. Instead, I want to press on the assertion that collaborations between artisans and scholars affected the nature of research in the seventeenth century. Lissa Roberts and Simon Schaffer, furthermore, assert that the rhetoric of revolutions is based, in part, on the

careful processes of carving, which visually signify accuracy, were coupled with detailed discussions of method to secure printed images' immediate and urgent relationships to knowledge.

"Each Judgement of his Eye"

Fellows sought to minimize the distance between themselves and their objects of study. Abraham Cowley nicely captured this commitment to closeness with their object of study in his lengthy ode "To the Royal Society," which was included at the beginning of Sprat's *History of the Royal Society*.

> Who to the life an exact Piece would make,
> Must not from Others Work a Copy take;
> No, not from *Rubens* or *Vandike*;
> Much less content himself to make it like
> Th'Ideas and the Images which ly
> In his own Fancy, or his Memory.
> No, he before his sight must place
> The Natural and Living Face;
> The real Object must command
> Each Judgment of his Eye, and Motion of his Hand.[75]

This passage summarized the dominant strands and concerns of contemporary art education while subverting them to prioritize first-hand observation. The traditional studio practice of copying masters' works is rejected, as is the controversial practice of relying on the imagination.[76] Instead, the close examination of "the real Object" was paramount. Making "an exact Piece" was dependent on training both the hand and the eye.

Direct observation and the creation of a visual record of those observations were essential to Fellow's view of their collective project. The emphasis on individualized, first-hand observation set the Fellows apart from earlier

assumption that the mind and the hand, the scholar and the artisan, are distinct. Roberts and Schaffer, "Preface," in *The Mindful Hand*, xiii.

75 Cowley, "To the Royal Society," in Sprat, *History of the Royal Society*, B2r. I have tried to faithfully capture the original mise-en-page of the printing of Cowley's poem.

76 For a discussion of the religious concerns regarding a reliance on the imagination for inspiration see: Parshall, "Graphic Knowledge," 393–410.

Continental uses of the terms "*counterfacta*," "*naer het leven*," and "*ad vivum*." In writing about the use of the term "*counterfacta*" and its vernacular translations, Peter Parshall argues that the term did not necessarily imply that the artist was working from the life and uses the example of Dürer's drawing and later prints of the rhinoceros as evidence.[77] With regard to sixteenth- and early seventeenth-century botany, Claudia Swan has written that "naer het leven" served as an "internationally valid password" that signified general working practices and that the "documentary value of such images does not depend on individual authorship."[78] Sachiko Kusukawa surveyed the use of *ad vivum* in Latinate natural history from the mid-sixteenth century and found that "ad vivum signaled an image that a learned audience was expected to be able to recognize and understand" rather than signifying a singular working method that relied on direct observation.[79] In the context of the Royal Society, there are also cases where images were not "from the life" but the authors use this phrase to describe their process.[80] What is essential to note here is that even if it was not the case that Fellows were using images they had drawn, there was an emphasis put on the importance of being able to draw and on drawing from nature. The methods propounded by the Royal Society as a corporate body were taken up and practiced by the Fellows as the following chapters on Robert Hooke, John Ray and Francis Willughby, and Henry Oldenburg and his correspondents will show.

Members of the Royal Society included intaglio printed images in their books as stand-ins for the objects depicted despite the great distance between the object and a representation of it. These images need to be considered in a social context because like the "fact" they represented mediated knowledge. Barbara Shapiro writes that the "fact" did not begin as something that existed in nature, but instead it originated in the field of law.[81] In addition, Mary Poovey draws attention to dual meaning of the "modern fact" as something both outside of theory and imbedded in a social context and identifies the early Royal Society as a key site for understanding this duality.[82] In formal terms, an engraving translates an individual's experience of a full-color, three-dimensional object into a black and white re-presentation created with line. The observer's preconceived notions regarding the natural world

77 Parshall, "*Imago Contrafacta*," 554–579.

78 Swan, "*Ad vivum*," 364, 363.

79 Kusukawa, "*Ad vivum*," 89–121.

80 Kusukawa, "*Historia Piscium*," 186.

81 Shapiro, *Culture of Fact*, 105.

82 Poovey, *History of the Modern Fact*, chap. 3, "The Political Anatomy of the Economy: English Science and Irish Land," 92–143.

also mediate the knowledge presented in these images. The reality of the difference between a court beauty and a cadaver informed the creation of those images. By unpacking what accuracy meant in the period, this book contributes furthermore to previous scholarship both on "truth" and "fact" as socially constructed terms by showing that accuracy was also defined based on consensus.

This notion of accuracy is distinct from the work of Lorraine Daston and Peter Galison on the development of scientific objectivity and their concept of "truth-to-nature."[83] While they are concerned with the nineteenth-century epistemic shifts that resulted in objectivity assuming prominence in scientific image-making, I am interested in an earlier moment: I ask what the relationship between knowledge and the processes that caused it to be recognized were before natural philosophers and natural historians sought to distance themselves from the knowledge they produced. As Daston and Galison rightly note, objectivity was not a concern in the seventeenth century.[84] Furthermore, the images under consideration pre-date the set of concerns Daston and Galison identify as "truth-to-nature."[85] Instead, the images and practices examined in this book relate to what Daston and Galison describe as "collections of anomalies."[86] I argue that accuracy was the goal of those producing images for consumption by the Fellows of the Royal Society and their correspondents. Accuracy then is to truth-to-nature as truth-to-nature is to objectivity. These three terms define the goals of three centuries of scientific image-making and this book explores what accuracy meant for the Fellows of the Royal Society in the middle of the seventeenth century.

Throughout its four chapters, this book avoids the assumption that an image that was useful to the Royal Society simply looked accurate according to an implicit or explicit standard. Instead, this book examines the collective practices that stemmed from the habitus shared by artisans and scholars to show how they produced an effect of accuracy through social conditions and technical innovation. "Accuracy" is not a neutral or natural term, rather it results from a mediated set of effects that this book excavates. The collective practices discussed in these chapters include: the disciplining of artisans and observers/experimenters; the use of the same tools to achieve accuracy as to teach accurate actions; the textual presentation of an image;

83 Daston and Galison, *Objectivity*.
84 Daston and Galison, *Objectivity*, 27–35.
85 Daston and Galison, *Objectivity*, 55–113.
86 Daston and Galison, *Objectivity*, 67.

the inclusion of visual references to other previously printed images; and the role of consensus-building through circulation. This book argues that it was an adherence to these collective practices and not the giftedness of individual artisans or observers that created an effect of accuracy.

"Examining it according to my usual manner"

Asking what accuracy meant in terms of intaglio printed images produced for the Royal Society yields a deeper understanding of the imbricated roles played by the engraver and the observer or experimenter. A well-trained eye was essential to this execution of these actions. As Cowley put it nature "must command each Judgment of his [Philosophy's] Eye, and Motion of his Hand."[87] The eye and the hand then had to work together "for the Improving of Natural Knowledge."[88] Accuracy is here understood to be the combined effect of good judgment in selecting a referent and framing the image and careful actions in drawing and carving the image. This interleaved set of effects, both in production and consumption, contributed to the construction of signs that could be trusted.

Images produced by and for the Fellows of the Royal Society are distinct from those produced previously and in other European intellectual centers. Their differences are linked to the intellectual goals of the Royal Society and to the intimate ties Fellows had to the production of their images. Robert Hooke's name has become synonymous with the visual culture of the early Royal Society, and as will be discussed in detail in chapter two this was also true in the period. In Hooke's *Micrographia*, the illustration of the head of a fly fills the entire large plate and spills out of the confines of the book.[89] (Fig. I.7) The facets of the fly's compound eyes are clearly delineated as well as the fine details of the mouth. After describing how he prepared his specimen for viewing, Hooke narrated his procedures for looking as well as his results: "Then examining it according to my usual manner, by varying the degrees of light, and altering its position to each kinde of light, I drew that representation of it which is delineated in the 24.

87 Cowley, "To the Royal Society," in Sprat, *History of the Royal Society*, B2r.

88 This phrase is borrowed from the title of Thomas Sprat's *The History of the Royal Society of London for the Improving of Natural Knowledge*.

89 Hooke, *Micrographia*, Scheme 24. The sheet for the fly's head is 300 mm x 265 mm. These measurements are for the Burndy Library copy at the Huntington Library (752346). In this copy, the sheet has been trimmed within the plate mark at the top, and the right-hand plate mark is bound into the center of the volume.

Scheme, and found these things to be as plain and evident, as notable and pleasant."[90] Aside from the shadow cast by its seemingly enormous head, nothing else is included on the plate. By detailing his working methods and providing his readers with an image of what they might expect to see if they too proceeded in his "usual manner," Hooke produced the illusion that accuracy emerged from his working practices, rather than through an artifice in which his readers actively participated.

The circumscribed view of Hooke's fly, a view that in other plates corresponded to the scope of his view finder, provided readers with a marked contrast to the rich allegory that accompanied the first published images created with the help of a microscope.[91] In 1625 members of the Accademia dei Lincei published a broadsheet, known as the *Melissographia*, depicting three bees shown in microscopic detail along with close-ups of a number of dissected parts.[92] (Fig. I.8) This large-scale image was published as part of a year-long celebration of the election of Pope Urban VIII, a member of the Barberini family, whose family crest is three bees arranged in a trigon.[93] The trigon in the Lincei's broadsheet is formed of three views of a single bee: seen from above, below, and the side. Together these three views provided a highly magnified, complete view of the structure of the bee. The trigon is framed on the left and the right by bay branches, which house putti holding the symbols of the papacy; the putti on the left raises the papal tiara above his head and the one on the right is entwined in the papal keys. The bay branches are joined at the top of the sheet with a banner proclaiming the Lincei's devotion to Urban VIII, their patron.

While the upper two thirds of the sheet are given over to the whole bee and a display of devotion to the Barberini Pope, the lower third presents more detailed views of individual parts of the bee. A trompe l'oeil scroll stretches and curls across the bottom of the image and enlarged details of the body of bee unfold before our eyes. As the left-hand section of the scroll unfurls from around the ends of the bay branches the viewer is presented with two close-ups of the full head of the bee and a further detail of the parts of the mouth. The head is shown from the front and the side; the side view gives a magnified view of the structure of the bee's mouth as the details of this are lost in the bay branches as the bee seen from the side stretches its proboscis

90 Hooke, *Micrographia*, 175.

91 For detailed studies of the early history of the microscope see: Wilson, *Invisible World* and Fournier, *Fabric of Life*.

92 For a detailed study of the Lincean Academy see: Freedberg, *Eye of the Lynx*.

93 The sheet measures 41.6 by 30.7 cm. These are the dimensions listed in Freedberg, *Eye of the Lynx*, 160.

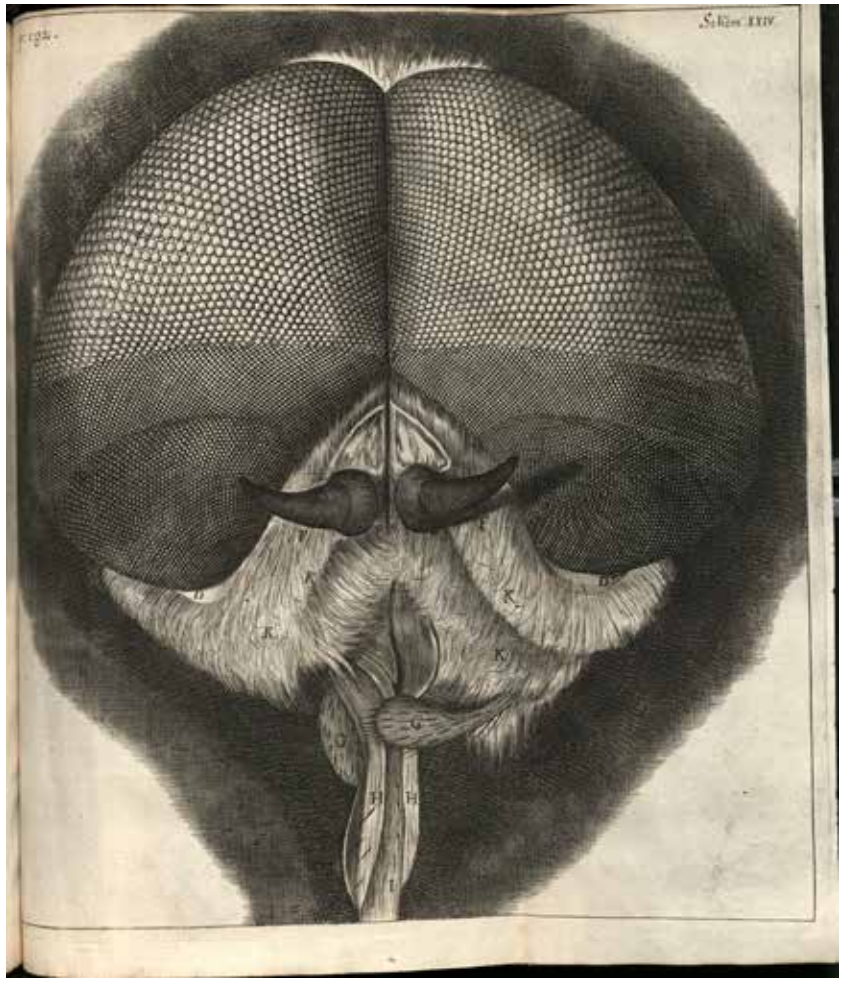

Figure I.7: Anonymous, *Scheme 24*, Engraving, from Robert Hooke, *Micrographia* (London: Printed by J. Martyn and J. Allestry, 1665). By courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin-Madison, Gift of Daniel and Eleanor Albert, Oversize RE26 O62 H66 M53 1665.

towards a delicate bay flower. Stretched along the lower edge of the center of the scroll are the bee's two back legs showing the delicate hairs on the legs and the articulation of the different parts of the legs. The right side of the banner shows a further close-up of the parts of the bee's mouth, a magnified eye, an enlarged stinger, and an antenna that shows its segmented nature, which cannot be seen in the images of the whole bees. In contrast with the stark, up-close view that Hooke presented, the Lincei's magnified insects inhabit a rich allegorical world. These bees were not simply objects to be viewed

Figure I.8: Francesco Stelluti, *Melissographia*, Engraving, Rome, 1625. The Vatican Library, Vat. lat.9685 – f.117r.

"by varying the degrees of light."[94] Instead, they were part of a larger bid for patronage by Federico Cesi and the other members of the Accademia dei Lincei. Whereas Hooke provided images to aid new users of microscopes, the Lincei used their microscopes to bring glory to their patron. Hooke's production

94 Hooke, *Micrographia*, 175.

of accuracy is in part based on the absence of allegory and performance and instead his insistence on showing what was "plain and evident."

At stake in this discussion is a deeper understanding first of how early modern natural philosophers worked to standardize the production and consumption of knowledge and second of how an artistic medium could foster the communication of new research within a community and produce images that had the visual signs of accuracy.[95] If we look more closely at the production of printed images including a nuanced view of sources, image-text-object relations, and the formal methods used to engrave and print these illustrations, then we gain a deeper understanding of the importance of print in the development of modern culture, and more specifically modern science.[96] As I have begun to suggest, this book does not argue for a sudden revolutionary change in the way that science was practiced; rather, I assert that studying the development of concepts of accuracy in terms of printed images further refines our understanding of how scientific inquiry changed during the seventeenth century because I track the several fronts along which the conventions of the engraved scientific illustration developed. The major concepts under consideration in the following chapters include: the creation of the visual effects of accuracy through careful actions; the development of visual judgment and connoisseurship in this context; the role of a network of individuals in the production of knowledge; the balancing of readers' expectations with representational conventions; the effects of acts of collecting on the creation and circulation of knowledge; and most importantly, the complex relationships among objects, drawings, and printed images, which are neither linear nor straightforward.

The first chapter, "Innocent Witch-craft of Lights," examines the precursors to the production of scientific illustrations by studying books that purported to teach the arts and drawing and engraving to examine how the eye and the hand of the naturalist were trained to consume and produce images that were useful to the production of natural knowledge. These books are used to gain an understanding of how a natural philosopher could accept a two-dimensional representation, often made by someone else, as a useful surrogate for an individual's lived experience of the three-dimensional world.

95 This portion of my argument builds on work on the power images had in the communication of scientific knowledge. See, for example, the essays in: Baigrie, ed., *Picturing Knowledge*; Jones and Galison, eds., *Picturing Science*; and Lefèvre et al., eds., *Power of Images*.

96 Some of the major voices in this discussion are: Eisenstein, *Printing Press as an Agent of Change*; Johns, *Nature of the Book*; and Chartier, ed., *Culture of Print*. For a more recent discussion that takes into consideration the nuanced movement of knowledge through manuscript and print, see: Yale, *Sociable Knowledge*.

The next three chapters offer case studies that examine how accuracy could be recognized and, in addition, study the critical role engraving played in presenting mediated knowledge to a wider audience. By mediated, I mean that the knowledge presented in the image had already been filtered in multiple ways before being translated into a set of engraved lines. The images studied in these chapters were presented as records of what the naturalists and natural philosophers saw and how they saw. The men involved with the production of the works under consideration were witnesses to actual events and saw specific objects. They were not disembodied, objective eyes, but rather embodied, human "I"s. These chapters show how the engraved line was both a precursor to and the medium for the production of knowledge. Each of these chapters examines a different type of mediation: the lens of the microscope and the training of an artist; the collecting practices of early modern natural historians; and the collaborative processes involved in producing a journal. These different forms of mediation required three distinct regimes of accuracy. One regime, based on portrait engraving, produced a visual effect of accuracy in Hooke's *Micrographia*. In a second regime, accuracy in Willughby's *Ornithology* was dependent on visual references to previous images. Finally, in the *Philosophical Transactions*, the effect of accuracy developed through a third regime: the accumulation of images among a community of researchers. Together these four chapters present a more nuanced understanding of the visual communication of science in early modern England.

Chapter two, "Discovering the 'True Form'," uses Robert Hooke's *Micrographia* to examine the intersection of visual conventions for portraiture with the viewing of the microscopic world. In the "Preface" to his *Micrographia*, Robert Hooke asserted that he had discovered "a new visible World" through the help of newly invented optical devices that add "*artificial Organs* to the *natural*." Hooke was also aided by the visual vocabulary developed by engravers for translating a three-dimensional world into a two-dimensional representation of it, and that his awareness of these conventions is what set his illustrations apart from his predecessors.

The third chapter, "Nearly Resembling the Live Birds," looks at the plates in Francis Willughby's *Ornithology* and unearths the sources used by the engravers to produce plates that nearly resembled the life, to use John Ray's phrase. While Ray asserted he was not repeating textual error put forth by his predecessors, such as Gessner and Aldrovandi, he used their illustrations as the basis for his own as well as drawings of live and dead birds that he collected. By uncovering the original sources for the illustrations in Willughby's *Ornithology*, this chapter argues that greater value was placed on recognizable, printed images than on drawings collected by the author.

This conclusion leads to a larger argument about the perceived truth-content of printed natural historical images in the seventeenth century.

The final chapter, "These Rude Collections," consists of a close study of the illustrated articles in the early years of *Philosophical Transactions*. Studying these engravings along with their sources reveals the importance of images to the process of communication within the early modern scientific community and highlights the important role of Oldenburg's network of correspondents in the production of a corporate record of experiments and observations. The accumulation of images in print and manuscript and their publication in the *Philosophical Transactions* created an effect of accuracy for the community of researchers involved in the production and consumption of knowledge about nature.

Taken together these four chapters create a historically grounded picture of the visual traces of accuracy that allowed images to be understood as authoritative and trustworthy. Close examination of images produced for and by the Fellows of the Royal Society reveals the visual and textual markers of accuracy. By combining this qualitative work of humanistic inquiry with more quantitative and macroscopic methods of surveying source materials, this book situates books and periodicals in a larger visual context in order to understand the deep connections between art and science in the period. This combination of different approaches provides readers with an awareness and appreciation of the intricacies of the complex interrelationships between material objects, drawings, engravings, and people that yielded richly illustrated books while also providing a deeper understanding of what accuracy meant in the period and of how accuracy was a way for images to achieve authoritative status.

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